Prepared for:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Programmatic Environmental Impact Statement

Chapter 4: Environmental Consequences

Final PEIS for Hawaiian Monk Seal Recovery Actions

March 2014

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes the predicted consequences, or potential effects, on the physical, biological, and human environment from implementing the alternatives described in Chapter 2. The chapter begins by describing the Project Area (Section 4.1), defining frequently used terms (Section 4.2), and explains how incomplete or unavailable information is dealt with in this document (Section 4.3). Section 4.4 describes the steps used for determining the level of impact including the resource-specific criteria used in the evaluation. Section 4.5 provides an overview of the approach to cumulative effects assessment. Section 4.6 presents resources not carried forward for further analysis. Sections 4.7 and 4.8 provide analyses of impacts to the biological environment and to the social and economic environment, respectively, from each of the alternatives.

4.1 *Project Area and Scope for Analysis*

The project area for this Programmatic Environmental Impact Statement (PEIS) encompasses the range where Hawaiian monk seals are found throughout the Hawaiian Archipelago (including the Northwestern Hawaiian Islands [NWHI] and Main Hawaiian Islands [MHI]) and Johnston Atoll (Figure 1.3-1).

More specifically, the Project Area includes portions of the open ocean and nearshore environment where monk seals may be found; and, the shorezone of the islands, islets and atolls that make up the Hawaiian Archipelago and Johnston Atoll. For the purposes of this project, the shore zone generally includes those terrestrial areas 5 meters (m) inland from the line where the shore meets the sea. In addition, secondary use areas, such as research field camps in the NWHI, are also considered for inclusion in the analysis.

In the NWHI, monk seals have six main reproductive sites including Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and French Frigate Shoals. Necker and Nihoa Islands have smaller breeding sub-populations and monk seals have been observed at Gardner Pinnacles and Maro Reef. Monk seals are also found throughout the MHI where the population appears to be increasing (National Marine Fisheries Service [NMFS] 2007).

The time frame for this analysis is defined as 1958 through approximately 2024. As described in more detail in Section 3.3.1, 1958 marks the point in time when the first beach counts of Hawaiian monk seals were conducted in all the primary NWHI. That year is considered a benchmark for the species' known historic high point of abundance. By the year 2024, NMFS will have potentially completed two more permit cycles for authorizing Hawaiian monk seal research and enhancement activities; in addition, 10 years is considered a reasonable amount of time for the life of an EIS document. Within this 10-year timeframe, NMFS will

continue to monitor the Hawaiian monk seal research and enhancement program to evaluate its potential impacts and to comply with NEPA as described in more detail in Chapter 5.

4.2 *Definition of Terms*

The following terms are used throughout this document to discuss potential effects. In this analysis, the terms "effects" and "impacts" are used interchangeably.

- Direct Effects – caused by the action and occurring at the same time and place (40 Code of Federal Regulations [CFR] § 1508.8).
- Indirect Effects – effects "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8).
- Cumulative Effects – additive or interactive effects that would result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). Direct impacts pertain to the proposed action and alternatives only, while cumulative impacts pertain to the additive or interactive effects that would result from the incremental impact of the proposed action and alternatives when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.
- Reasonably Foreseeable Future Actions – reasonably foreseeable future actions (RFFA) are those that are likely to occur and are not purely speculative. Typically, they are based on documents such as existing plans, permit applications, or announcements. The process for determining what is considered reasonably foreseeable is further described in Section 4.5.2.

4.3 *Incomplete and Unavailable Information*

The CEQ guidelines require that:

"When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking (40 CFR 1502.22)."

In the event that there is relevant information, but "the overall costs of obtaining it are exorbitant or the means to obtain it are not known" (40 CFR 1502.22), the regulations instruct that the following should be included:

- A statement that such information is unavailable;
- A statement of the relevance of such information to evaluate reasonably foreseeable significant adverse impacts;
- A summary of existing information that is relevant to evaluating the adverse impacts; and
- The agency's evaluation of adverse impacts based on generally accepted scientific methods.

This PEIS identifies those areas where information is unavailable to support a thorough evaluation of the environmental consequences of the alternatives. In particular, as described in more detail in Section 4.8, there are challenges to analyzing potential impacts on fisheries resources (commercial, subsistence and recreational) due to constraints associated with data confidentiality, and also cases where little or no relevant data exist. Evaluations of direct and indirect effects on fisheries were largely based on a recent NMFS analysis of fish biomass, fishery landings and monk seal prey consumption (Sprague 2013). In that publication, whenever there was uncertainty, assessments erred on the side of overestimating impacts.

Similarly, the analysis of potential effects on cultural and historic properties is based on known properties listed in the National Register of Historic Places (NRHP) and other data publicly available from the State of Hawai'i Division of Land and Natural Resources (DLNR). While additional cultural and historic properties exist, the assessment presented in this PEIS is based on publicly available information on documented sites and any information available on sites eligible for listing in the National Register. Efforts have been made to obtain all relevant information regarding cultural and historic properties as defined under NEPA, and a separate National Historic Preservation Act (NHPA) Section 106 compliance process was undertaken (see Appendix B) to gather unpublished information on historic properties as defined under NHPA. This compliance process included gathering additional information via NHPA Section 106 consultations. However, where data gaps still exist, the implication is that these areas qualify for the CEQ guidelines above.

Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on any historic properties located within the Area of Potential Effect (APE) of a proposed project. These effects may be either direct or indirect. Impacts to historic and cultural resources, including historic structures, archaeological sites, and traditional cultural properties, would be considered significant if they result in adverse effects to the integrity of historic properties that are listed or are eligible for listing on the National Register of Historic Places (National Register). Integrity can be considered to mean not simply the physical integrity of a structure, but "the integrity of [its] location, design, setting, materials, workmanship, feeling, and association" (Title 36 C.F.R. § 60.4). Adverse effects are those that detract from the qualities that give a property its significance and contribute to its NRHP eligibility. Direct effects are those that physically alter the historic property in some way. Indirect effects diminish some significant aspect of the historic property, but do not physically alter it.

4.4 *Steps for Determining Level of Impact*

The CEQ regulations implementing NEPA state that an EIS should discuss the significance, or level of impact, of the direct, indirect, and cumulative effects of the proposed alternatives (40 CFR 1502.16).

- Significance is determined by considering both the context in which the action will occur and the intensity of the action (40 CFR 1508.27).
- Context can be referred to as the extent of the effect (geographic extent or extent within a species, ecosystem, or region) and any special conditions, such as endangered species status or other legal status.
- Intensity of an impact is the result of its magnitude and duration.

Actions may have both adverse and beneficial effects on a particular resource. A component of both the context and the intensity of an effect is the likelihood of its occurrence.

Geographic extent of potential impacts to wildlife may be described using the following terms:

- Species level – change in species or population throughout its range that would likely affect its long-term survival.
- Subpopulation or local level – change in a species age- or size-classes in a limited area of its range. Subpopulations are described in Section 3.3.1.3 Hawaiian Monk Seal Population Status and Trends.
- Individual level – change to a specific animal or small number of animals.

Duration or frequency provides the context of time and may use the following terms:

- Short-term – temporary effect that lasts from a few minutes to a few days, after which the affected animals or resource revert to a "normal" condition.
- Long-term – more permanent effects that may last for years or from which the affected animals or resource never revert to a "normal" condition.
- Intermittent or infrequent effects – effects that only occur a couple times a year or fewer.
- Frequent – effects that occur on a regular or repeated basis each year.

Other species-specific characteristics, such as whether the effects occur during a sensitive or critical part of the year (for example, breeding), are described in the analyses for each species or resource.

The combination of context and intensity is used to determine the level of impact on each type of resource. Analysts follow these steps to accomplish this analysis:

1) Examine the mechanisms by which the proposed action could affect the particular resource.
2) For each type of effect, develop a set of criteria to distinguish between major, moderate, minor, or negligible impacts (defined in Tables 4.4-1 through 4.4-8).

3) Use these impact criteria to rank the expected magnitude, extent, duration, and likelihood of each type of effect under each alternative.

Determining the likelihood of an effect serves to assess whether it is plausible or just speculative. For the purposes of this analysis, "likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50 percent (%). This does not imply that the analysts will perform a formal probability calculation but, in their professional judgment, the probability of the effect occurring is more likely than not.

Tables 4.4-1 through 4.4-8 provide guidelines for the analysts to assess the context of a potential effect and serve as tools for comparing the alternatives based on the conclusions drawn from the analysis. The impact criteria tables use terms and thresholds that are both quantitative and qualitative.

Qualitative thresholds are used where resource-specific baseline data may be lacking or potential effects are difficult to predict quantitatively (*e.g.*, quality of life is difficult to measure in quantitative terms). For a qualitative assessment, analysts must use professional judgment about where a particular effect falls in the continuum from "negligible" to "major."

The criteria and definitions of levels of impact provided in Tables 4.4-1 through 4.4-8 are used only in reference to effects projected to occur within 10 years (see Section 4.1 Project Area and Scope for Analysis). Predictions beyond 10 years are challenging due to uncertainty and the number of independent factors that may alter the environment. Thus potential long-term effects are described using more qualitative terms.

4.4.1 IMPACT CRITERIA FOR HAWAIIAN MONK SEALS

Table 4.4-1 presents criteria for analyzing potential effects on Hawaiian monk seals. The effects of various actions on population status through direct and indirect mortality or through improvements in survival can be evaluated by various metrics. The choice of the appropriate metric to be used depends on a suite of factors including the nature of the actions, the mechanism of potential demographic effects, and our confidence in predicting the expected effects.

As described in Chapter 3, in the NWHI, protracted low juvenile survival has led to an ageing breeding population and dwindling numbers of pups being born. If juvenile survival improves naturally, or as a result of enhancement actions, the number of monk seals at the six most-studied NWHI is projected to continue to decline at least for several years before the inertia in current age structures can be overcome. As such, population modeling suggests the NWHI subpopulations will decline for some time under *all* PEIS alternatives. However, some alternatives will slow the decline, improve population status, and ultimately reverse the decline more rapidly than others.

The quantitative metrics used to compare and contrast the expected outcome associated with the different actions included in the alternatives are:

- Population growth rate;
- Age-specific survival rates and survivorship; and
- Population reproductive value (V_{pop}).

Additionally, the expected benefits associated with certain new interventions for which applicable data are not yet available, are evaluated qualitatively. For each intervention, the approach or metric believed to be most revealing for describing the expected outcome of the action is presented.

The intrinsic growth rate, or lambda (λ) for a subpopulation or group of subpopulations is determined from the demographic rates (age-specific survival and reproductive rates) for that population. When all of the demographic rates are assembled into a single table or matrix, they form the lifetable for that population.

Mathematical analysis of that lifetable allows the calculation of certain lifetable descriptors, including λ, that reveal much information about the expected behavior of the population in the future. The value of λ provides an estimate for the long-term likelihood that a population will grow or decline, with values above 1.0 representing growth and values below 1.0 representing decline. A value of exactly 1.0 would correspond to a stable population that will remain at approximately the same abundance over time.

The actual growth rate of a population will vary from the intrinsic growth rate depending on the age structure of the population. For example, more females that can reproduce in a population than normally expected within the population's lifetable may allow the population to exceed the growth rate predicted by λ. Conversely, fewer reproductive females than normally expected might mean the population would fail to meet λ. In recent years, subpopulations in the NWHI have typically had $\lambda < 1.0$ (declining), whereas, in contrast, the MHI have had λ well above 1.0 (growing). Also, as described in Chapter 3, most subpopulations in the NWHI now have poor age structures that are likely to limit their capacity to achieve the growth rate predicted by λ.

One can think of V_{pop} as analogous to the quantity of potential energy stored in the population, which is likely to translate into future pup production.

Survival rates are often the most direct measure for describing the expected outcomes for an action, or for comparing effects across the alternatives. Age-specific survival (often abbreviated as p_x) indicates the probability that a seal will survive from age x to the next age, or age $x+1$. Similarly, survivorship (abbreviated l_x) gives the probability that a newborn pup will survive to age x. Of particular interest for recovery of the monk seal is survivorship to the subadult stage (approximately age 4yr); shorthand for this measure is l_4. A number of the research and enhancement activities included in Alternatives 1, 3 and 4 are specifically targeted at improving the value of l_4 in the NWHI.

The metric population reproductive value (V_{pop}) is used to evaluate the effects of certain actions included in some alternatives. This metric is an extension of a

related demographic measure known as *age-specific reproductive value*, or v_x. This measure essentially informs us about the relative value of female seals of different ages in terms of their probable contribution to future population growth.

Females of prime reproductive age have a higher v_x than very young females that might not survive to reproductive maturity, or very old females that are past their prime reproductive years and may not produce many more pups. V_{pop} extends the concept of age-specific reproductive value by incorporating information on the current population size and age/sex composition. This parameter is the sum of the age-specific reproductive values for all of the females currently in the population.

One can think of V_{pop} as analogous to the quantity of potential energy stored in the population, which is likely to translate into future pup production. Thus:

- An action that increases the number of reproductively aged females will result in a higher V_{pop} as compared to a "baseline" scenario without the action.
- An action that results in the loss of reproductively aged females will lower V_{pop} at that site.

The effects of some actions may also be expressed as simply the change in number of reproductively-aged females in a subpopulation. Reproductively- aged females are defined as those of age 5-20.

V_{pop} is ideally suited for assessing potential effects of the proposed translocations because that activity is focused on augmenting the number of reproductively-aged females within the high v_x age classes, thereby increasing V_{pop} for the treated subpopulation.

For clarity, and because V_{pop} may be an unfamiliar concept to some readers, the effects of some actions may also be expressed as simply the change in number of reproductively-aged females in a subpopulation. This value expresses much the same thing as V_{pop}, but is slightly less informative as it does not account for the differences in v_x among females of different ages. For this measure, "reproductively aged females" are defined as those of age 5-20, corresponding to the youngest age of first reproduction through the approximate age at which fecundity tapers off in the monk seal.

In addition to evaluating the number of potential mortalities, it is important to understand how sublethal effects may result in changes to the species' status. For the purposes of this analysis, we evaluate sublethal effects in terms of how they could result in changes to reproductive success.

Finally, in order to understand how the proposed research and enhancement activities contribute to conservation of the species more broadly, the proposed actions are compared against specific actions listed in the 2007 Hawaiian Monk Seal Recovery Plan (NMFS 2007). This element of the effects analysis qualitatively discusses how well the scope of research and enhancement

represented under each alternative would be able to address information needs for taking management actions that would promote recovery of the species.

The goal of the Recovery Plan is to promote the recovery of Hawaiian monk seals to the point that they could be down-listed from "endangered" to "threatened" and ultimately to the point that it could be removed from the list of threatened and endangered species under the ESA. Additional information on the 2007 Recovery Plan and its relevance to this PEIS is provided in Section 3.3.1.8.

Table 4.4-1 Impact Criteria for Hawaiian Monk Seals

Type of Effect	Impact Component	Impact Level			
		Major	**Moderate**	**Minor**	**Negligible**
Mortality or survival enhancement	Magnitude and Intensity	Sufficient to cause measurable change in population status (*i.e.*, population growth rate, survival rates, V_{pop})	Equivocal change in population status (*i.e.*, population growth rate, survival rates, V_{pop})	Mechanism for effects on population status (*i.e.*, population growth rate, survival rates, V_{pop}), but status indistinguishable from baseline	NA
	Geographic extent/Biological level	Affects entire species throughout range	Effects limited to a single or a few subpopulations	Effects limited to a small number of individuals	NA
	Duration and Frequency	Long-term duration and high frequency	Moderate duration with high frequency or long-term duration with medium frequency	Short-term duration with moderate frequency or moderate duration with low frequency	NA
	Likelihood[1]	Likely	Likely	Not Likely	Not Likely
Reproductive effects	Magnitude and Intensity	Sufficient to cause measurable change in reproductive success	Equivocal change in reproductive success	Mechanisms for effects but reproductive success similar to baseline	No mechanisms for reproductive effects
	Geographic extent/Biological level	Effects entire species throughout range	Effects limited to a single or a few subpopulations	Effects limited to a small number of individuals	No measurable effects
	Duration and Frequency	Long-term duration and high frequency	Moderate duration with high frequency or long-term duration with moderate frequency	Short-term duration with moderate frequency or moderate duration with low frequency	No measurable effects
	Likelihood[1]	Likely	Likely	Not Likely	Not Likely
Contribution toward conservation objectives	Magnitude and Intensity	Addresses all conservation objectives in Recovery Plan	Addresses multiple conservation objectives in Recovery Plan	Addresses a few conservation objectives in Recovery Plan	Addresses no conservation objectives in Recovery Plan
	Geographic extent/Biological level	Research and enhancement benefits conservation of species throughout range	Research and enhancement benefits conservation of a single or a few subpopulations	Research and enhancement benefits a small number of individuals	Provides no enhancement benefits or useful information for management

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
	Duration and Frequency	Provides immediate and long-term enhancement benefits and/or information needs	Provides periodic and long-term enhancement benefits and/or information needs	Provides periodic and short-term enhancement benefits and/or information needs	Provides no enhancement benefits or information for management
	Likelihood[1]	Likely	Likely	Not Likely	Not Likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

4.4.2 *IMPACT CRITERIA FOR OTHER BIOLOGICAL RESOURCES*

Tables 4.4-2 through 4.4-5 indicate the types of effects Hawaiian monk seal research and enhancement activities may have on other biological resources (species other than monk seals) that are assessed in this NEPA analysis. These tables summarize the criteria for determining the level of impact based on the magnitude, extent, duration and likelihood of occurrence. Where additional resource-specific information may provide further insight into the rationale behind impact criteria, these details are presented following each table. Sections 4.7.2 through 4.7.7 summarize the anticipated direct, indirect and cumulative effects under each alternative for other biological resources.

Table 4.4-2 Impact Criteria for Sea Turtles

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Reproductive effects	Magnitude or Intensity	Population level changes in reproduction over several breeding seasons.	Population changes in reproduction over one breeding season.	Changes in reproduction at the individual rather than population level.	No measurable effects
	Geographic Extent	Regional impacts observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location (bay or beach)	No measurable effects
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Mortality	Magnitude or Intensity	Population-level effects observed	Sub-population or community level effects observed	Individual mortality observed but not sufficient to affect population survival.	No measurable effects
	Geographic Extent	Regional impacts observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location	No measurable effect

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effect
	Likelihood[1]	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

Table 4.4-3 Impact Criteria for Cetaceans

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Mortality	Magnitude or Intensity	Population-level effects observed	Sub-population or community level effects observed	Individual mortality observed but not sufficient to affect population survival.	No measurable effects
	Geographic Extent	Regional impacts observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location	No measurable effects
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Reproductive effects	Magnitude or Intensity	Population level changes reproduction in several species over several seasons.	Population changes in reproduction over one season.	Changes in reproduction effect a small number of individuals	No measurable effects
	Geographic Extent	Regional impacts observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location	No measurable effect
	Duration or Frequency	Chronic and long-term changes that are likely to be permanent	Periodic, temporary, or short-term changes in an annual or several season cycle	Periodic, temporary, or short-term changes over one or two seasons	No measurable effect
	Likelihood[1]	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

Table 4.4-4 Impact Criteria for Fish

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Mortality	Magnitude or Intensity	Mortality to large numbers of fish.	Mortality to individual fish; no population level effects.	Mortality to very small numbers of fish.	No measurable effects
	Geographic Extent	Effects realized in multiple locations	Effects realized in multiple locations	Effects realized at few locations	No measurable effects
	Duration or Frequency	Chronic and long-term changes that are likely to be permanent	Periodic, temporary, or short-term changes in an annual or several season cycle	Periodic, temporary, or short-term changes over one or two seasons	No measurable effect
	Likelihood	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

Table 4.4-5 provides criteria for analyzing the potential direct, indirect and cumulative impacts to birds based on their nesting, brood-rearing, and seasonal use patterns within the terrestrial portion of the Project Area. This area includes beach habitat up to 5 m inland from the upper reaches of the wash of the waves, as described in Section 1.3 Project Area Description, and areas where seasonal field camps at French Frigate Shoals, Pearl and Hermes Reef, Midway and Kure Atolls, and Laysan and Lisianski Islands are located (see Section 3.3.1.9).

Impact levels for the endangered Laysan finch were based on the Incidental Take Statement in the USFWS 2009 Biological Opinion for the Issuance of a Permit to Conduct Field Research on Hawaiian monk seals (USFWS 2009c).

Table 4.4-5 Impact Criteria for Birds

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Altered survival or reproduction (other than Laysan finch)	Magnitude or Intensity	Changes in survival or productivity in one or more avian species over several years.	Changes in survival or productivity in one avian species over several years.	Changes in survival or productivity in one avian species during one year.	No measurable effects
	Geographic Extent	Regional effects observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location	No measurable effects
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effects

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Habitat loss or alteration	Magnitude or Intensity	Population level changes in one or more avian species over several years.	Sub-population or level changes in one avian species over one or two years.	Impacts to individuals observed during one year.	No measurable effect
	Geographic Extent	Regional impacts observed throughout the islands	Effects realized in multiple locations over several islands	Effects realized at one location	No measurable effect
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effect
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Altered survival or reproduction of Laysan Finch	Magnitude or Intensity	Disturbance of more than 200 Laysan finch and/or more than 10 Laysan finch are incidentally injured over 5 years.	Disturbance of 200 Laysan finch and/or incidental injury or mortality of 10 Laysan finch over 5 years.	Disturbance of less than 200 Laysan finch and/or incidental injury or mortality of less than 10 Laysan finch over 5 years.	No measurable effect
	Geographic Extent	Effects realized at Laysan Island and Pearl & Hermes Reef	Effects realized at Laysan Island and Pearl & Hermes Reef	Effects realized in one location	No measurable effect
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons	Periodic, temporary, or short-term changes that could be reversed in an annual or several season cycle	Periodic, temporary, or short-term changes that are reversed over one or two seasons	No measurable effect
	Likelihood[1]	Likely	Likely	Not likely	Not likely

1 - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

4.4.3 *IMPACT CRITERIA FOR SOCIOECONOMIC RESOURCES*

Table 4.4-6 presents a summary of mechanisms used to measure the effects that Hawaiian monk seal research and enhancement actions would have on the social and economic environment, and the criteria for determining the level of impact based on the magnitude, extent, duration, and likelihood of occurrence. These effects are primarily related to commercial fishing, subsistence fishing, recreational fishing, and recreation and tourism activities. Section 4.8 summarizes the anticipated direct and indirect effects under each alternative for these resources.

This analysis takes into account the economic and distributional effects of the various alternatives and their associated elements. The criteria in Table 4.4-6 specify the impact level in the context of existing socioeconomic activity. The impacts identified are translated into measures of overall expected changes in jobs, income, and quality of life in MHI.

The analysis of socioeconomic effects also discusses the distribution of effects of the proposed action – *e.g.*, what human populations are likely to be affected and

how, where the effects will occur, and what businesses or industries will be advantaged or disadvantaged.

Specifically, the analysis considers how certain elements of the alternatives would affect fishing and recreation/tourism in the MHI in terms of income and employment. It further looks into the specific populations that could be affected, such as commercial fishermen, residents involved in subsistence fishing, and residents and tourists recreating in the MHI. Social and economic effects are related to effects of an action or alternatives on human populations. Given that the NWHI is designated as the Papahānaumokuākea Marine National Monument (Monument), the only human presence relates to research or other permitted activities. There are no recognized communities on these islands. Further, there is no commercial fishing allowed in the Monument. Therefore, social and economic effects of the alternatives are unlikely in the NWHI, and this analysis focuses on the MHI.

For commercial fishing, the key indicator for measuring effects is the value of commercial landings, whereas effects on recreation/tourism and recreational fishing are largely based on the number of tourists or residents recreating in the MHI. Finally, effects on subsistence fishing are evaluated by looking at potential changes in the quantity of fish consumed for subsistence purposes and how that might vary across alternatives.

Table 4.4-6 Impact Criteria for Socioeconomics

Type of Effect	Impact Component	Impact Level			
		Major	**Moderate**	**Minor**	**Negligible**
Changes in commercial fishing	Magnitude or Intensity	More than 10% increase or decrease in quantity and/or value of commercial landings	3% - 10% increase or decrease in quantity and/or value of commercial landings	Less than 3% increase or decrease in quantity and/or value of commercial landings	No measurable effects
	Geographic Extent	Effects realized in most of the MHI (over 50% of the MHI)	Effects realized in numerous locations in the MHI (10% - 50% of MHI)	Effects realized at few locations in the MHI (2% - 10% of MHI)	Effects realized at less than 2% of locations in MHI
	Duration or Frequency	Long-term (over 10 years) and/or frequent	Moderate (1 - 10 years) and/or intermittent	Short-term (1 month - 1 year) and/or periodic	Less than 1 month
	Likelihood[1]	Likely	Likely	Somewhat unlikely	Unlikely
Changes in subsistence fishing	Magnitude or Intensity	More than 10% change in quantity of fish consumed for subsistence	3% - 10% change in quantity of fish consumed for subsistence	Less than 3% change in quantity of fish consumed for subsistence	No measurable effects
	Geographic Extent	Effects realized in most of the MHI (over 50% of the MHI)	Effects realized in numerous locations in the MHI (10% - 50% of MHI)	Effects realized at few locations in the MHI (2% - 10% of MHI)	Effects realized at less than 2% of locations in MHI

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
	Duration or Frequency	Long-term (over 10 years) and/or frequent	Moderate (1 - 10 years) and/or intermittent	Short-term (1 month - 1 year) and/or periodic	Less than 1 month
	Likelihood	Likely	Likely	Somewhat unlikely	Unlikely
	Magnitude or Intensity	More than 10% change in number of recreational fishing trips	3% - 10% change in number of recreational fishing trips	Less than 3% change in number of recreational fishing trips	No measurable effects
Changes in recreational fishing	Geographic Extent	Effects realized in most of the MHI (over 50% of the MHI)	Effects realized in numerous locations in the MHI (10% - 50% of MHI)	Effects realized at few locations in the MHI (2% - 10% of MHI)	Effects realized at less than 2% of locations in MHI
	Duration or Frequency	Long-term (over 10 years) and/or frequent	Moderate (1 - 10 years) and/or intermittent	Short-term (1 month - 1 year) and/or periodic	Less than 1 month
	Likelihood[1]	Likely	Likely	Somewhat unlikely	Unlikely
	Magnitude or Intensity	More than 10% change in recreation/tourist visits or expenditures	3% - 10% change in recreation/tourist visits or expenditures	Less than 3% change in recreation/tourist visits or expenditures	No measurable effects
Changes in recreation or tourism	Geographic Extent	Effects realized in most of the MHI (over 50% of the MHI)	Effects realized in numerous locations in the MHI (10% - 50% of MHI)	Effects realized at few locations in the MHI (2% - 10% of MHI)	Effects realized at less than 2% of locations in MHI
	Duration or Frequency	Long-term (over 10 years) and/or frequent	Moderate (1 - 10 years) and/or intermittent	Short-term (1 month - 1 year) and/or periodic	Less than 1 month
	Likelihood	Likely	Likely	Somewhat unlikely	Unlikely
	Likelihood	Likely	Likely	Somewhat unlikely	Unlikely

NEPA requires the consideration of possible effects of proposed Hawaiian monk seal recovery actions on cultural resources as part of the human environment. The impact criteria for cultural resources (other than historic properties, which are dealt with separately) and traditional cultural practices are presented below. Cultural impacts are considered to be significant if they result in adverse effects to cultural resources or in any way impeded traditional cultural practices.

Table 4.4-7 Impact Criteria for Cultural Resources and Traditional Cultural Practices

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Changes to cultural resources or traditional cultural practices	Magnitude or Intensity	Adversely affects cultural resources and impedes traditional cultural practices	Cultural resources are affected, but not adversely; traditional cultural practices not significantly impeded	Possible contact with cultural resources, but no effect; no effect on traditional cultural practices	No contact with cultural resources; no effect on traditional cultural practices
	Geographic Extent	Effects realized throughout the project area	Effects realized in numerous locations	Effects realized at few locations	No measurable effects
	Duration or Frequency	Chronic and long-term	Moderate and frequent or long-term and intermittent	Periodic, temporary, or short-term	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

Section 106 of the National Historic Preservation Act (NHPA) requires Federal agencies to take into account the effects of their undertakings on any historic properties located within the Area of Potential Effect (APE) of a proposed project. These effects may be either direct or indirect. Impacts to historic and cultural resources, including historic structures, archaeological sites, and traditional cultural properties, would be considered significant if they result in adverse effects to the integrity of historic properties that are listed or are eligible for listing on the National Register of Historic Places (National Register). Integrity can be considered to mean not simply the physical integrity of a structure, but "the integrity of [its] location, design, setting, materials, workmanship, feeling, and association" (Title 36 C.F.R. § 60.4). Adverse effects are those that detract from the qualities that give a property its significance and contribute to its NRHP eligibility. Direct effects are those that physically alter the historic property in some way. Indirect effects diminish some significant aspect of the historic property, but do not physically alter it.

Table 4.4-8 Impact Criteria for Historic Properties

Type of Effect	Impact Component	Impact Level			
		Major	Moderate	Minor	Negligible
Changes to Archaeological Sites	Magnitude or Intensity	Adversely affects the qualities that contribute to NRHP eligibility	Site is affected, but not adversely	Possible contact with site, but no effect	No measurable effects
	Geographic Extent	Effects realized throughout the project area	Effects realized in numerous locations	Effects realized few locations	No measurable effects
	Duration or Frequency	Chronic and long-term	Moderate and frequent or long-term and intermittent	Periodic, temporary, or short-term	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Changes to Historic Structures	Magnitude or Intensity	Adversely affects the qualities that contribute to NRHP eligibility	Site is affected, but not adversely	Possible contact with site, but no effect	No contact with site
	Geographic Extent	Effects realized throughout the project area	Effects realized in numerous locations	Effects realized at few locations	No measurable effects
	Duration or Frequency	Chronic and long-term	Moderate and frequent or long-term and intermittent	Periodic, temporary, or short-term	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely
Changes to traditional cultural properties	Magnitude or Intensity	Adversely affects the qualities that contribute to NRHP eligibility or that significantly impede traditional cultural practices	Property is affected, but not adversely; traditional cultural practices not significantly impeded	Possible contact with property, but no effect; no effect on traditional cultural practices	No contact with property
	Geographic Extent	Effects realized throughout the project area	Effects realized in numerous locations	Effects realized at few locations	No measurable effects
	Duration or Frequency	Chronic and long-term	Moderate and frequent or long-term and intermittent	Periodic, temporary, or short-term	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

Impact Criteria for Environmental Justice

According to 1997 CEQ guidelines, federal agencies must evaluate whether a proposed action would have a disproportionately high adverse impact on low income populations, minority populations or Indian tribes due to a proposed

action (CEQ 1997). Analysis of potential impacts may rely on available demographic data from credible sources such as the U.S. Census. The analysis of potential Environmental Justice impacts is based on the results of the other socioeconomic impact assessments such as fisheries, cultural and historic resources and tourism. Therefore, no specific impact criteria are presented here.

Impact Criteria for Military Activities

The criteria presented in Table 4.4-8 provide a scale on which to measure potential impacts of the proposed alternatives on military activities. Specific details and results of the analysis are presented in Section 4.8.7.

Table 4.4-8 Impact Criteria for Military Activities

Type of Effect	Impact Component	Impact Level			
		Major	**Moderate**	**Minor**	**Negligible**
Changes to military training or operational activities	Magnitude or Intensity	Year-round change in military use or operations	Seasonal change in military use or operations	Slight change of military use or operations	No measurable effects
	Geographic Extent	Effects realized throughout the project area	Effects realized in numerous locations	Effects realized at few locations	No measurable effects
	Duration or Frequency	Long-term or permanent	Moderate and frequent or long-term and intermittent	Periodic, temporary, or short-term	No measurable effects
	Likelihood[1]	Likely	Likely	Not likely	Not likely

[1] - "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%.

4.5 Steps for Identifying Cumulative Effects

The CEQ guidelines for evaluating cumulative effects state that the greatest environmental effects may result not from the direct effects of a particular action but from the combination of individually minor effects of multiple actions over time (CEQ 1997). The CEQ regulations for implementing NEPA define cumulative effects as follows:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).*

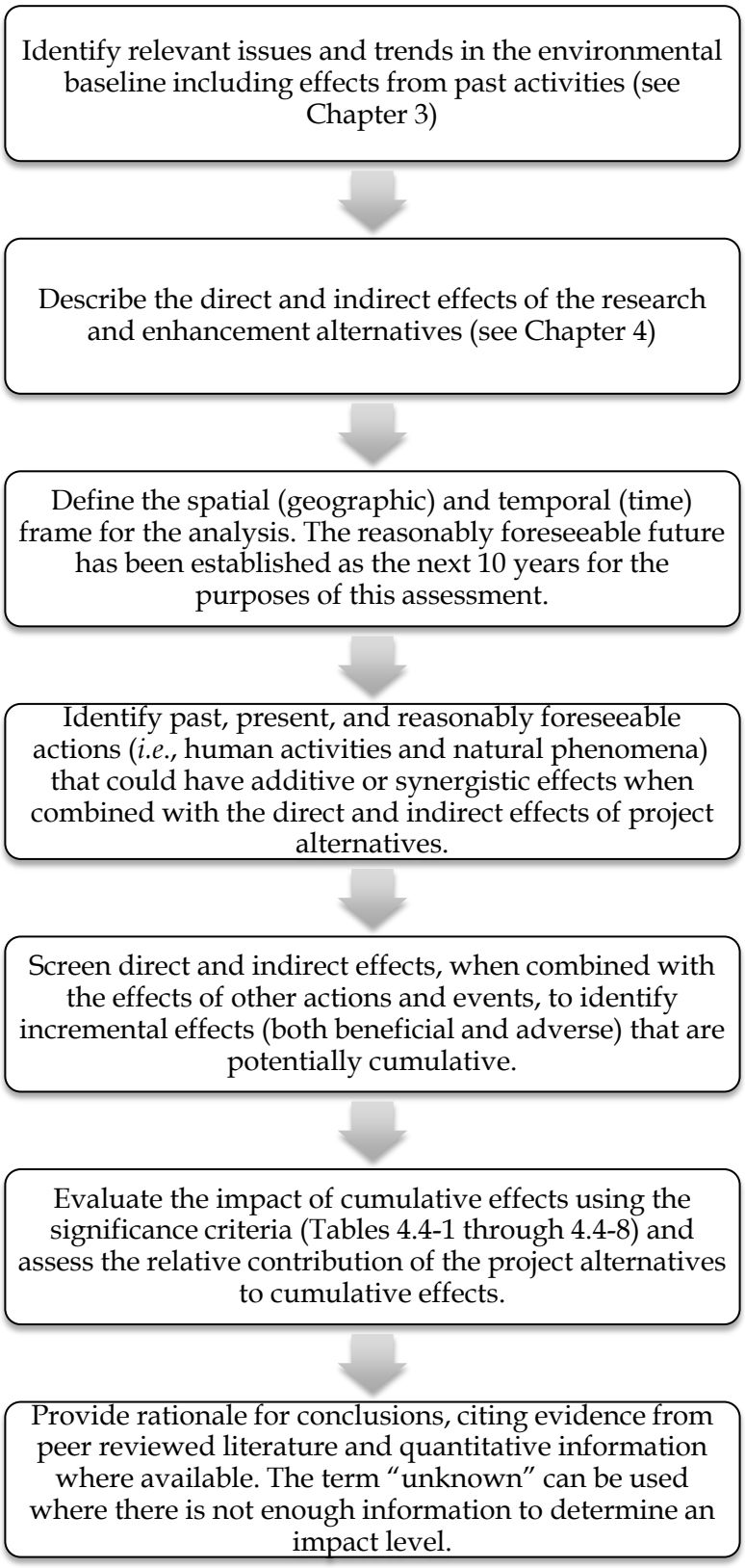
For this PEIS, assessment of cumulative effects requires an analysis of the direct and indirect effects of the proposed research and enhancement alternatives, in combination with other past, present, and RFFAs potentially affecting monk seals and other biological, physical, and socioeconomic resources. The intent of this analysis is to capture the total effects of many actions over time that would

be missed by evaluating each action individually. It is important to note that if the results of the analysis of direct or indirect effects of the proposed action are negligible, the contribution of the proposed action to a cumulative effect would not occur and thus an analysis of cumulative effects would not be presented. For example, physical oceanography will not be directly or indirectly affected by the proposed action and is therefore not carried forward for a cumulative analysis (see Section 4.6). Therefore, for resources where there would be negligible direct or indirect effects of alternatives (*i.e.*, marine water quality and environmental justice) do not have a detailed analysis of potential cumulative effects per CEQ guidance. Exceptions to this are certain topics of particular concern raised during the public comment period. For example, although negligible effects of proposed monk seal research and enhancement alternatives are expected for recreation and tourism, a more detailed assessment of potential cumulative impacts is presented due to specific stakeholder concerns.

Another purpose of this analysis is to assess the relative contribution the proposed action and its alternatives have on cumulative effects. The cumulative effects assessment then describes the additive or synergistic result of the research and enhancement alternatives as they are reasonably likely to interact with actions external to the proposed actions. The ultimate goal of identifying cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the alternatives.

The methodology used for cumulative effects analysis includes the steps outlined below. The advantages of this approach are that it closely follows 1997 CEQ guidance, employs an orderly and explicit procedure, and provides the reader with the information necessary to make an informed and independent judgment concerning the validity of the conclusions.

Figure 4.5-1 Steps in the Impact Assessment



4.5.1 RELEVANT PAST AND PRESENT ACTIONS WITHIN THE PROJECT AREA

Relevant past and present actions (federal and non-federal) and events are those that have influenced the current condition of a resource. For the purposes of this PEIS, past and present actions/events include both human controlled events (such as shipping or commercial fisheries), and natural events, such as predation. Table 4.5-1 provides a list of past actions and events considered in the cumulative effects analysis in this PEIS.

Table 4.5-1 Relevant Past and Present Actions within the Project Area

Action / Event	Region	Status	Resource(s) Potentially Affected	Source
Natural Events				
Natural Events (Tsunami, Volcano, Earthquake, Hurricane)	Hawaiian Archipelago	Ongoing	All	Pacific Disaster Center 2012
Climate Change	Hawaiian Archipelago	Ongoing	All	Hare & Mantua 2000; Friedlander et al. 2009; etc.
Introduction of Invasive species	Hawaiian Archipelago	Ongoing	1, 3, 4, 5, 6, 7, 8, 10	HISC
Shark predation	Hawaiian Archipelago	Ongoing	1	NOAA
Male monk seal aggression	Hawaiian Archipelago	Ongoing	1	NOAA
Scientific Research				
Research and enhancement permits issued since 2000 (HMS only)	Hawai`i	Ongoing	1	NOAA
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) (6 missions)	Hawai`i	August 16, 2008 - August 15, 2009	1, 3, 4, 5, 6, 7, 8	SURTASS 2012
Activities to Enhance Understanding of Hawaiian Monk Seal Foraging Ecology at Nihoa Island	Nihoa Island	Complete	1, 3, 6	PMNM
Bathymetric Mapping of the Intersection of Necker Ridge with the Hawaiian Ridge	Necker Ridge to Hawaiian Ridge	Complete	3, 4, 5, 6	PMNM
Comparison Study of the Biological Community Structure and Diversity of Maritime Heritage Resource Sites	PMNM	New permit	11	PMNM
Coral Reef Bioerosion Rates as Indicators of Community Response to Ocean Acidification	PMNM Shallow water reefs	New permit	8	PMNM
Determine prevalence of disease on coral reefs in shallow waters	PMNM shallow waters	New permit	8	PMNM
Genetic Surveys to Address the Level of Isolation Between Shallow and Deep Reef Ecosystems	PMNM	New permit	1, 2, 3, 4, 5, 6, 7, 8	PMNM
Humpback whale research	Maui, Molokai, Lanai, and Kahoolawe	Complete	4	NOAA
Incidence and Effects of Coral and Fish Disease within Shallow Water Reefs	PMNM shallow water reefs	New permit	6, 8	PMNM

Action / Event	Region	Status	Resource(s) Potentially Affected	Source
Long term monitoring Laysan & black footed albatross	Midway, FFS, Laysan	New permit	7	NOAA
Monitoring shark activity on monk seal pupping sites	FFS	New permit	1, 5	PMNM
Pacific Reef Assessment and Monitoring Program	PMNM	New permit	8	PMNM
Permit to conduct level B harassment and biopsy sampling of cetaceans in Hawaiian waters	Leeward coast of the island of Hawai`i	Complete	4	NOAA
PR 1 Permit #1071-1770 Long-term population studies of cetacean species in North Pacific Ocean	Main study area is Hawai`i	Complete	4	NOAA
PR 1 Permit #731-1774 cetacean scientific research	Hawai`i	Complete	4	NOAA
PR 1 Permit #978-1791 auditory research on stranded and rehabilitated cetaceans	Hawai`i (waters and rehabilitation facilities)	Complete	4	NOAA
PR1 Permit #587-1767 scientific research on long-term social affiliations among humpback whales	Alaska/Hawai`i	Complete	4	NOAA
Numerous PR1 Permits for cetacean research throughout Hawai`i and Pacific Ocean	Hawai`i	Complete	4	NOAA
Military Activities				
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS); NOAA Incidental Harassment Permits 18702 - 18705	Hawai`i	Ongoing	1-7, 10, 14	NOAA
Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai`i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	Hawai`i	Ongoing	1-7, 10, 14	NOAA
Permit 17860 US Navy Acoustic Technology Experiments	Hawai`i	Ongoing	1-7, 10, 14	NOAA
Other Activities				
Whaling	Hawai`i	19th Century	4	DLNR 2005
Guano mining	PMNM	19th and 20th Century	1, 3, 7	Rauzon 2001
Feather poaching	PMNM	20th Century	1, 3, 7	Rauzon 2001
Whale watching (tour boats)	MHI	Ongoing	4, 12	USN
Removal of marine debris from high entanglement zones	Hawai`i	Ongoing	1, 3, 4, 5, 6, 7, 8, 10, 12	NMFS

Action / Event	Region	Status	Resource(s) Potentially Affected	Source
Entanglement of Hawaiian monk seals in marine debris or fishing gear	Hawai`i	Ongoing	1	NMFS
MMHSRP and other NMFS Permits to disentangle, dehook and relocate seals away from harmful situations; Permit also includes activities for other marine mammals and sea turtles including: stranding networks ; responses/investigations of mortality events Biomonitoring; tissue/serum banking; and analytical quality assurance.	Hawai`i	Ongoing	1, 3, 4, 10	NMFS
Intentional shooting, maiming, injury or other harm of Hawaiian monk seals	MHI	Ongoing	1	NMFS
Habitat protection, loss mitigation and restoration	Hawai`i	Ongoing	1, 3, 4, 5, 6, 7, 8, 10, 12	NMFS
Natural resource and species education and outreach	MHI	Ongoing	1, 3, 4, 5, 6, 7, 8, 10, 12	NMFS
SEIS Measures to End Bottomfish Overfishing in the Hawaiian Archipelago	Hawai`i	Complete	6, 8, 10	WPRFMC 2006
Final EIS Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region (2005)	Hawai`i	Complete	6, 8, 10	WPRFMC
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	NWHI	Complete	6, 8, 10	WPRFMC
Fishery Ecosystem Plan for the Hawai`i Archipelago	Hawai`i	Complete	1-10, 12, 14	WPRFMC
Pilot Aquaculture Project (Tuna cultivation)	2.6 mi. off Malae Point, Hawai`i	Complete	10	USACE 2010
UNESCO World Heritage Site Monument	NWHI	Designated 2010	11	UNESCO
Building islands using dredge and fill	PMNM	Mid-20th Century	1-8	Rauzon 2001
LORAN station	PMNM	Mid-20th Century	1-8	DLNR 2005
Wailupe Stream Flood Control	East Honolulu	Underway as of 2008	1, 2, 3, 5, 6, 7, 8	HRC FEIS/OEIS 2008
Beach Park Improvements	MHI (various sites)	Ongoing	12	DLNR 2013
Wai`anae Wastewater Treatment Plan (deep ocean outfall)	Wai`anae Coast (Oahu)	NPDES Permit 2011-2016	1, 2, 3, 4, 5, 6, 7, 8, 10	HRC FEIS/OEIS 2008
Lā`ie Wastewater Collection System Expansion Phase II	Lā`ie (Oahu)	2004	1 - 10	HRC FEIS/OEIS 2008
Permit 17268 Honolulu Seawater AC (Incidental Take)	Offshore Kakaako (Oahu)	September 2012 – 2013	4	NOAA
Seabird consumption, egg harvest, nest loss to	Lay, Lis, Mid	1842-1915	7	Schultz et al. 2011.

Action / Event	Region	Status	Resource(s) Potentially Affected	Source
guano harvest, introduced species, chick mortality due to removal of adults				
Monk seal harvest for meat, skins and shark bait	NWHI	19th century	1	Schultz et al. 2011.
Turtle harvest for meat, eggs and shark bait	NWHI	18th-19th centuries	3	Schultz et al. 2011.
Shark harvest for fins and oil.	NWHI	1859-1900; 2000	5	Schultz et al. 2011.
Unregulated fishing	NWHI	1913-2002	6, 10	Schultz et al. 2011.
Commercial, recreational and subsistence fisheries	Hawai`i	Ongoing	1, 3, 5, 6, 10	WPFMC 2013
Sea cucumber harvest	Lay, Lis, PHR, FFS	1882	6, 10	Schultz et al. 2011.
Black-lipped oyster harvest	PHR	1928-1930	6, 10	Schultz et al. 2011.
Coral harvest and illegal poaching	NWHI, Gardner, Lay	1965-1980s	8, 10	Schultz et al. 2011.
Lobster harvest	NWHI	1970-1999	6, 10	Schultz et al. 2011.
Legislation				
Hawai`i Act 165 (Class C felony to harass or kill monk seals	Hawai`i	June 2010	1	State of Hawai`i
Hawai`i Cultural Impact Assessment Bill: House Bill 2895	Hawai`i	January 1, 2012	11	State of Hawai`i
Hawai`i Environmental Justice Bill: Senate Bill 2145	Hawai`i	2006	10, 11, 13	State of Hawai`i
Hawai`i Environmental Policy Act (HRS 343)	Hawai`i	1974	All	State of Hawai`i
National Historic Preservation Act	United States	1966	11	U.S. Government
EO 12898: Environmental Justice	United States	1994	10, 11, 13	U.S. Government
Resource Key: 1 – Hawaiian monk seals 6 – Other Fish Species 11 – Cultural & Historical	2 – Water Quality 7 – Birds 12 – Recreation & Tourism	3 – Sea Turtles 8 – Coral 13 – Environmental Justice	4 – Cetaceans 9 – Invasive Species 14 – Military Activities	5 – Sharks 10 – Fishing (Commercial, Recreational & Subsistence NA - Not available

4.5.2 *Reasonably Foreseeable Future Actions*

Reasonably foreseeable future actions (RFFAs; federal and non-federal human-controlled actions and natural events) are those that:

- Have already been or are in the process of being funded, permitted, or described in coastal zone management plans;
- Are included as priorities in government planning documents; or
- Are likely to occur or continue based on environmental data, or historical patterns.

Judgments concerning the probability of future impacts must be informed rather than based on speculation. RFFAs to be considered must also fall into the temporal and geographic scope described in Section 1.3 (Project Area Description).

Reasonably foreseeable future human controlled actions and natural events were screened for their relevance to the alternatives proposed in this PEIS. Because the regulations in 40 CFR 1508.8 state that the actions and events must be considered probable, not just possible, only those actions with an occurrence probability of high or medium have been included for analysis and shown in Table 4.5-2. Due to the large geographic scope of the Project Area, the identification of RFFAs was conducted on a broad scale, although some specific RFFAs were considered where applicable. Table 4.5-2 provides a list of RFFAs considered in the cumulative effects analysis in this PEIS. Also included in the following table is a list of resources that may potentially be affected (beneficially or adversely) by the activity. The resources listed are limited to only those that have been carried forward for analysis in this PEIS.

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Table 4.5-2 Reasonably Foreseeable Future Actions Within the Project Area

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
Natural Events						
Climate Change	Hawaiian Archipelago	Ongoing	Ongoing	High	All	NOAA
Tsunami, Volcanic eruption, Earthquake, Hurricane	Hawaiian Archipelago	Ongoing	NA	Medium	All	NOAA
Japanese Tohoku earthquake and tsunami debris	Hawaiian Archipelago	Ongoing	Ongoing	High	All	IPRC 2012a, b
Introduction of invasive species	Hawaiian Archipelago	Ongoing	Ongoing	Medium	1-10	HISC
Disease	Hawaiian Archipelago	Ongoing	Ongoing	High	All	NOAA
Commercial Activities						
Inter-Island Transmission Cable	Maui, Oahu	Draft EIS	2014	High	1, 2, 3, 4, 5, 6, 8, 9, 10	DBED Hawai`i State Energy Office
Kampachi Farms, LLC permit to Culture and Harvest Coral Reef Fish Species (*Seriola rivolialla*); Permit WP-CRSP-01	Island of Hawai`i (west coast)	Permitted	Ongoing	High	10	NMFS
Residential & Commercial construction (beach, near shore)	Various	Ongoing	Ongoing	High	1, 2, 3, 9, 10, 11, 12	DBED (Hawai`i) CIP List
Honolulu Harbor Pier 12 & 15 Improvements	Honolulu, Hawai`i	Permitting	2013/2014	High	8	DOT Harbors Division
Kalaeloa Barbers Point Harbor Fuel Pier	Ewa, O'ahu	EIS	September 9, 2013	High	2	DOT Harbors Division
Whale & dolphin watching tours	MHI	Permitted	Ongoing	High	1, 3, 4, 12	NOAA
Other Activities						
Hawaiian Monk Seal Rehabilitation Facility at Natural Energy Laboratory of Hawai`i Authority	Keahole Point, Hawai`i	Permitted	Operational 2013	High	1	National Energy Laboratory
Kalaupapa NHP General Management Plan and EIS	Moloka`i	Draft EIS	2013-2014	High	11, 12	NPS
Fishery Ecosystem Plan for the Hawai`i Archipelago	Hawaiian Archipelago	Ecosystem Plan	Ongoing	High	1-12, 14	WPRFMC

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
Commercial, recreational and subsistence fisheries	MHI	Ongoing	Ongoing	High	1, 3, 5, 6, 10	Sprague et al 2013
Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan Revisions	Hawaiian Archipelago	DEIS Fall 2013	Ongoing	High	1-9	NOAA
Hawaiian Spinner Dolphin Human Interaction Protection Measures	MHI	DEIS/Proposed Rule	Ongoing	High	1, 3, 4, 10, 12	NOAA
Hawaiian Monk Seal Critical Habitat Revisions	Hawaiian Archipelago	Proposed Rule Under Revision	Ongoing	High	1	NOAA
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	MHI	2011 Declaratory Ruling	Ongoing	High	1-12	USACE
Shark Removal Activities. Permit Number: PMNM-2013-017	PMNM	Permitted	May 31, 2014	High	1, 5	NOAA
ESA Proposed Listing of 82 Coral Species	Hawaiian Archipelago	Status Review	Unknown	High	8	NOAA
Kukuiula Bay Beach Nourishment	Koloa, Kaua`i	Draft EA	2013/2014	High	12	DLNR
CDUA: MA-3633 Stable Road Beach Groins project (beach restoration)	Wailuku, Mau`i	Permit Application	DLNR Recommendation for approval March 2013	High	12	DLNR
Waikoloa Beach Tsunami Restoration Project	South Kohala, Hawai`i	Permit Application	September - December 2013	High	11, 12	DLNR
Military Activities						
Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai`i Range Complex (Hawai`i Southern California Training and Testing Activities [HSST])	Hawai`i (235,000 nm^2 around the MHI	Permitted	Permitted	High	1, 4, 14	US Navy
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA); Permits 18702 - 18705	Pacific Ocean	FEIS	Permitted	High	4, 5, 14	SURTASS
Permit 17860 US Navy Acoustic Technology Experiments	Hawai`i	Permitted	Permitted	High	1, 4, 5	NOAA

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
Joint High Speed Vessel	Hawai‘i	Ongoing	2012 Vessel Trials	Medium	3, 4, 5	NOAA
Scientific Research						
Permit 15453 Enhancing Survival of Hawaiian monk seal (*Monachus schauinslandi*) (Captive animals [research enhancement])	Waikiki Aquarium, University of Hawai‘i 2777 Kalakaua Avenue Honolulu, HI 96815	Permitted	April 2012 – April 2017	High	1	NOAA
Permit 10018 Level B Harassment of Humpback Whales in the Near Shore Waters Around Maui, Hawai‘i (Harass)	Waters of the Au-Au Channel and in the near shore waters of Maui, Molokai‘i, Lāna‘i, and Kaho‘olawe.	Permitted	June 2010 – June 2014	High	4	NOAA
Permit 13427 Vessel surveys and photo-id of non-listed cetaceans (Harass)	Pacific Ocean deeper waters (>100 fathoms) South and West of Lanai and Kahoolawe	Permitted	June 2008 – June 2014	High	4	NOAA
Permit 13545 Global ecology and toxicology of cetaceans (Harass / Sampling)	Pacific Ocean, High seas	Permitted	June 2010 – June 2015	High	4	NOAA
Permit 13846 Behavior, social organization and communication in humpback and gray whales in Hawai‘i, Alaska and Washington (Harass; Sampling)	MHI	Permitted	July 2010 – July 2015	High	4	NOAA
Permit 14097 NMFS Southwest Fisheries Science Center (SWFSC) pinniped, cetacean and sea turtle studies (Harass)	North Pacific Ocean	Permitted	July 2010 – June 2015	High	3, 4	NOAA
Permit 14118 Medium to long-term satellite, acoustic, and multi-sensor tagging studies on large and small cetaceans (Harass)	HI, including PMNM	Permitted	May 2012 – April 2017	High	4	NOAA
Permit 14245 Cetacean Research at the National Marine Mammal Laboratory (Harass)	Alaska and US West Coast (CA, HI, OR, WA)	Permitted	April 2011 – May 2016	High	4	NOAA

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
Permit 14353 Humpback whale research around Maui, Hawai`i (Harass; Harass / Sampling)	Au-au Channel; Moloka`i; Maui; Kaho'olawe, and Lāna`i	Permitted	July 2010 – July 2015	High	4	NOAA
Permit 14381 Sampling sea turtle bycatch in Hawaiian Longline Fisheries (Handle / Release)	Hawai`i Shallow-Set Longline Fishery	Permitted	February 2010 – March 2015	High	3	NOAA
Permit 14451 Assessing distribution and abundance of marine mammals on Navy operational area; surface vessel surveys, photo identification, videography, and acoustic recording (Harass)	MHI; HIHWNMS; PMNM; US Navy PMRF	Permitted	July 2010 – July 2015	High	4	NOAA
Permit 14585 Behavior and biology of humpback whales (Harass; Harass / Sampling)	Hawaiian Islands EEZ	Permitted	July 2010 – July 2015	High	4	NOAA
Permit 14682 Scientific Research or to enhance the survival or recovery of a stock (Harass; Harass / Sampling)	Western O`ahu; Au Au Channel	Permitted	August 2010 – November 2015	High	4	NOAA
Permit 15240 Scientific Research and to enhance survival and recovery of Central and Western Pacific cetacean species (Harass; Harass/Sampling; Import/export/receive only; Incidental take)	U.S. EEZ waters. International waters, and foreign waters, subject to permission of the sovereign host State	Permitted	May 2012 – May 2017	High	4	NOAA
Permit 15330 Studies of population size, population structure, habitat use, movements, behavior and ecology of cetaceans (Harass / Sampling)	Hawai`i, territories (*e.g.*, Palmyra, American Samoa, Guam, Wake), and International waters)	Permitted	July 2011 – August 2016	High	4	NOAA
Permit 15409 Population and photo-id studies of small (Harass)	Pacific Islands (EEZ and American Samoa)	Permitted	June 2010 - June 2015	High	4	NOAA

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
Permit 15685 Ocean capture research of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in the Hawaiian Islands (Capture/Handle/Release)	Coastal waters (bays, reefs, canals, etc.); Kaneohe Bay	Permitted	January 2012 – January 2017	High	3	NOAA
Permit 16053 Measuring the hearing of stranded cetaceans in U.S. waters, beaches and rehabilitation centers using auditory evoked potential procedures (Captive)	U.S. coasts and rehabilitation centers	Permitted	February 2012 – February 2017	High	4	NOAA
Permit 16163 Studies of movements, habitat use, ecology, behavior, and risk factors of cetaceans in the Pacific Ocean. (Harass; Harass/Sampling)	Pacific Ocean: WA, OR, CA, HI, AK, High Seas North Pacific Ocean	Permitted	June 2012 – June 2017	High	4	NOAA
Permit 16479 Whale surprise encounters and near misses: proxies of vessel strikes in Maui County waters (Harass)	Maui County Waters (Latitude: 20.901025 Longitude: -156.615839)	Permitted	September 2012 – June 2017	High	4	NOAA
Permit 16599 Evoked Potential Auditory Tests for Stranded Marine Mammals (Handle / Release)	All US Waters - Stranding locations; beaches and rehabilitation centers	Permitted	March 2012 – April 2017	High	4	NOAA
16992 Paul Nachtigall – auditory research on captive cetaceans (HIMB) (Captive)	Hawaii Institute of Marine Biology	Permitted	May 2013 – May 2018	High	4	NOAA
Permit 17159 Spinner dolphin filming at Midway Atoll (Harass)	Midway Atoll; PMNM	Permitted	May 2012 – May 2017	High	4	NOAA
Permit 727-1915 scientific research (Harass; Harass / Sample)	Hawai'i / Palmyra Atoll	Permitted	February 2008 – February 2014	High	4	NOAA
File No. 14809 Permit to take cetaceans for ecological and bioacoustic research using tagging and behavioral research methodologies (Harass / Sampling)	Coastal and offshore waters surrounding MHI and NWHI	Application for 5-year permit	In-process	High	4	NOAA

RFFA	Region	Status	Time Frame	Probability	Resource(s) Potentially Affected	Source
File No. 16239 Aerial and vessel surveys, behavioral focal follows, and PAM monitoring techniques to further our understanding of marine mammals sharing waters with US Naval training, offshore energy development, and construction (Harass)	Pacific Ocean - Focal areas include Navy Hawaii Range Complex	Application for 5-year permit	In-process	High	4	NOAA
File No. 17312 Study of Marine Mammal Use of Sound and Response to Anthropogenic Impacts (Harass; Harass / Sample)	Hawai`i	Application for 5-year permit	In-process; will replace Permit 727-1915	High	4	NOAA
File No. 17845 Habitat use and behavioral dynamics of maternal-female, calf and juvenile humpback whales in feeding and breeding regions (Harass)	Coastal waters around Main Hawaiian Islands / All coastal waters and inter-island channels around MHI; Kauai and Ni'ihau, Oahu, Big Island and Penguin Banks, west of Lanai.	Application for 5-year permit	In-process; will replace Permit 10018	High	4	NOAA
Monitoring of Red-footed, Brown, and Masked Boobies from Midway Atoll and French Frigate Shoals	Tern Island, FFS, Eastern Island, Midway Atoll NWR	Permit Application	Dec 2010 - Dec 2015	High	7	PMNM
Retrieval of Ecological Acoustic Recorders (EARs) in Deep Marine Areas	Kure, Lisianski, FFS, Nihoa	Permitted	NA	High	1, 3, 4, 5	PMNM
Tuna Tagging	Near NOAA weather buoys in MHI	Permitted	Ongoing	High	6	PFRP (SOEST)

Resource Key:
1 – Hawaiian monk seals
2 – Water Quality
3 – Sea Turtles
4 – Cetaceans
5 – Sharks
6 – Other Fish Species
7 – Birds
8 – Coral
9 – Invasive Species
10 – Fishing (Commercial, Recreational & Subsistence
11 – Cultural & Historical
12 – Recreation & Tourism
13 – Environmental Justice
14 – Military Activities
NA - Not available

4.6 *Resources and Characteristics Not Carried Forward for Analysis Under Environmental Consequences*

CEQ regulations require NMFS to focus attention on important issues and avoid extraneous material in this impact statement (40 CFR 1502.15). Under CEQ regulations for implementing NEPA:

- "Direct effects" are effects that are caused by the action and occur at the same time and place (40 CFR 1508.8[a]).
- "Indirect effects" are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]).

Agencies must only consider indirect effects that are "reasonably foreseeable." Several of the resources and characteristics described in Chapter 3 may contribute to cumulative effects but would not be affected measurably by any of the alternatives for Hawaiian monk seal research and enhancement measures. Thus, additional analysis of these resources would not be useful to the decision makers or public.

As described in Section 2.6 Alternatives Carried Forward for Analysis, the range of Hawaiian monk seal research and enhancement activities proposed could include:

- Conducting land-based, vessel, and aerial surveys and observations;
- Mitigating infectious disease, and fishery and human/domestic animal interactions;
- Translocating seals to improve survival;
- Translocating seals to alleviate male aggression, and mitigating adult male aggression using chemical intervention;
- De-worming seals and providing supplemental feeding; and
- Capturing, restraining and handling seals for marking and attaching scientific instruments, measuring, and sampling (*e.g.,* for health and genetics).

None of these activities would have a measurable effect on the resources described below. The following subsections present each resource or factor not carried forward for detailed analysis.

4.6.1 *PHYSICAL ENVIRONMENT - CIRCULATION PATTERNS, WATER TEMPERATURES AND NUTRIENT REGIMES, AIR QUALITY, CLIMATE CHANGE*

None of the research and enhancement alternatives would be expected to have any effects on the circulation patterns in the Pacific Ocean, water temperatures and nutrient regimes, or air quality. Therefore, detailed analysis for these parameters under the alternatives is not warranted. In addition none of the proposed project alternatives would be expected to induce measurable effects on climate change. However, climate change is being considered from the

perspective of cumulative effects. The potential effects of climate change generated by other sources are evaluated as part of the cumulative effects analyses for each resource evaluated in Chapter 4.

4.6.2 *SHARKS*

As described in Section 3.3.4, approximately 40 species of sharks are found in Hawaiian waters. None of the proposed Hawaiian monk seal research and enhancement alternatives covered by this PEIS and that would occur in the coastal waters surrounding the Hawaiian Islands is likely to have direct or indirect effects on sharks. Researchers accessing beaches and inshore areas by small boat to observe, capture, handle or transport Hawaiian monk seal would not be likely to disturb pelagic sharks. Research vessels might encounter sharks while traveling in small or large vessels between islands to areas where Hawaiian monk seal are located, but any encounters are not expected to impact sharks. In addition it is not expected that the small increase in numbers of monk seal pups that could be realized in the MHI under Alternative 4 would attract additional large numbers of sharks.

As described in Table 1.6-1, NMFS currently has a permit for "Selective removal of predatory sharks at Hawaiian monk seal pupping sites of French Frigate Shoals" (Monument Permit No. PMNM-2013-017). This activity is not part of the proposed research and enhancement actions covered by this PEIS, and it has been documented under a separate NEPA process (Section 1.7).

4.6.3 *ESA-LISTED PLANTS*

Proposed Hawaiian monk seal research and enhancement activities would have no effect on any of the endangered plants that occur in the NWHI or MHI (NMFS 2009b). The proposed activities would be located in coastal waters on the beach or within 5 m inland of the splash zone. Field research camps in the NWHI are located further inland than this immediate shoreline area.

Some listed plants may occur near field camps or trail paths leading to beaches where monk seals haul out. These species are threatened by human disturbance and are known to exist in areas where humans access beaches. Monument Permit PMNM 2011-001 (Appendix L) allows NMFS researchers to enter the Monument to conduct research and enhancement activities, and covers field camp support and supply activities. Although the permit does not specifically identify procedures for protecting ESA-listed plants, NMFS would take all precautions necessary to avoid contact with these plants. This includes training biologists on the identification and locations of such plants and working with the USFWS to develop a training protocol to implement for work in the MHI (similar to that implemented for work in the NWHI). When accessing beaches by foot, researchers would stay on the path where no vegetation occurs. When accessing beaches by boat, they would only land on sandy beaches below the vegetation

line. It would be highly unlikely that research biologists would encounter coastal ESA-listed plant species, or they would be easily avoidable.

4.6.4 SANCTUARIES, MONUMENTS, AND REFUGES

As described in Section 3.4.11 Sanctuaries Monument and Refuges, the State of Hawai`i has a system of conservation areas that include wildlife and marine sanctuaries, monuments, parks, refuges, natural area reserves, and marine life conservation districts (MLCD). The jurisdictional authorities for these public lands are described in Section 3.4.11. The majority of these areas are federally managed; however the MLCDs are managed by the state. Some of the proposed research and enhancement activities could occur on or near Hawaiian shorelines and waters that fall under one or several of these special designations.

Whether under state or federal jurisdiction, these areas are protected; therefore, research and enhancement activities that would access coastal or refuge lands would require permits and/or approvals for access to these areas. For example, research scientists wishing to work within the Monument are required to obtain a Monument research permit. The permit allows the permit holder to conduct their permitted activities within the Monument. For work within the state protect areas, a Special Activity Permit for Scientific, Educational or Propagation Purposes is required under HRS 187A-6. The permit allows any person with a bona fide scientific, educational or propagation purpose to legally take certain aquatic life, use certain gear, and gain entrance into certain areas otherwise prohibited.

The permit applications required in sanctuaries, monuments and refuges must go through a public process as well as regulatory and agency reviews. Thus, impacts to protected lands and waters from research and enhancement activities are not expected because of imposed requirements such as mitigation to avoid adverse effects to these areas. Also, none of the proposed alternatives would be expected to affect or change the designations of these protected areas in any way. Therefore, sanctuaries, monuments and refuges are not carried forward for detailed analysis.

4.7 Biological Environment

4.7.1 HAWAIIAN MONK SEALS

This section presents the analyses of the effects of the four different research and enhancement alternatives on Hawaiian monk seals. The general methodology for performing this assessment is introduced in Section 4.4. However, a description of the Hawaiian monk seal-specific analysis is presented here in more detail. The alternatives represent discrete sets of research and enhancement activities varying in scope, each with a range of research and enhancement techniques and intensities that could be authorized by NMFS OPR.

Research and enhancement activities on endangered species are intended to determine factors limiting recovery, design intervention measures and execute those measures, evaluate their efficacy and repeat the process as warranted. However, any research and enhancement activity that has the potential to disturb animals has some risk of adverse effect for animals exposed. Animals disturbed by research and enhancement may exhibit a variety of behavioral and physiological responses that could result in injury, reduced reproductive success, or mortality. Similarly, animals' behavioral and physiological responses to capture, chemical or physical restraint, tissue sampling, attachment of tags or instruments, and exposure to various other marking or sampling procedures can result in injury, infection, reduced fitness, and mortality.

For each type of research and enhancement activity there are one or more possible responses from the animals. For some research and enhancement activities (*e.g.,* aerial surveys) most monk seals exhibit no observable response, although it is possible they may have elevated adrenaline levels or other internal stress responses. For research and enhancement activities that require the presence of researchers on land near monk seals, most animals will remain sleeping undisturbed, others will simply watch researchers, and others may move their bodies, vocalize or enter the water.

Seals that are captured and handled will be subject to additional types of stress and risks compared to those that are simply observed. The intensity and probability of potential responses is a function of a variety of factors including the sex/age class of the animal, the tendency of the individual animal to respond in certain ways, the approach and handling technique of the researchers, timing and location of the research or enhancement activity, and environmental factors such as sea conditions and weather. Each research and enhancement activity therefore has inherent potential risks, which are influenced by all the above factors.

Potential population- or species-level impacts could result depending on the nature of all individual responses and the number of animals involved. The effect of exposure to a variety of research and enhancement procedures may be additive or synergistic (*i.e.,* the effect of two or more procedures combined could be greater than simply adding them together). For all of the procedures analyzed, it is assumed that all researchers are experienced and qualified to fill their assigned roles and that all procedures are carried out under "best practices" conditions, including all mitigation measures specified in program protocols and the relevant permits.

The analysis of the direct and indirect effects of research and enhancement activities is divided into three major components:

- An assessment of research- and enhancement-related injuries that lead to serious injury or mortality;

- An assessment of research and enhancement-related effects on reproductive success; and
- An assessment of how well each alternative research and enhancement strategy would address recovery and conservation objectives for the species.

Potential positive effects of research and enhancement are evaluated based on the project's likelihood of contributing to the species recovery or conservation, in consideration of the potential adverse effects. The criteria for determining the impact level of each component are summarized in Table 4.4-1.

4.7.1.1 *ASSESSMENT OF DIRECT AND INDIRECT MORTALITY OF HAWAIIAN MONK SEALS DUE TO RESEARCH AND ENHANCEMENT*

There are many potential mechanisms for research and enhancement-related injuries to occur, some of which may lead directly or indirectly to the death of individual animals. Some injuries may affect the ability of an animal to forage or behave normally but are not directly fatal (*i.e.*, sub-lethal effects). The thresholds for sub-lethal effects (*i.e.*, when they start to affect an animal's ability to survive) are not well known. There are many other natural and anthropogenic factors that also affect survival of individual animals, so attributing the fate of an animal to a particular factor is often highly uncertain. The key question for this impact assessment is whether or not effects on individuals translate into population-level effects such as population growth rate.

The following begins with an extensive narrative describing the potential or hypothetical ways that the research and enhancement activities represented in the various PEIS alternatives (see Chapter 2) might affect survival of individual seals. Following that, available information from published studies, publications in development and unpublished data are brought to bear to guide the quantitative and qualitative analysis of potential effects of research and enhancement activities on monk seal mortality.

4.7.1.2 *MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM DISTURBANCE*

The extent to which human activities may have adverse effects on wildlife has recently become a source of conservation interest. Human disturbance causes a deviation in an animal's behavior from normal patterns that occur without human influence. There are numerous potential responses to different disturbances that could affect an individual's chance of survival and reproductive success. If the disturbance is severe and/or frequent enough to affect the fitness of many individuals, it may have population-level effects.

One type of response to disturbance is an animal's decision to move away from disturbed areas. This decision may be influenced, other than by the disturbance itself, by factors such as quality of the site being occupied, distance and quality to

other suitable sites, relative risk of predation, density of competitors, and the investment the individual has made onsite (Gill *et al.* 2001a). The decisions made by animals in response to human disturbance, and the consequences thereof, have been compared to the decisions they make in response to predation risk (Frid and Dill 2002). Animals with suitable habitat nearby may move away from a disturbance simply because there is an alternative site. Conversely, animals with no suitable habitat nearby may remain despite disturbance and regardless of the survival or reproductive consequences (Gill *et al.* 2001b).

A review of available literature on responses of numerous species to a variety of human activities suggests that the behavioral and physiological responses of individuals and their consequences are highly variable and influenced by multiple factors. For example, Anderson *et al.* (1996) found that there were no long-term effects of military activities on moose, and Englehard *et al.* (2002) concluded there were no long-term effects on elephant seals from human disturbance. However, Kerley *et al.* (2002) found that roads and traffic affected the reproductive success and survivorship of Amur tigers, and Blackmer *et al.* (2004) found that human disturbance affected hatching success and nest-site fidelity of Leach's storm petrel.

In addition to assessing behavioral responses and population parameters, a frequently measured indicator of the vertebrate stress response is stress hormones: glucocorticoids (GC), typically cortisol and corticosterone (Wingfield *et al.* 1997). Research on drivers influencing hypothalamic-pituitary-adrenal (HPA) activation, GC release and related physiological and behavioral processes are also numerous (Keay *et al.* 2006). A short-term stress response to an acute, ephemeral stressor represents an adaptive ability to cope with the stimulus, focusing on the immediate survival of the animal while suspending future processes such as energy storage as fat, production of gametes and growth (Reeder & Kramer 2005). A chronic stress response to a persistent stressor, however, can be detrimental to the organism and result in cell death, immunodeficiency, muscle wasting, reproductive suppression, and memory impairment (Reeder & Kramer 2005).

Studies on a wide range of vertebrates indicate that physiological stress responses can be reliably and repeatedly characterized by measuring GCs pre- and post-disturbance or among population subsets that vary in their exposure to a disturbance (Baker *et al.* 2013; Busch & Hayward 2009). Assessing adrenal activity through GC measurement in blood and fecal samples has become increasingly popular in recent decades, however, other physiological measures, such as cardiac response and immuno-competence are also common (MacArthur *et al.* 1979; Moen *et al.* 1982; Tarlow and Blumstein 2007).

In a review of 290 studies on stress responses of wildlife to ten disturbances, the effect of capture and handling was most frequently examined, followed by land use and alteration, human presence (*e.g.* tourism, number of people in an area, human-flushing, human interaction) and husbandry activities (*e.g.* confinement,

herding, hot-branding, stocking, feeding) (Baker *et al.* in review). An increase in GCs was consistently associated with capture and handling (significant in 80% of tests) and land use and alteration (significant in 100% of tests) across species tested; whereas the effects of human presence and husbandry were more variable (significant in 62-65% of tests) (Baker *et al.* in review).

GCs have been measured in a number of marine mammals in association with disturbances. For example, GCs increased with toxin exposure, predators, capture, and entanglement, but not significantly influenced by isoflurane anesthesia and hot-branding; other correlates were also influential (pregnancy, lactation, other hormones, age, season, time of day, gender) (Gulland *et al.* 1999; Ortiz *et al.* 2000; Oki & Atkinson 2004, Bozza & Atkinson 2005; Petrauskas *et al.* 2005; Hunt *et al.* 2004; Mashburn and Atkinson 2007; Mellish *et al.* 2007). Most of these studies focused on captive animals.

For wild marine mammal populations, identifying, monitoring and analyzing covariates demonstrated to be relevant to stress physiology in other vertebrates (*e.g.,* age, reproductive state, social status) may aid in accurate characterization and interpretation of results (*e.g.*, Goymann *et al.* 2001 and Gobush *et al.* 2008). A failure to account for a sufficient number of relevant variables may preclude an adequate context for sound evaluation. For example, significant GC patterns may be masked by noise from other biological factors and a particular disturbance may incorrectly be deemed to have no effect on stress physiology, contributing to some inconsistent trends between vertebrate stress responses and disturbances that are apparent across studies and species.

A measured temporary rise in GCs in response to capture or disturbance might have consequences on individual fitness if it became chronic. However, though baseline GC measures can predict the relative fitness of individuals and populations, the relationship is not always consistent or present for a particular population or species (Bonier *et al.* 2009). For example, increased GCs were associated with increased probability of death (of individuals) or diminished viability (of offspring) in 73% of tests across 42 vertebrate studies (Baker *et al.* in review). GCs may be evaluated in Hawaiian monk seals in the future to help indicate stress.

Behavioral indices can provide a useful complement to GC measures and can help determine the risks of their activities to populations. For example, some studies have considered post-disturbance recovery to be attained when a certain percentage of the animals present at the time of the disturbance return to shore (*i.e.*, Allen *et al.* 1984) or by applying statistical approaches that consider average densities and daily variation in numbers onshore (*i.e.*, Kucey 2005). Alternatively, long-term population assessment, which can determine relationships between disturbances such as handling events and individual condition and survival, offer considerable insight.

In the case of Hawaiian monk seal research and enhancement activities, great pains are taken to avoid disturbance. In the cases when it does occur, it typically involves only a single or at most a few animals at once. Disturbances that occur during activities that do not involve capture or handling monk seals, usually amount to the seal simply looking at the researcher, perhaps swinging its head and lying back down. The most dramatic response is that a seal may move down the beach, enter the water and swim some distance away. Even in these cases, the seals rarely exhibit what would be interpreted as a panic flight response.

Thus, observable monk seal response to disturbance is entirely distinct from research on other types of pinnipeds which congregate in dense colonies, where hundreds to thousands of animals can be disturbed in a single event, leading to stampedes to the water (Lewis 1987). One study (McMahon *et al.* 2005) tracked the survival of endangered southern elephant seal pups (*Mirounga leonina*) that had been handled repeatedly and subjected to intrusive research procedures in their first six weeks of life and found no short-term (24 day nursing period) or long-term (first year of life and beyond) effects on survival. The results from studies of stress on one species may not apply to the responses of another species. No physiological studies of Hawaiian monk seal response to disturbance alone (*i.e.*, not involving capture and handling) have been conducted.

The most common scenario for disturbance of Hawaiian monk seals is during research activities that involve the presence of researchers on NWHI beaches where seals are resting. The seals tend to be distributed around the islands in singles or small clusters usually fewer than a dozen in number. Perhaps because most Hawaiian monk seals are rarely captured following a brief tagging event soon after they wean as pups, they are typically not particularly wary of human presence.

However, it is thought that past circumstances, especially those involving prolonged, frequent and intense harassment and disturbance associated with military and USCG activities on NWHI beaches, caused Hawaiian monk seals to avoid certain important beach habitats (Ragen 1999).

In response to researcher presence, seals often simply return to sleep, or watch the researcher until they are no longer visible. Sometimes, however, seals do get agitated and move a few body lengths down the beach before settling down. While the above describes the most common disturbance scenario, not all seals exhibit the same response to the same disturbance, nor does an individual seal necessarily exhibit the same response on any given day. Hawaiian monk seal researchers have noted that juvenile seals tend

Past circumstances, especially those involving prolonged, frequent and intense harassment and disturbance associated with military and USCG activities on NWHI beaches, caused Hawaiian monk seals to avoid certain important beach habitats (Ragen 1999).

to be more wary and likely to respond to researchers.

Thermoregulation may also play a role in seals' responses. Commonly, seals that have slept on land overnight spend the morning resting as well. As the temperature rises during the day they often slowly make their way to the water to cool off. This transit from the beach berm to the water may take several hours, with the seals sleeping for periods on the way. However, if a seal is feeling hot and is on the way to the water, seeing a researcher may hasten their entering the sea. Finally, seals that have recently been captured and handled understandably tend to be more likely to go to the water the next time they see a researcher. At the other extreme, there are individual seals that seem to have no concern about human presence. For example, when field camps are established on NWHI, it is common that one or more seals will habitually haul out and sleep in camp.

In the MHI, seals have been exposed to the large resident and transient human populations. Many seals have become extremely habituated to people and choose to rest on beaches with hundreds of humans in proximity.

However, Baker and Johanos (2004) conducted aerial surveys of all MHI shorelines in 2000 and 2001, and found that most of the seals seen had chosen to land at beaches less frequented by people.

This suggests that beach habitat selection of MHI Hawaiian monk seals may be influenced by human disturbance. A similar avoidance of the vastly smaller scale of human presence in the NWHI has not been detected.

Baker and Johanos (2004) conducted aerial surveys of all MHI shorelines in 2000 and 2001, and found that most of the seals seen had chosen to land at beaches less frequented by people.

Despite the fact that outwardly, Hawaiian monk seals do not usually exhibit strong disturbance responses, it is not possible to rule out that there may be unobserved deleterious responses. Indeed, human disturbance has long been considered a threat to monk seal conservation, due mostly to population declines and local extinctions associated with the long history of first persecution and hunting by people up to the early 20th Century, and subsequent intensive prolonged harassment by military personnel and others visiting the NWHI prior to the seals receiving protection (Ragen 1999). As noted above, the frequency and intensity of research and enhancement related disturbance is vastly less than the seals' historical treatment.

Thus, while there is reason to believe that the level of disturbance associated with human disturbance from research and enhancement activities that do not involve capture and restraint are benign, we must consider the potential that disturbance could cause injury or harm. The following is a list of conceivable potential mechanisms for such harm:

- Increased corticosteroid levels or other physiological stress responses;

- Seals sustaining scrapes or cuts while fleeing over abrasive substrates (*e.g.*, coral);
- Increased risk of shark predation to seals that enter water when they would otherwise be on the beach;
- Increased risk of pups being subjected to adult male seal aggression if they enter the water in proximity to an aggressive male seal; and
- Disruption of nursing of mother/pup pairs leading to lower energy and nutrient intake by the pup.

4.7.1.3 *MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM CAPTURE AND RESTRAINT*

In contrast to simple disturbance described above, seals that are captured and restrained during research and enhancement activities are subject to additional risks. As described in Chapter 2, capture and restraint can involve a range from brief procedures for tagging to longer procedures involving sedation, attachment of instruments, biomedical sampling, etc. Upon release from capture and restraint, most seals immediately flee to the water. The exception is that recently weaned pups often remain on land after being captured, tagged and measured. The following are mechanisms by which animals may be injured during capture and restraint without sedation:

- Efforts to avoid or escape capture could lead to contusions, lacerations, abrasions, hematomas, concussions, and fractures, as well as hyperthermia (excessively high body temperature which could lead to muscle rigidity, brain damage, or death) and myopathy from increased muscle activity;
- Increased energy expenditure with the potential for hyperthermia for those animals involved in strenuous or prolonged activity; and
- Capture myopathy is associated with prolonged or repeated stress responses in many mammals (though whether it occurs in pinnipeds is uncertain) and is characterized by degeneration and necrosis of striated and cardiac muscles (Fowler 1986). Capture myopathy may be fatal and may not develop until many days after capture and handling.

4.7.1.4 *MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM SEDATION OR ANESTHESIA*

Diazepam (valium) is the drug used for field sedation of Hawaiian monk seals, and midazolam may also be used for sedation in some cases (see Appendix D). Gas anesthesia (*e.g.*, isoflurane) has also been successfully used in clinical settings, for example, surgeries to remove embedded fish hooks from seals. However, these latter cases involve stranding response and are covered under the Marine Mammal Health and Stranding Response Program's permit and PEIS

(NMFS 2009c) and not by this PEIS. Thus, this discussion is limited to risks associated with diazepam and midazolam sedation. These include:

- Miscalculation of dosage could lead to overdose and consequently death;
- Administration of IV diazepam could cause pain, stress, and damage to the extradural vein or surrounding tissue;
- Administration of IM midazolam could cause pain, stress, and damage to surrounding tissue; and
- Possible side effects include bradycardia (slowed heart rate), respiratory depression, tremor, confusion, blurred vision, nausea, vomiting, depressed gag reflex, lethargy, and ataxia (inability to coordinate muscle activity during voluntary movement) (NMFS 2005a).

4.7.1.5 *MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM BIOMEDICAL SAMPLING, MARKING, ATTACHMENT OF TELEMETRY INSTRUMENTS, DE-WORMING, ADMINISTERING ANTIBIOTICS AND OTHER DRUGS, DISENTANGLEMENT AND OTHER RESEARCH AND ENHANCEMENT PROCEDURES*

Numerous research and enhancement procedures involve the handling of animals, including collection of various tissues as biomedical samples, weighing, measuring, attaching flipper tags, applying pelage (fur) bleach marks, attaching various telemetry (*e.g.*, satellite or GPS tracking) devices, and administering de-worming medications. In addition to the following risks associated with these procedures, all of the handled animals are exposed to the risks of researcher disturbance and capture/restraint presented above.

- Blood collection can cause pain, stress, damage to the extradural vein or surrounding tissue, and potentially infection;
- Biopsy punches for skin and blubber samples can cause pain and stress, and produce a small wound that has the potential for infection;
- Swab sampling of orifices could cause pain or irritation. Fecal sampling with a fecal loop could also cause pain and irritation; additionally, perforation of the rectum is a possibility. In female seals, accidental insertion of a fecal loop into the vagina could result in discomfort or possibly introduction of pathogens;
- Flipper tags involve creating a small hole in the flipper, through which plastic tags are threaded. This can cause temporary pain, stress, and possibility of infection. The tag might tear out over time, causing additional wounding to the flipper;
- Use of hair bleach to temporarily mark the pelage of Hawaiian monk seals can awaken the seal, causing a disturbance response. Bleach could cause irritation to areas it might come into contact with (eyes, nose or skin surfaces);

- Attachment of instruments to the fur with epoxy can cause irritation and in some cases minor skin wounds at the margins of the attachment area. The hydrodynamic drag created by the instrument might hinder swimming performance and result in increased energetic costs of swimming and diving, potentially affecting foraging efficiency;
- Administration of de-worming and other medications (*e.g.*, antibiotics and emergency response drugs) can occur by various routes, each with some potential risk (see Appendix D). Injections (intra-muscular or subcutaneous) can cause pain, stress, swelling, and the risk of infection at the injection site. Oral intubation of drugs also can cause pain and stress, and carries the risk of introducing fluids into the trachea and lungs, which may lead to pneumonia. Topical application of medication has a potential to disturb or stress seals if they awaken during the application; additional information on potential effects of drug administration is presented in Appendix D;
- It is possible that de-worming a seal that has a sufficiently heavy parasite burden could result in a bolus of dead worms causing an intestinal blockage and death; and
- During disentanglement of seals caught in marine debris, removal of debris from severe wounds or from seals which have become very compromised by their entanglement, can pose a risk of causing excessive bleeding and other complications, potentially leading to death.

4.7.1.6 MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM TRANSLOCATION

A number of enhancement activities involve translocation of Hawaiian monk seals. The seals involved include nursing pups that have been abandoned or separated from their mothers, weaned pups, juveniles and adult males. The details of translocations are presented in Chapter 2 and Appendix F (Two-Stage Translocation: A Proposal for Endangered Hawaiian Monk Seals). The procedures associated with these actions vary with the logistics of each case and to some degree, the age of the animals involved. However, all translocations will entail some portion or all of the following elements:

- Capture;
- Restraint;
- Holding in a cage or other enclosure;
- Transport via small boat, automobile, ship or aircraft;
- Sedation;
- De-worming;
- Health and disease screening (*i.e.*, biomedical sampling);
- Pre-release quarantine;
- Attachment of telemetry devices; and

- Release at a destination site.

Risks of many of these procedures have been identified in the foregoing sections and are applicable to translocation to the extent that they occur as part of a translocation action. The following is a list of risks specific to procedures involved only in translocation:

- Temporary holding and transport may cause stress, leading to any number of related ailments, including immuno-suppression, and potentially death;
- Some monk seals in captivity have developed eye problems that make them non-viable for release into the wild;
- Seals could be harmed if an accident occurs during transport;
- Seals released in a new area may encounter risks that they were unaccustomed to in their previous location (*e.g.*, increased shark predation or competition for prey, increased human disturbance, and potential harm by humans);
- Seals released in a new area may forage less efficiently, either because the new site has less available prey, or because the seal is unfamiliar with the novel foraging landscape;
- Seals may be exposed to new diseases either through contact with other seals being translocated at the same time, or through contact with seals at the release location; and
- Translocated seals themselves may pose a risk to other seals if they carry communicable disease.

4.7.1.7 MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM BEHAVIORAL MODIFICATION

Research to determine the safest and most effective methods for modifying undesirable behavior of seals that, for example, become habituated to humans in the MHI, will potentially involve a number of techniques. These would include methods such as capture, restraint, sedation, biomedical sampling, instrumentation, translocation, and temporary holding. Seals may also be hazed using visual, audible and tactile means. They may be guided or have their movements impeded by temporary barriers. Some of these actions have already been described and would entail the same risks identified above. Risks of actions unique to behavioral modification include:

- Hazing and use of barriers to movement may cause stress;
- Tactile means might involve momentary, minor pain or discomfort, though the techniques would not involve any type of intentional infliction of injury;
- Visual and audible hazing could cause stress; and
- In cases where the objective of behavioral modification is to move seals away from a specific area where they are, for example, interacting with

people, achieving this objective could also displace the seal from resources (*i.e.*, foraging or resting areas) that are important for maintenance and growth.

Behavioral modification of aggressive male Hawaiian monk seals that harm other seals could involve experimental use of gonadotropin-releasing hormone (GnRH) agonist (*e.g.*, decapeptyl or deslorelin), to lower testosterone levels and, ideally, aggressive behavior. Decapeptyl has been used safely with no ill effects in HMS (Atkinson *et al.* 1993; Atkinson *et al.* 1998). The effects of deslorelin have proven safe in other mammals (Bertschinger *et al.* 2001; Trigg *et al.* 2006). The drugs would be given via injection after capture and restraint, and would therefore entail the same risks described above for these procedures. Potential harm or injury that could result from treatment with these drugs include:

- An initial relatively brief rise in testosterone levels prior to their suppression (as shown in other mammals injected with GnRH agonists). During this period there is a risk that male seals could exhibit elevated levels of aggression, posing a risk of harm to other seals;
- Treatment might cause the subjects to be attacked or harmed by other males;
- If effective in reducing testosterone, subject males would be temporarily "chemically castrated," such that they potentially have lower reproductive success; and
- GnRH agonists may have side effects.

4.7.1.8 *MECHANISMS OF INJURY TO HAWAIIAN MONK SEALS FROM VACCINATION*

Vaccines currently used for prevention of viral diseases in domestic animals can be divided into three types: those based on a dead inactivated virus; those using live attenuated virus; and vaccines consisting of recombinant viruses. Recombinant viruses use a vector virus that does not typically infect the target host but expresses antigen from the pathogen of interest, stimulating an immune response against it (Griffin and Oldstone 2009). Vaccines using a dead virus are considered the safest as the virus cannot replicate in the host or cause disease; however, this lack of replication often means that the immune response generated following vaccination is short lived and may not be protective. Live vaccines typically generate the most effective immune response, but present the risk (when used in species other than the one for which the vaccine was developed) of the virus replicating in the host and either causing disease in the vaccinated animal, or being shed in secretions and becoming infective to other contacted animals. Numerous carnivores, especially mustelids (weasel family) and procyonids (*e.g.*, raccoons), have died in zoological collections following vaccination with live canine distemper virus (CDV) vaccine (Deem *et al.* 2000). To overcome this risk of live vaccine use, recombinant vaccines to CDV are now used extensively in zoological collections (Bronson *et al.* 2007).

Vaccines currently being considered for Hawaiian monk seal include a recombinant canary pox (Purevax, Meriel) vaccine against morbillivius and an inactivated West Nile Virus (WNV) (Innovator, Fort Dodge). The canary pox vaccine has been safely used on a wide range of non-domestic carnivores including pinnipeds. It has not been associated with live virus shedding and is likely to stimulate higher immunity than a dead vaccine. The canary pox is also commercially available in the U.S. and is recommended by the American Association of Zoo Veterinarians for use in non-domestic carnivores. The Fort Dodge WNV vaccine has been used to date on Hawaiian monk seals in captivity in San Antonio, Texas, with no adverse reactions observed (Workshop to Evaluate the Potential for Use of Morbillivirus Vaccination in Hawaiian Monk Seals, Final Report 2005).

Vaccines would most likely be administered to Hawaiian monk seals through injections which could involve capture and restraint. Vaccination would thus entail the risk associated with disturbance, injection and potentially capture/restraint. Other specific risks of vaccination may include an immune response, which can rarely result in a local reaction at the site of injection characterized by heat and swelling that resolves in 5-7 days, or febrile response (*i.e.*, fever).

4.7.1.9 NUMBER OF HAWAIIAN MONK SEALS AFFECTED BY RESEARCH AND ENHANCEMENT UNDER EACH ALTERNATIVE

Section 2.5 describes the different research and enhancement "take" activities that may occur under the various alternatives. Permits must specify the number of seals that could potentially be affected by research and enhancement take activities. Thus, each alternative may involve different numbers of animals.

The take numbers indicate the maximum number of animals that may be affected by each take category under each alternative and are presented in Appendix H (Take Tables).

When applying for MMPA/ESA marine mammal research and enhancement permits, applicants request the maximum number of takes that they believe might potentially occur during their permitted activities. Exceeding these take levels would amount to a permit violation. In the case of the Hawaiian monk seal, NMFS historically has not reached the total level of takes authorized for research and enhancement. Nevertheless, these maximum levels will be analyzed here. The numbers of takes for different research and enhancement activities under the following alternatives are presented in Appendix H and support the analysis of the alternatives presented herein.

- Alternative 1 (Status Quo) is based on the current Hawaiian monk seal research and enhancement permit (10137). Permit No. 10137 expires in June 2014 and Alternative 1 assumes that the same levels of take would be authorized in the future with no changes.

- Alternative 2 (No Action) assumes that no further research and enhancement permits would be authorized once the current permit (10137) expires in 2014;
- Alternative 3 (Limited Translocation, Preferred Alternative) includes a suite of additional research and enhancement activities with their associated number of takes, as well as some additional takes for existing (Status Quo) actions; and
- Alternative 4 (Enhanced Implementation) has identical take levels as Alternative 3, but is distinguished by the added potential to translocate weaned pups from the NWHI to the MHI and subsequently return them to the NWHI when they are 2-3 years old.

Implementation of any alternative will depend on the availability of sufficient funding, which is not guaranteed. Alternatives 3 and 4 would likely require a substantial increase in future funding levels compared to the current funding available for implementing Status Quo (Alternative 1). However, for the purposes of this analysis, it is assumed that sufficient funding would be secured to fully implement each alternative.

4.7.1.10 ASSESSMENT OF MORTALITY OF HAWAIIAN MONK SEALS DUE TO RESEARCH AND ENHANCEMENT

Analysis of mortality effects associated with research and enhancement activities will be primarily based on up to three sources of lethal takes presented in Appendix H (Take Tables). These include:

- Euthanizing moribund seals and adult male removals. These involve humanely euthanizing seals deemed by an attending veterinarian as highly likely to die (*e.g.*, due to injury or illness) and either lethal removal or permanent captivity of adult male seals that have harmed or killed other seals. Because permanent captivity is equivalent to mortality from the perspective of the wild populations, captivity is treated as a mortality in the analysis of alternatives;
- Unintentional mortality (research). This includes any unintentional deaths of seals that may occur as a result of research; and
- Unintentional mortality (enhancement). This includes any unintentional deaths of seals that may occur as a result of enhancement activities.

These sources of mortality are considered to be entirely observable. NMFS has a long history of evaluating the potential effects of research and enhancement on Hawaiian monk seals as evidenced by numerous published reports and papers showing that Hawaiian monk seals subjected to specific research and enhancement activities do not subsequently exhibit higher mortality than seals not subjected to the activities (Baker and Johanos 2002; Littnan *et al.* 2004; Baker *et al.* 2011*b*). Moreover, these studies have often sought to detect sub-lethal effects (for example, on behavior, movement, body condition, etc.) of research and

enhancement activities, but have failed to find evidence of any such deleterious effects. Based on these publications, coupled with the fact that most Hawaiian monk seals are uniquely identifiable and closely monitored, it is assumed that there are no unobserved mortalities associated with research and enhancement activities.

Thus, NMFS concludes that the unintentional or intentional (in the case of moribund seals or aggressive adult male seals) mortalities that are observed as an immediate result of research or enhancement constitute the totality of mortality associated with these activities. It is important to note that this is not a claim that research and enhancement have no associated mortality; rather it asserts that such mortality will be entirely observable and documentable.

4.7.1.11 RESEARCH AND ENHANCEMENT ACTIVITIES THAT INVOLVE TAKE OF HAWAIIAN MONK SEALS

Below is a discussion of each type of activity involving take that is proposed under various alternatives and the evidence supporting the above conclusion.

Tagging – Since the early 1980s, nearly all Hawaiian monk seals have been captured, restrained and tagged with plastic flipper tags as soon as possible after weaning. To ensure that this practice did not have negative effects, Henderson and Johanos (1988) conducted a study at Lisianski Island to compare the early survival, behavior and movements of tagged and untagged weaned pups. They found no differences in any of these metrics. For most Hawaiian monk seals, this initial tagging at weaning is the only time in their lives they are handled by humans. However, some seals may be captured, restrained and retagged at an older age if they have lost, worn or broken flipper tags. Baker and Johanos (2002) compared the survival, migration and condition of 437 seals during the year subsequent to retagging to an equal number of matched controls with pre-existing tags. It was important to choose control seals that were already tagged so that probability of resighting would not be biased between the two groups. No differences in survival, migration or condition were found between the retagged and control groups.

Bleach Marking – Seals are marked with hair dye, providing marks that last until the seal's next molt. While no directed study of the effects of bleach marking has been conducted on Hawaiian monk seals, it is reasonable to assume that since the more intensive activity of capture, restraint and tagging has no detectable negative effect, bleach marking is even less likely to cause mortality. Most seals do not even awaken during bleaching so that there is no disturbance effect. Field staff is instructed not to place bleach in areas where the seal could sweep it with their flippers into their eyes, nose or mouth. Further, despite many thousands of bleach markings of monk seals, no negative effect of this procedure other than minor disturbance has ever been observed (NMFS PIFSC Annual Permit Reports for Permits No. 10137 and 848-1695-). Bleach marking aids in detection of a seal's identity from a greater distance than would be possible with

flipper tags alone, thereby reducing the necessary approach distance and consequently the chances of disturbance.

Health Screening and Foraging Studies – Although these two activities have distinct goals and involve different procedures, in practice they quite often occur simultaneously and are therefore discussed together here. For example, almost every time a seal is captured to attach a telemetry instrument (to study foraging behavior) a health screening is conducted at the same time. Baker and Johanos (2002) evaluated the same metrics (survival, migration and condition) of seals that were instrumented and/or health screened compared to matched controls and found no difference. The number of cases of health screening was small (N = 19), however the sample for foraging instrumentation was much larger (N=93) and many in this latter group were also health screened, lending confidence to the conclusion that neither procedure had negative effects.

Further Littnan *et al.* (2004) evaluated a suite of diving and foraging-related parameters of juvenile Hawaiian monk seals fitted with the largest type of foraging instrument used in this species, a seal-mounted video camera (*i.e.,* "Crittercam"). The foraging behavior parameters of seven seals were compared while they had both the Crittercam and a much smaller dive recorder attached versus a period when they carried the dive recorder alone. No statistically significant differences were detected in the seals' behavior during the two periods.

De-worming – Although treatment for gastrointestinal parasites has long been a somewhat routine procedure for captive monk seals and other pinnipeds brought into captivity for rehabilitation, there has been relatively little experience with field treatment of free-ranging seals for parasites to reduce worm burden and improve body condition and survival. However, such a study was implemented at Laysan Island in 2009-2010 (Gobush *et al.* 2011). A pilot trial using orally administered de-wormers proved unsuccessful in that it was too difficult to administer a reliable dose orally in field conditions. Subsequently, an injectable medication trial was conducted. This involved 43 juvenile seals that were captured, weighed, measured, feces sampled and either given an intra-muscular injection of the anti-helmintic (Praziquantel), or served as controls three times on an 8-16 week interval.

The effect of treatment on survivorship, egg presence and gain in mass was evaluated. Survivorship of the subset of the three cohorts included in the study was 100% for the 2007 and 2008 cohorts, and 85.2% for the 2009 cohorts. There was no difference in survival of the treatment and control seals. Nearly all collected fecal samples had cestode eggs; there were no significant differences in egg presence between control and treated seals. Percent mass change differed with season and by age. Mass gain was greatest in the period from March to May. Percent mass gain was significantly greater for treated than control seals during March to May, but not during December to March or over the entire treatment period (December to May). The above study was designed to both

evaluate potential beneficial effects of de-worming and also detect any potential negative effects. The fact that there was no difference in survival and a suggestion of higher growth rates in treated seals during a portion of the study indicates that there was no negative effect on survival or condition.

The following describes additional observations relevant to potential negative de-worming effects (Permit No. 10137, *Hawaiian Monk Seal Deworming Project: Year One Summary*). Typically, seals entered the water within minutes of being released from treatment with no indication of adverse effects of capture or treatment. However, adverse conditions for two seals treated during the course of the study were observed. One seal displayed signs of respiratory distress and another developed an abscess at the injection site. The respiratory distress case was reviewed by veterinarians and it was deemed unlikely that this symptom could be attributed to de-worming.

The seal with the abscess was captured, the abscess lanced and flushed. The wound healed and the seal survived and gained a large amount of mass by the next capture. Three other seals developed minor swellings near their injection sites within days of treatment; these swellings subsided on their own within 1-3 weeks. One seal that had a swelling was re-injected at the next treatment period and did not develop another swelling.

As a precaution against further swellings, protocols for cleaning the injection site were reviewed and standardized, improved restraining techniques were implemented, and the Praziquantel dose was split into two injections for half of the treated seals to test whether reducing the injected volume might mitigate swelling. The dose was divided between two bilateral intramuscular injections, each with a volume of 5 milliliters (ml) or less for five treated seals in August. The maximum injection volume for the split dose group was 3.7ml for an 85 kilogram (kg) seal, and for the single dose group it was 6.2ml for a 71kg seal. Subsequently, no injection site swellings occurred in any of the seals treated.

Due to apparently weak efficacy, lack of compelling benefits and the minor risk of potential negative effects (abscess at injection) of Praziquantel injection, the de-worming study was suspended (Permit No. 10137, *Hawaiian monk seal Deworming Project: Year One Summary*). Ongoing and future studies will consider other routes of drug administration or other drugs. For example, in 2011 and 2012, a topical dewormer that could be applied without waking seals was tested on monk seals and the results are currently being analyzed. In such cases as above, researchers will be closely monitoring individuals to detect both negative and positive effects, and in cases of the former (as with the abscess described above) be prepared to mitigate negative effects. Thus, it is very unlikely that any mortalities or injuries associated with future de-wormer studies will go undetected.

Treatment with Antibiotics and Other Drugs – Appendix D provides a list of the drugs currently used or proposed to be used in Hawaiian monk seals,

possible adverse effects including any observed in Hawaiian monk seals, and the pharmacokinetics of each drug (*i.e.*, how the drug is absorbed, distributed, the rate of action and duration of effect, chemical changes in the body, and effects and routes of excretion of metabolites).

All of the drugs included have been used on Hawaiian monk seals with no severe adverse reactions observed that would preclude future use (Appendix D). Drugs are only used if prescribed by an attending veterinarian, and the purpose of using drugs in Hawaiian monk seals is to benefit the seals. For example, sedatives are given to reduce stress during certain handling events. Emergency drugs are administered if a seal has an adverse reaction during handling and needs supportive care. Long-acting antibiotics are given to seals with wounds (*e.g.*, abscesses from adult male injuries) to prevent or treat infection.

In addition to the drugs listed in Appendix D, supportive fluids such as electrolytes, dextrose, and sodium bicarbonate may be administered at the discretion of the attending veterinarian in response to adverse reactions to capture, handling, and drug administrations. New drugs may become available or other drugs may be prescribed for use in Hawaiian monk seals by the attending veterinarian. Information on such new drugs would be provided by PIFSC to the OPR Permits Division and may be incorporated into the protocols if indicated by the attending veterinarian. Possible adverse effects of any new drugs would be weighed against the benefits of using the drugs for each case. Also, if any severe adverse reactions are reported in Hawaiian monk seals, the drugs would be discontinued or dosages modified per recommendation by the attending veterinarian.

Translocation – Baker *et al.* (2011b) summarized and analyzed an extensive history of experience involving translocation of 247 Hawaiian monk seals to achieve a variety of objectives, including mitigating shark predation and male seal aggression, reducing human-seal interactions, and taking advantage of favorable foraging habitats to improve survival. A total of three mortalities (two adult male seals and one weaned pup) occurred during either capture or temporary captivity for translocation. While cause of death could not be determined in any of these cases, it is conservatively assumed that the deaths were attributable to the translocation action.

For all cases with data available to analyze, survival and dispersal behavior of translocated seals was statistically indistinguishable from comparable seals native to the release sites. This study indicates that, like other research and enhancement activities, mortalities associated with translocation are observable and quantifiable. However, as noted above, because two-stage translocation has some novel and yet untested aspects, negative and positive impacts of this activity will be assessed using simulation modeling as described in the Quantitative Approach section below and in Appendix M (Description of Monk Seal Stochastic Simulation Model).

Adult male removal – Aggressive adult male Hawaiian monk seals may be removed from their subpopulation either via translocation to another subpopulation, permanent captivity, or by lethal removal (euthanasia). As noted above, captivity will be treated the same as mortality for evaluation of impacts on populations. Baker *et al.* (2011b) found that aggressive males translocated from Laysan Island to the MHI in 1994 had high survival rates commensurate with those of native-born adults. However, while data were very sparse, it seems that post-release survival of seals taken to Johnston Atoll was likely poor. In the future, translocations to Johnston Atoll are possible but unlikely; and, if they should occur, the fate of those translocatees would be closely monitored. Any that died or disappeared after release at Johnston Atoll would be considered mortalities in the context of the permit.

Disentanglement and De-hooking – When Hawaiian monk seals are entangled in marine debris or are observed with an embedded fishing hook, they may be captured to remove the offending items. In some cases, debris is cut away from seals while they are asleep and no disturbance occurs. Marine debris and hooking are known sources of serious injury and mortality. As such, the risks associated with disentanglement/dehooking are weighed against the risks of leaving the debris or hooks in place. Over 300 Hawaiian monk seals have been observed entangled in marine debris and 75 have been observed with embedded hooks from 1989-2010 (Carretta *et al.* 2013). Many of these animals have been captured and disentangled or dehooked and none have subsequently died from causes attributable to this enhancement activity.

Over 300 Hawaiian monk seals have been observed entangled in marine debris and 75 have been observed with embedded hooks (Carretta et al. 2013).

Behavioral modification – As described above, behavioral modification research will involve a variety of techniques that entail some risk of injury or mortality. Though experience to date with these techniques is limited to a few seals hazed or subjected to temporary barriers to movement, there have been no injuries or mortalities as a result. Further, any seals that are subject to behavioral modification in the MHI in the future will be monitored very closely to determine the efficacy of the treatments as well as to detect any adverse effects on the seal. It is therefore very unlikely that any mortality associated with behavioral modification would go undetected.

Chemical behavior modification of adult males through the use of GnRH agonists has been the subject of some experimentation in captivity and the wild in the past (Atkinson *et al.* 1993; Atkinson *et al.* 1998). While the efficacy of this approach to mitigate aggressive male behavior is undetermined, there were no deaths associated with the administration procedures or from effects of the drug itself. Testosterone reducing drugs would be tested on seals in captivity prior to use in wild seals. As with other behavior modification research, study subjects in

the future would be closely monitored so that any resulting adverse reactions or mortalities could be detected and quantified.

Vaccination –To date, there have been no vaccination programs for wild pinnipeds, though some captive seals, including Hawaiian monk seals, have been vaccinated against morbillivirus and WNV (Vaccination Research and Response Plan). Under Alternatives 3 and 4, vaccine research would occur and potentially vaccination would be used for enhancement as needed. These research and enhancement projects would potentially involve either inactivated dead virus or recombinant virus vaccines.

No adverse reactions have been reported following use of the recombinant canary pox vaccine in marine mammals to date (Steller sea lions, sea otters [Jessup et al. 2009], harbor seals [Quinley *et al.* 2013], and one captive Hawaiian monk seal). The only data on vaccination of pinnipeds against WNV are from SeaWorld, San Antonio, where captive Hawaiian monk seals have been vaccinated with an inactivated WNV vaccine from Fort Dodge following an outbreak of WNV in the park and the loss of one monk seal to WNV infection. The vaccinated seals have sero-converted following vaccination with no adverse reactions (Workshop to Evaluate the Potential for Use of Morbillivirus Vaccination in Hawaiian Monk Seals, Final Report 2005).

Any future vaccination programs with monk seals would proceed cautiously, testing safety and sero-conversion on surrogate species and on captive monk seals prior to use in the wild. Careful monitoring would ensure that any resulting mortalities would be detected.

Disturbance – In this section, we consider mortality due to disturbance alone (that is, seals that are disturbed by research and enhancement but not captured or handled in any way). This may occur in two ways. First, seals may be disturbed during monitoring activities (aerial, vessel or land-based) where they are approached for identification, photographic documentation, etc. Second, seals may be incidentally disturbed when they are present near other seals that are approached for monitoring, capture, handling or any other research or enhancement activity. In either case, there is no indication that the level of disturbance proposed in any of the alternatives would be likely to cause any mortality.

As noted above, prolonged, repeated and intensive harassment and disturbance (not associated with research or enhancement) likely contributed to habitat avoidance and decline in monk seal populations in the past. However, as described above, the intensity and frequency of disturbances related to past Hawaiian monk seal research and enhancement has been very low. Records on how seals react when they alert to a researcher's presence showed that during 2012, only 1.4% of seals sighted raised their head, 0.15% of seals moved away <2 body lengths, and 0.36% of seals went into the water, demonstrating a very low

level of disturbance resulting from permitted activities (2012 Annual Report for Permit No. 10137).

The proposed alternatives allow for at most 5 disturbances per seal in any given year, though the average for any seal will be far less. More importantly, because all disturbances are recorded, it is even less likely that should such a disturbance-related mortality occur it would go undetected. The primary potential mechanisms for disturbance-related mortality in Hawaiian monk seals would be avoidance of habitat critical for survival, or stress-induced mortality.

While there have been no studies specifically quantifying and evaluating the potential impacts of disturbance on Hawaiian monk seals, it stands to reason that disturbance alone would elicit far less impact than much more intensive activities such as capture, restraint, tagging, health screening, instrumentation, etc. The fact that these activities have been shown not to change survival, migration or body condition compared to seals that did not undergo such procedures (Baker and Johanos 2002), is compelling evidence that the low levels of disturbance proposed in the alternatives would be even less likely to induce harm. It is further worth noting that no harm or mortality due to simply disturbing a Hawaiian monk seal during research or enhancement has been documented in over 30 years (Permit No. 10137, *Hawaiian monk seal Deworming Project: Year One Summary*).

4.7.1.12 *SEPARATION OF POSITIVE AND NEGATIVE EFFECTS IN SUBSEQUENT ANALYSIS*

To compare effects of various alternatives, it is important to explicitly identify both negative effects (such as mortalities) from positive effects, or benefits (such as lives saved) to Hawaiian monk seals. The overall balance of these opposing effects leads to conclusions about the relative merits of each alternative. In order to distinguish and explicitly present negative and positive effects, the following approach is applied in the subsequent alternatives analyses.

All ***negative*** effects are analyzed in sections entitled:

- "Direct and Indirect Mortality Due to Research and Enhancement", and
- "Direct and Indirect Reproductive Effects Due to Research and Enhancement"

All ***positive*** effects are analyzed in sections entitled:

- "Contributions to Conservation Objectives"

In this way the positive and negative effects are readily identifiable in their respective sections.

4.7.1.13 *QUANTITATIVE APPROACH TO ANALYZE THE EFFECTS OF THE LETHAL TAKE OF HAWAIIAN MONK SEALS*

The monk seal simulation model (Appendix M) was used to assess the population level effects of the lethal take levels allowed in the alternatives. In general terms, a simulation model combines all of the important data for a population and, starting with the current population size and composition, projects the population forward to predict what the probable future state will be under various scenarios. Details of the model structure are provided in Appendix M with additional details available in Harting (2002).

For these simulations, each of the seven subpopulations was initialized at its current status (age/sex composition) and projected forward for 10 years, using the recent estimates for the vital rates (survival and reproduction) at each subpopulation. To better represent how the population behaves in the real world, simulated vital rates varied year-to-year according to historically observed variability. In the projections, seals were allowed to move among subpopulations in accordance with the movement rates observed in the wild.

As stipulated in the descriptions of the alternatives, the takes due to unintentional mortality from research can apply to any age or sex class. This means that the consequences of the mortality to the welfare of the population can vary depending on exactly which individuals are lost. In general, the loss of females is of much greater consequence to the population than is the loss of males because the population forfeits not just that individual female but also any pups she was likely to produce in the future. Further, females at or near prime reproductive age are especially important to the population because they comprise the age class likely to produce the most pups and thereby promote future population growth (refer to the discussion of age-specific reproductive value, Section 4.4). For these reasons, an exceptionally high-impact simulation scenario was used to represent the allowable take in each alternative, in which all of the take mortality was applied to females with high age-specific reproductive value (age 4 years). The maximum number of seals removed and the number allowed each year conformed to the provisions specified in the take tables (Appendix H). For example, to simulate the four unintentional takes during research allowed under Alternative 1, two females were removed during the first year of the simulation and two additional females were removed in the following year.

As with the research-related takes, the allowable take for the loss of weaned pups and juveniles during enhancement activities (Alternatives 3-4) can apply to either sex. As with the research take, a hypothetical exceptionally high-impact scenario was specified by assuming that all of this mortality would apply to females.

Because the simulated takes might occur at any subpopulation, the outcome was evaluated in terms of the effects on abundance and realized growth rate (from

first to last year of the simulations) for the total population (that is, all subpopulations combined).

4.7.1.14 *ASSESSMENT OF REPRODUCTIVE EFFECTS DUE TO RESEARCH AND ENHANCEMENT ON HAWAIIAN MONK SEALS*

Even if research and enhancement activities do not lead to mortality, it is possible that the activities could reduce the probability that seals produce viable offspring. Thus, effects on individual and population-level reproduction are possible from research and enhancement activities. This element of the direct and indirect effects analysis discusses the ways in which the scope of research and enhancement activities represented by each alternative may affect reproductive success.

The potential mechanisms for effects on reproductive success could happen to either gender; however, effects on females are naturally far more plausible and of greater concern. If research and enhancement activities were to impact the ability of some male seals to reproduce (*i.e.*, compete for or encounter mates, produce viable sperm or through any other mechanism), it is unlikely to translate into population level effects. The monk seal mating system is not well known but is probably promiscuous (Stirling 1983). Multiple male seals seek access to mate with females in estrous, such that if one or more males were unavailable due to some reproductive harm, other males would almost certainly ensure that any available female would be mated. For this reason, the remainder of this discussion focuses on reproductive effects on females. Possible mechanisms for reproductive effects on females include:

- Injury to the reproductive organs or damage to hormonal regulation that leads to temporary or permanent sterility.
- Physiological responses to stress that cause reproductive failure at any stage (ovulation, fertilization of ova, embryonic implantation, embryonic or fetal development).
- Changes in maternal behavior that reduces feeding of pups, consequently reducing their growth and survival rates.
- Delayed sexual maturation due to slow growth or poor health.

As noted in Chapter 2, NMFS has a long-standing conservative approach to disturbance or capture of adult female seals. For example, no adult female is captured that appears to be pregnant or is otherwise thought likely to be well into a pregnancy even if it is not visually apparent. The only exception is for a life-threatening situation such as a severe entanglement. Also, great efforts are made to minimize the disturbance of mother-pup pairs. Because of these precautionary policies, the risks to reproductive females are minimized, but at the same time risk-averse procedures complicate any analysis to evaluate whether any effects are occurring. For example, in the Baker and Johanos (2002) study on effects of research handling, reproductive effects could not be

evaluated. Because pregnant females were actively avoided in the study, there were no control seals to compare subsequent reproduction of the adult females that were handled (*i.e.*, the adult female treatment group was biased).

There has never been a reported or documented case where research or enhancement related disturbance has caused a female to abandon a pup.

Despite the complications with quantitative evaluation of reproductive effects based on actual research and enhancement activities in the past, it is possible to qualitatively infer the likelihood of such effects. For example, many of the hypothetical mechanisms for reproductive effects are mediated through reduced growth or body condition of female seals. Avoiding handling pregnant females reduces this risk. Also, the lack of any indication that actions such as tagging, health screening, instrumentation, and de-worming have had any negative effects on growth or body condition (Baker and Johanos 2002; Gobush *et al.* 2011), suggests that growth-related effects on reproduction are highly unlikely. Likewise, the strict avoidance of disturbance to mother-pup pairs and the prohibition on capturing either a mother or her offspring during the period between birth and weaning, means that effects on the nursing process are also very unlikely.

There has never been a reported or documented case where research or enhancement related disturbance has caused a female to abandon a pup.

It is difficult to evaluate the remaining mechanisms: stress-related reproductive failure or damage to reproductive organs. Again, by avoiding handling pregnant female seals (or those who could be pregnant) the potential for stress-related effects is minimized. Goebel *et al.* (2003) evaluated the birth rates of female Antarctic fur seals the year following capture, restraint, anesthesia, and post-canine tooth extraction (for age determination) to a control group of females that was not captured. There were no differences detected in birth rates of these two groups. The procedures these fur seals were subjected to were arguably far more intense than any procedure proposed for Hawaiian monk seals. While one cannot assume that results from another species are applicable to Hawaiian monk seals, this information is encouraging. We cannot rule out that handling could damage reproductive organs. On the other hand, if organ damage of any kind did occur, one would expect vital organs important to survival would be as likely, or more likely, to be involved than specific reproductive organs. The lack of any detectable effects on survival described in the preceding sections suggests that vital organ damage, and by inference, reproductive organ damage, is unlikely.

In summary, directly evaluating reproductive effects is far more complex than is the case for effects on survival. While we cannot rule out the potential for reproductive effects of proposed research and enhancement activities, several lines of evidence, including years of monitoring data for Hawaiian monk seals, suggest that this is a minor concern for Hawaiian monk seals.

4.7.1.15 *ASSESSMENT OF BENEFICIAL CONTRIBUTIONS TOWARD CONSERVATION OBJECTIVES FOR HAWAIIAN MONK SEALS*

This element of the direct and indirect effects analysis discusses how well the scope of research and enhancement represented under each alternative would promote recovery and conservation of the species. The evaluation of the alternatives will be conducted with reference to the 2007 Recovery Plan for the Hawaiian Monk Seal (NMFS 2007, hereafter referred to as the Recovery Plan) (see Section 3.3.1.8). The goal of the Recovery Plan is to promote the recovery of the Hawaiian monk seal to the point that it could be down-listed from "endangered" to "threatened" and ultimately to the point that it could be removed from the list of threatened and endangered species under the ESA. The Recovery Plan focuses on factors impeding recovery of the population and the actions necessary to promote recovery. The following is an excerpt from the Executive Summary of the Recovery Plan:

RECOVERY STRATEGY: While recommendations within this report are many and detailed, there are four key actions required to alter the trajectory of the Hawaiian monk seal population and to move the species towards recovery:

1. Improve the survivorship of females, particularly juveniles, in sub-populations of the NWHI. To do this requires the following:

- *maintaining and enhancing existing protection and conservation of habitat and prey base;*
- *targeting research to better understand the factors that result in poor juvenile survival;*
- *intervening where appropriate to ensure higher survival of juvenile and adult females;*
- *continuing actions to protect females from individual and multiple male aggression and to prevent excessive shark predation;*
- *and continuing actions to remove marine debris and reduce mortality of seals due to entanglement.*

2. Maintain the extensive field presence during the breeding season in the NWHI. Field presence is critical not just to the monitoring and research efforts, but also to carry out the active management and conservation of Hawaiian monk seal subpopulations in these areas.

3. Ensure the continued natural growth of the Hawaiian monk seal in the MHI by reducing threats including interactions with recreational fisheries, disturbance of mother-pup pairs, disturbance of hauled out seals, and exposure to human and domestic animal diseases. This should be accomplished with coordination of all federal, state, local and non-government parties, volunteer networks, and increased outreach and education in order to develop a culture of co-existence between humans and seals in the MHI.

4. Reduce the probability of the introduction of infectious diseases into the Hawaiian monk seal population.

The various alternatives will be qualitatively analyzed with reference to how well they address the Recovery Plan's Recovery Strategy.

4.7.1.16 *METHODOLOGY USED TO EVALUATE TWO-STAGE TRANSLOCATION EFFECTS ON HAWAIIAN MONK SEALS*

The option to conduct two-stage translocation to enhance juvenile survival is included in Alternatives 3 and 4. The conservation benefits of two-stage translocation are evaluated independently from the effects of other activities. The methods used for this evaluation rely on simulation modeling and are described in detail in Appendix F (Two-Stage Translocation: A Proposal for Enhancement of the Endangered Hawaiian Monk Seal). Key aspects of the methodology are summarized below and in Appendix F. Because this is a new type of intervention, there are limited existing data with which to formulate predictions about its expected benefits or risks. In such cases, it is often beneficial to employ simulation modeling to provide quantitative analysis of the expected outcomes.

For this evaluation, the monk seal stochastic simulation model (Appendix M) was used to compare the expected outcomes from a representative set of translocation scenarios as permitted under each alternative. In practice, the specific two-stage translocation plan to be undertaken in a given year will be determined according to the most recent data available for each subpopulation in accordance with the decision framework described in Appendix F and summarized in Chapter 5. Results from preceding translocation efforts, logistics to accomplish the translocation, funding, and other considerations will be important factors in that determination. Based on that assessment, the translocation plan implemented in a given year might involve either single or multiple donor and nursery sites, provided that the site selection is consistent with the provisions of the operative alternative (no translocations of weaned pups from the NWHI to the MHI are allowed under Alternative 3). Further, the number of seals collected and translocated to each site can vary and will be determined following the provisions of the decision framework (Appendix F).

The allowance for flexibility in site selection and number of handled seals means that no single simulation scenario can fully represent all of the possible combinations and outcomes that might be undertaken pursuant to the translocation strategy. The simulation scenarios used for this evaluation are hypothetical and were selected to illustrate the salient aspects of the two-stage translocation concept as permitted under each alternative. In practice, prior to initiating an action, additional simulations and ancillary analyses will be undertaken to inform NMFS about the relative benefits that might accrue from various translocation scenarios under consideration in a given year.

For all simulation scenarios presented here, French Frigate Shoals was chosen to represent the "donor" site because this site has consistently had the poorest juvenile survival of any site (recent years' survivorship to age 3 and age 4 is 0.137 and 0.123, respectively). The simulations modeled the collection of 10 female

pups annually for 5 years at French Frigate Shoals, with subsequent release at the nursery site. Simulations were run with and without a first-year survival decrement ("nursery site decrement") for translocatees as compared to survival of the native born seals at the release site. This decrement was primarily intended to represent a survival penalty that might result from smaller weaning girth as compared to native born seals at the nursery site.

The survival decrement, or penalty, represents a proportionate reduction in the survival rate for the translocated seals relative to other, non-managed seals of the same age at the nursery or return site. For example, if the survival rate for age 1 seals is normally 0.60 and the survival decrement is 0.90, the translocated seals will have a survival rate = 0.54 (0.90 * 0.60). As described in Appendix F, a decrement value of 0.90 (10% survival penalty) was used in those simulations that included the decrement. For the next two simulation years subsequent to the first year after release, translocated seals shared the same survival rate as native-born seals.

For all of the simulated translocations described here, seals were returned to their birth site at age 3 years. At this second stage of the simulated translocations, another survival decrement ("return decrement") was optionally applied to represent differential survival relative to non-translocated seals left at the original site. This decrement was primarily intended to represent the survival penalty that might result from translocated seals being unfamiliar with their new environment. As with the previous "nursery site survival decrement", the "return decrement" applied only to the first year after release. In the simulations that included this decrement, the value was set to 0.71 (29% survival penalty relative to non-treatment seals) to indicate the worst performance expected from the second stage of the translocation. The derivation of this value is described in Appendix F.

The metrics used to evaluate the outcome of the translocation simulations were:

- Mean final abundance (N) at the original donor site;
- Population reproductive value (V_{pop});
- Number of mature females (Nf_{mature});
- Realized growth rate ($\lambda_{realized}$) for the donor subpopulation from year 1 to year 10 of the simulation;
- Survivorship of the translocated seals (l_x to age 4); and
- Intrinsic growth rate (λ_{trans})[1] for the lifetable representing the translocated seals.

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[1] There are some subtleties associated with computing λ_{trans}, which make this a somewhat conservative value. First, it is assumed that the observed reproductive schedule for the translocated seals will match the estimated rates for the non-translocated French Frigate Shoals, which grew up at that subpopulation. However, if as

All results are compared to results of a baseline simulation scenario of the same duration in which no translocation occurred. The baseline scenario projected that in 10 years, the mean number of monk seals in the total population would be 898.##

4.7.1.17 *DIRECT AND INDIRECT EFFECTS ON HAWAIIAN MONK SEALS OF ALTERNATIVE 1 – STATUS QUO*

Direct and Indirect Mortality Due to Research and Enhancement on Hawaiian Monk Seals (Alternative 1, Status Quo)

Alternative 1 allows for the following lethal takes for both research and enhancement combined (see Table 4.7-3 and Appendix H Alternative 1 Take Table):

- Adult male removal: 10 males can be removed from the population over a five-year period. These seals can be taken for permanent captive care or by euthanasia, and may be removed in one or multiple years.
- Unintentional mortality: Four seals may be unintentionally killed over a five-year period, with no more than two seals taken per year. These seals can be of any size and of either sex. As noted previously, to model an exceptionally high-impact scenario, it is assumed that all these mortalities involve 4-year-old female seals. Note that in Alternative 1, these lethal takes could result either from research or enhancement activities, or both.
- Humane euthanasia: 10 moribund or seriously injured seals may be euthanized. These takes are not simulated in the model. By definition, this would involve seals that would definitely have died without euthanasia, so that there would be no additional mortality attributable to research or enhancement associated with this activity.

In the 10-year projection of Alternative 1 (Status Quo), the simulated loss of four 4-year old females reduced the total abundance from 898 seals (Baseline: scenario 1 of Table 4.7-3) to 889 seals (scenario 2). That difference (9 fewer seals) is attributable both to the lost female seals and the offspring they were likely to produce during the 10-year projection. The additional loss of 10 males over 5

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expected, the translocated seals returned to French Frigate Shoals are in better condition than the non-translocated seals, their reproductive patterns may be closer to the nursery sites, (Laysan Island or the MHI) which have more favorable reproductive curves (see Figure 3 of Appendix F, Translocation Paper). Further, the lifetable from which λ_{trans} is calculated contains a pre-weaning survival value (0.77) equal to that observed at French Frigate Shoals in recent years. In fact, translocated seals would be selected *after* weaning, so that their actual pre-weaning survival value would be 1.0, which if used instead, would yield higher estimates of λ_{trans}. However, because these seals' survival to weaning was not attributable to the two-stage translocation, using a pre-weaning survival value of 1.0 might suggest the translocation would yield more favorable results than is actually the case. Using either value (1.0 or 0.77) is imperfect, but the latter was chosen as it more conservatively characterized the benefits to conservation.

years (scenario 3) reduced the mean abundance by an additional 3 seals. This reduction is less than the number of males removed because the losses were randomly allocated to individual males present in the subpopulation and many of those males were older individuals likely to die sometime within the 10-year projection. These losses reduced the realized population growth rate ($\lambda_{realized}$) from 0.985 to 0.983, when both types of loss (unintentional mortality and male removals) were incorporated into the simulations.

Conclusions for Mortality Effects on Hawaiian Monk Seals (Alternative 1, Status Quo)

Under the exceptionally high-impact scenario modeled, Alternative 1 could result in a reduction of total abundance of 9 seals, representing a 1% decline compared to baseline projections without these takes. This can also be viewed as a reduction in realized growth rate of 0.002. While possible, it is unlikely that all the lethal takes due to research or enhancement would occur, or that they would all involve female seals at peak reproductive value. Thus, the research and enhancement impacts will likely be less than those simulated above.

These very small changes in the population may not be detectable compared to baseline values, so the magnitude and intensity of mortality effects would be minor. Further, because the losses amount to a small number of individuals, the geographic extent/biological level of the impacts would also be minor. The frequency of allowable lethal takes is expected to be low given that they could at most average 0.8 unintentional deaths per year, and would occur with moderate (over a 5–year permit cycle) duration, such that the duration and frequency would be minor. Overall, Alternative 1 would likely result in minor adverse effects on mortality, especially when considered with positive benefits of enhancement actions that directly or indirectly improve survival as described below.

Direct and Indirect Reproductive Effects of Research and Enhancement on Hawaiian Monk Seals (Alternative 1, Status Quo)

As described above, it is difficult to reliably quantify the degree, if any, of negative reproductive effects from research and enhancement activities. To assess a more severe case than would occur by random chance, the simulations assumed that all lethal takes involved females with high reproductive value and also accounted for the loss of the offspring they would have produced, had they not been killed. Mortality effects were all determined to be minor, thus we would assume reproductive effects on the same number of females would be even less consequential.

If reproductive effects extended to a larger number of female seals, they could result in greater impacts but it is unlikely they would be detectable. Thus, mechanisms for possible adverse reproductive effects as a result of research or enhancement exist, but are likely indistinguishable from other natural stresses, so that their magnitude and intensity would be minor. Any such effects would not

be measurable, so that their geographic extent/biological level and duration and frequency would be negligible. Overall, as described more in detail in Section 4.7.1.14 (Assessment of Reproductive Effects Due to Research and Enhancement), the direct and indirect effects from research and enhancement would likely result in negligible reproductive effects given the applicable precautionary measures (no adult female is captured that appears to be pregnant or is otherwise thought likely to be well into a pregnancy even if it is not visually apparent).

Contribution to Conservation Objectives for Hawaiian Monk Seals (Alternative 1, Status Quo)

Alternative 1 represents the Status Quo, representative of current research and enhancement activities under the existing permit. Close monitoring of Hawaiian monk seals over decades of research and enhancement activities included under Alternative 1, with the exception of the more recent addition of de-worming research and small-scale translocations of weaned pups within the NWHI, have demonstrated that procedures used do not result in major adverse effects on this species. In fact, potential effects on mortality and reproduction due to Alternative 1 research and enhancement are considered either minor or negligible.

Despite the fact that Alternative 1 does address many of the Recovery Plan objectives (see Section 3.3.1.8) to varying degrees, Status Quo efforts have not reversed the decline. Field research monitoring in the NWHI would continue to fulfill Recovery Plan objectives to monitor that portion of the population. Juvenile survival of females would potentially be improved by continued de-worming (if determined effective), current levels of translocations of nursing and weaned pups, disentanglement/de-hooking, and removal of aggressive males under Alternative 1. Continued growth of the MHI population would be supported by de-hooking and disentangling seals, and by translocations of weaned pups from areas where they may be at risk. However, mitigation of disease risk and reduction of unmanageable human-seal interactions would be very limited under Alternative 1 measures.

Conclusions for Conservation Objectives for Hawaiian Monk Seals (Alternative 1, Status Quo)

Alternative 1 would, to some degree, address many of the objectives of the Recovery Plan, though not at a level that would be expected to result in maximum potential effects on recovery. For this reason, the magnitude and intensity of Alternative 1 in meeting conservation objectives would be moderate. Research and enhancement activities would occur throughout the species range such that the geographic extent/biological level would be major. The effects of implementing Alternative 1 would be somewhat periodic in that many enhancement activities are reactive and can only be conducted when opportunities arise (such as disentangling seals). Yet, such interventions that do occur may have long-term effects. Thus, the duration and frequency of

conservation contributions would be moderate. Given the past track record of the Status Quo activities, and these considerations described, Alternative 1 would result in a moderate beneficial contribution to conservation objectives.

4.7.1.18 *DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)*

Direct and Indirect Mortality Due to Research and Enhancement on Hawaiian Monk Seals (Alternative 2, No Action)

Under Alternative 2, existing levels of research and enhancement could continue until the current permit expires in 2014. As of Spring 2013, there have been no unintentional research or enhancement mortalities during the current 5-yr permit cycle, and one adult male has been brought into captivity (none was lethally removed). Assuming the risk of these mortalities is constant over time, mortality for the remainder of the current permit cycle through 2014 is not likely to result in the total number of allowed mortalities or adult males that could be removed (10 takes per year as authorized in the current Permit 10137). Because Alternative 1 mortality effects were all judged to be minor, and mortalities under Alternative 2 would be fewer given that after the permit expires in 2014, no additional research or enhancement would occur on wild seals. Thus, it stands to reason that there would be minor adverse effects on mortality under Alternative 2 until expiration of the permit in 2014 and negligible effects thereafter due to no research or enhancement.

Direct and Indirect Reproductive Effects of Research and Enhancement on Hawaiian Monk Seals (Alternative 2, No Action)

As described under Alternative 1, mechanisms for possible adverse reproductive effects as a result of research or enhancement exist, but are likely indistinguishable from other natural stresses. Alternative 2 reproductive effects would also be negligible once the existing permit expires in 2014.

Contribution to Conservation Objectives for Hawaiian Monk Seals (Alternative 2, No Action)

The difference between Alternative 2 and Alternative 1 in terms of conservation is that under Alternative 2 any positive contributions would cease after 2014. Some conservation actions, such as education/outreach, etc. could continue and some enhancement (*i.e.*, entanglement/de-hooking) could be accomplished but only under the separate permit for the Marine Mammal Health and Stranding Response Program (see Section 1.9.3) and not as part of this research and enhancement program. Given that most entangled monk seals are encountered in the NWHI during research field camps the majority of disentanglements are done under the Pacific Islands Fisheries Science Center (PIFSC) research and enhancement permit. Under Alternative 2, those field camps would cease after 2014, so there would be no opportunity to disentangle these seals. With the exception of those activities that could be accomplished without permits or

under the auspices of stranding response, none of the objectives of the Recovery Plan would be obtained. There would be no field research to monitor populations and detect problems, and no interventions such as de-worming, translocation, etc. to improve juvenile survival.

Conclusions for Conservation Objectives for Hawaiian Monk Seals (Alternative 2, No Action)

Considering that almost all research and enhancement would cease after 2014, the Alternative 2 would not address many of the Recovery Plan objectives, therefore the contribution of this alternative to conservation of the species would be negligible in the long term. Because access to NWHI monk seals would practically cease after 2014, the geographic extent/biological level would be negligible because only scat and spew samples could be collected from vacant beaches, and seals could only be observed and photographed at great distances. The duration and frequency of meeting conservation objectives would be short-term, ending in 2014. Lack of future research and enhancement permits would result in major adverse contributions to conservation given the benefits of continued research and enhancement activities would cease and higher mortality could result from the lack of disentanglement or translocation of pups from harmful situations.

4.7.1.19 *DIRECT AND INDIRECT EFFECTS ON HAWAIIAN MONK SEALS OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

There are two notable differences between Alternative 3 and Alternative 1 (Status Quo). While, Alternative 3 includes the same activities as Alternative 1, the number of takes allowed is greater for certain activities (*e.g.*, two-stage translocation). In addition, new activities such as expanded deworming efforts and vaccinations are included in Alternative 3. These differences are described more fully in the following sections in order to provide context for the effects analysis for Alternative 3. Appendix H, Alternative 3 Take Table provides the numbers of animals proposed to be taken under this alternative (see also Table 4.7-3).

Increased Takes of Hawaiian Monk Seals For Ongoing Activities Under Alternative 3

For some activities, the number of takes that may occur under Alternative 3 exceeds that allowed under Alternative 1, because of a recognition that new or expanded enhancement activities (*e.g.*, two-stage translocation, de-worming, behavioral modification) will require additional monitoring in order to evaluate the efficacy of these activities. Thus, for example, the number of monitoring takes was increased at most locations (except French Frigate Shoals where the steep decline in population has reduced the number of seals likely to be available for monitoring).

For sites in the MHI and Nihoa, the numbers of seals taken by monitoring, tagging and marking were all increased relative to status quo. This recognizes both the need for more monitoring at these historically under-sampled sites and the fact that these populations are expected to be increasing naturally (*i.e.*, independently of any NMFS action). Therefore, more takes would be required to monitor larger numbers of seals. Likewise, the increased number of weaned pups that may be translocated for risk alleviation (*i.e.*, to move them away from harm) is in anticipation of the growing MHI population and the probability that more pups will be weaned in high risk areas in the foreseeable future.

Health screening and foraging studies (instrumentation) are also higher in Alternative 3 in order to support activities such as translocation and the associated health screening and tracking after their release to monitor outcomes. De-worming takes are also higher under Alternative 3, which would allow for broader application of this potential enhancement tool, should research determine it is effective. Total allowable adult male removals (via euthanasia, placement in captivity, or translocation) were also increased from 10 over 5 years to 20 annually (although the number that could be lethally removed remained at 10 for a 5-yr period). This is in response to recent signs of increasing multiple male aggression at Laysan Island. When the current research and enhancement permit was granted (the basis for Alternative 1), adult male removals were primarily designed to deal with single male aggression. Should there be an increase in multiple male aggression, Alternative 3 allows for the flexibility to translocate sufficient numbers of aggressive males in any year to mitigate this source of mortality on juveniles or females.

Despite the fact that numbers of animals potentially involved in research activities under Alternative 3 increased relative to Alternative 1, the number of unintentional research mortalities remains the same. This is because in the past, Status Quo levels of research and enhancement have not led to the allowable number of lethal takes. It is anticipated that the addition of some research and enhancement activities will not lead to more than the allowed level of takes under Alternative 1.

Increased Takes of Hawaiian Monk Seals for New Activities Under Alternative 3

New research and enhancement activities in Alternative 3 include:

- Two-stage translocation (described in detail in Appendix F). This does not include any translocation of weaned pups born in the NWHI to the MHI.
- Translocations of juvenile seals for research to determine survival of juvenile seals post-translocation.
- Behavioral modification of seals in the MHI.
- Chemical (*e.g.*, GnHR agonist) behavioral modification of aggressive males as an alternative to translocation, permanent captivity or euthanasia.

- Vaccination research and implementation to mitigate infectious disease.
- Unintentional mortality due to enhancement. Recognizing that the increased enhancement efforts listed above entail increased risk as well as increased benefits, additional enhancement-only-related mortalities would be allowed under Alternative 3.

Direct and Indirect Mortality Due to Research and Enhancement of Hawaiian Monk Seals (Alternative 3, Preferred Alternative)

Excluding authorization for the humane euthanasia of up to 10 moribund or severely injured seals, Alternative 3 allows for three other types of lethal take of monk seals:

1. **Adult male removal**: Up to 20 males can be removed from the population over a 5-year period. These seals can be taken into permanent captive care or by euthanasia (no more than 10 by euthanasia over the 5-year period), and may be removed in one or multiple years. While this alternative caps the lethal removals at 10 over 5 years, many more could hypothetically be taken into permanent captivity. However, in reality it has proven extremely difficult to identify a captive facility with space and resources to take any adult male monk seals. Therefore the simulated scenario allows for a rather liberal 10 to be taken into permanent captivity in addition to 10 lethal removals, for a total of 20.

2. **Unintentional mortality due to research**: A maximum of 4 seals may be taken in 5 years, with no more than 2 seals taken per year. These seals can be of any size and of either sex. This level of lethal take for research only is equal to that allowed for both research and enhancement under Alternative 1. Because there are separate allowances specifically for enhancement-related mortality under Alternative 3 (see below), the 4 research mortalities allowed could be viewed as an increase over Alternative 1. This is justified in the following way. Research-related mortalities have been rare. For example, during the past 4 complete years of permitted research, there has been 1 unintentional mortality, for an average of 0.25 per year. Under Alternative 3, there may be 4 mortalities in 5 years (an average of 0.8 per year). However, mortalities occur in whole numbers only, not fractions, and the proposed takes (4) is already a small whole number.
   Thus, while it is unlikely that this level of takes will occur, it is certainly within the realm of reason that 4 lethal accidents could occur over a 5-year period of research. Moreover, Alternative 3 involves increased research takes in various categories. Many of these takes entail capture, restraint and sometimes sedation, which are the types

of activities that present higher risk of unintentional mortality. Specifically, over 5 years, Alternative 3 allows an additional 320 flipper taggings, 150 health screenings, and 30 juvenile monk seal research translocations over and above that allowed under Alternative 1. This additional risk exposure justifies maintaining the requested level of unintentional research mortality.

3. **Unintentional mortality during enhancement activities**: This lethal take is further subdivided into three groups:

    a. Weaned pup (either sex): Up to 4 pups over 5 years, with no more than 2 in one year

    b. Juveniles/subadults (either sex): Up to 8 seals over 5 years, with no more than 4 in one year

    c. Adult Males: Up to 4 males over 5 years, with no more than 2 in one year.

Alternative 3 entails a dramatic increase in enhancement efforts in comparison to Alternative 1. New or expanded enhancement activities included in Alternative 3, which might result in increased takes include:

- Weaned Pups
    - Increased deworming
    - Increased translocation for risk alleviation
    - First stage of two-stage translocation
    - Behavioral modification
    - Vaccination
- Juveniles
    - Increased deworming
    - Second stage of two-stage translocation
    - Behavioral modification
    - Vaccination
- Adult males
    - Doubling potential number of removals in response to increased multiple-male aggression.
    - Initiation of chemical behavior modification

Compounding the risk of simply increasing the number of animals involved in enhancement is that for some of the proposed activities, the inherent risks are not well known. Whereas a large number of weaned pup translocations have been conducted and the level of risk involved is quite low (Baker *et al.* 2011b), far fewer cases of juvenile translocations have occurred. The general sense, however, is that juvenile seals are at greater risk of stress and mortality when being held captive. In a 2006 captive care program at Midway Atoll, 6 weaned pups and 1 juvenile seal were held in shoreline pens to be fattened up. All the pups gained

weight and were released in good body condition, while the single juvenile died of complications related to stress a few weeks after being brought into captivity (Baker and Littnan 2008). Because juveniles seem subject to greater risk in captivity, the number of allowed lethal juvenile takes in Alternative 3 (8 in 5 years) is higher than that for weaned pups (4 in 5 years), notwithstanding the fact that more weaned pups are likely to be involved in enhancement activities.

Compared to translocation, other enhancement activities with young seals (deworming, behavioral modification, vaccination) are thought to present lower risk. However, these are either entirely new or only rarely tested activities, so that their true risks remain uncertain and difficult to quantify pending initial trials.

A final risk magnifier that is reflected in the number of proposed unintentional mortalities is that some activities, most notably two-stage translocation, involve "grouped risk" whereby several animals will be captured, transported, held in quarantine and released together. In statistical language, by grouping seals in this way, the risk of unintentional mortality becomes "non-independent". That is, if some rare but lethal event should occur (disease outbreak, boating or vehicle accident, etc.), there is greater likelihood of losing multiple seals at one time.

Combining all of these types of take, under Alternatives 3, the total number of seals that could be removed from the population over a 5-year period consists of 24 males (20 removals and 4 unintentional mortality), and 16 additional unintentional mortalities of either sex (including 4 weaned pups, 8 juveniles, and 4 seals of any age/sex).

The simulated loss due to unintentional mortality, in which all of the mortality not specifically designated as males was assumed to apply to females (juvenile females were assumed to be age 3 yr), reduced the mean total population abundance from 898 seals to 874 seals (2.7% reduction; scenarios 1 and 4 in Table 4.7-3). The additional removal of 20 aggressive males (scenario 5) reduced the mean abundance to 864 seals (3.8% reduction). The realized growth rate decreased from 0.985 to 0.981 when all of the allowable takes were included in the simulations.

Conclusions for Mortality Effects on Hawaiian Monk Seals (Alternative 3, Preferred Alternative)

Under the exceptionally high-impact scenario modeled, Alternative 3 could result in a reduction of total abundance of 34 seals, representing a 3.8% decline compared to baseline projections without these takes. This can also be viewed as a reduction in $\lambda_{realized}$ of 0.004.

While possible, it is unlikely that all the lethal takes would occur, nor is it likely that all those not specified as males would turn out to be female seals.

The expected small changes in the population would likely amount to an equivocal change in population status, so that the magnitude and intensity of

mortality effects would be *moderate*. Further, because the losses amount to a small number of individuals, the geographic extent/biological level of the impacts would be minor. The allowable lethal takes are moderate frequency (no more than a few per year would be likely) and would occur with moderate duration (according to the 5-year permit cycle), such that the duration and frequency would be moderate. The majority of the potential lethal takes of female seals under Alternative 3 are associated with enhancement activities. These activities will focus on seals that are already at elevated risk of natural mortality and enhancement activities are expected to achieve benefits in improved survival (presented below) The overall adverse direct and indirect effects of research and enhancement on mortality would be minor to moderate adverse.

Direct and Indirect Reproductive Effects of Research and Enhancement on Hawaiian Monk Seals (Alternative 3, Preferred Alternative)

Reproductive effects of Alternative 3 are based on the same assumptions as described for Alternative 1, such that Alternative 3 reproductive effects would be negligible as in Alternative 1.

Contribution to Conservation Objectives for Hawaiian Monk Seals (Alternative 3, Preferred Alternative)

All of the contributions to conservation that would occur under Alternative 1 would also be realized under Alternative 3. However, the suite of additional enhancement activities available under Alternative 3, while they may entail some additional unintended mortalities, are, in aggregate, expected to reap far more benefits. For example, the expansion of de-worming, if effective, would improve juvenile survival and condition. While additional removals of aggressive males would reduce the number of adult males in the future, this would only occur if adult females or young animals were being harmed and killed by these males. In such a case, there is no question that removing aggressive males would yield far greater population benefit by saving female seals relative to the loss of a small number of males (Johanos *et al.* 2010). Moreover, to the extent that chemical treatment of aggressive male behavior proves feasible, this could also result in improved female survival.

Behavior modification research is intended to develop tools that would allow seals in the MHI that have developed undesirable behaviors to remain in the wild population. This would likely prevent the need to either translocate such seals to areas where their survival may be impaired (NWHI) or to bring them into captivity. Any additional seal that remains wild in the MHI addresses the Recovery Plan objective of fostering MHI population growth. Vaccination research, should it lead to a tool for mitigating the introduction or spread of infectious disease, also directly addresses a Recovery Plan objective.

Illustrative simulations to evaluate conservation benefits of two-stage translocation under the constraints of Alternative 3 are as follows. Alternative 3

allows for two-stage translocation to occur among sites within the NWHI, or among sites within the MHI. Seals can also be translocated from the MHI to the NWHI, but no facilitated movements from the NWHI to the MHI are allowed under this alternative (that is, no two-stage translocation from the NWHI to the MHI is permitted). For this alternative, the monk seal model was used to simulate the two-stage translocation of 10 pups per year, collected at French Frigate Shoals and released at Laysan Island (chosen because the most recent data indicate this site has the most consistently favorable juvenile survival among the six main NWHI subpopulations). All surviving seals were returned to French Frigate Shoals at age 3 years. This pattern was repeated for the first 5 years of each simulation.

In the simulated translocations, the translocated seals were returned to their natal site at age 3 years, and therefore the effects of the translocations at the nursery site (Laysan Island) were ephemeral (in other words, they did not cause a direct, long-term change in the local population at the nursery site because they were moved back to French Frigate Shoals). As expected, final abundance at Laysan Island was approximately the same with or without the translocations (171 seals), but the mean population trajectory was elevated while the project was underway (years 1-8) as compared to the baseline trajectory.

At French Frigate Shoals, the mean abundance at the end of the 10-year projection increased from 93 seals (baseline scenario) to 96-101 seals as a result of the temporary translocation of seals to Laysan Island. The highest value (101 seals) resulted from imposing no survival decrements following either stage of the translocation. Similarly, V_{pop} in year 10 increased from 165 newborn equivalents to 203 newborn equivalents with the translocation and no survival decrements. The basis for the V_{pop} increase is evident in the number of mature females present at French Frigate Shoals: 26 with no translocation, versus a maximum of 33 mature females with translocation. With no survival decrements, survivorship to age 4 yr (l_4) of the translocatees increased from 0.123 (baseline) to 0.226 with translocation and no decrements, thereby increasing the intrinsic growth rate of the lifetable describing the demography of the translocated seals ($\boldsymbol{\lambda}_{trans}$) from 0.916 to 0.952.

Table 4.7-1 represents results of simulated translocations from French Frigate Shoals to Laysan Island (10 female pups per year for five consecutive years). Result columns are: N = mean final abundance at French Frigate Shoals (5% and 95% tails in parentheses); V_{pop} = population reproductive value in year 10 of the ten year simulation (5% and 95% tails in parentheses); Nf_{mature} = mean final number of mature females (age 5-20 yrs); l_4 = survivorship of translocated seals to age 4 yrs; and $\boldsymbol{\lambda}_{trans}$ = intrinsic growth rate of modified life table applicable only to the translocated seals.

Table 4.7-1 Results of Simulated Translocations from French Frigate Shoals to Laysan Island

Scenario	Survival Decrements*	N	V_{pop}	Nf_{mature}	l_4	λ_{trans}
Baseline	NA	93 (61,131)	165 (100, 244)	26	0.123	0.916
No decrements	1.00, 1.00	101 (67,141)	203 (124, 299)	33	0.226	0.952
Nursery decrement only	0.90, 1.00	99 (67, 138)	198 (120, 291)	32	0.205	0.944
Return decrement only	1.00, 0.71	97 (66, 135)	187 (115, 275)	30	0.161	0.932
Both decrements	0.90, 0.71	96 (65, 133)	181 (112, 274)	29	0.145	0.926

* Survival decrements for first year after initial release at nursery site, and first year after return to natal site. Tabulated values give proportion of mean survival rate as compared to resident (non-treatment) seals on site.

Conclusions for Conservation Objectives for Hawaiian Monk Seals (Alternative 3, Preferred Alternative)

Alternative 3 would, to the highest degree considered feasible, address all of the objectives of the Recovery Plan. Under Alternative 3 (Preferred), weaned pups may be taken from areas of lower survival to areas of higher survival (1) within the NWHI, (2) within the MHI, or (3) from the MHI to NWHI, with the option of returning the seals to their birth location or nearest appropriate site at age 2 years and older. This alternative excludes moving weaned pups born in the NWHI to the MHI.

Maximum potential benefits might not be realized through the two-stage translocation proposed under Alternative 3 because weaned pups could not be moved from areas of current low survival in the NWHI to higher survival in the MHI. This limits the potential effectiveness of the translocation process given current demographic rates. If future conditions are such that translocations from the NWHI to MHI would be even more beneficial than they may be currently, the inflexibility to conduct such translocations would reduce potential conservation benefits of Alternative 3 further. However, implementing two-stage translocations from the NWHI to the MHI would be infeasible at this time. NWHI pups, if brought to the MHI, could become involved in fishery and other human interactions, just as has occurred among some seals born in the MHI. Capacity and techniques for monitoring translocated seals, and intervening to prevent and mitigate such interactions, must be further developed before this action can be conducted without risking failure as measured both in terms of seal survival and public attitudes toward monk seal conservation.

The effects of implementing Alternative 3 would be quite immediate in that many enhancement activities could begin right away. Because this Alternative offers a variety of ways to conduct enhancement at any one time, the benefits are more likely to be long-term (because in any year it is likely that some suite of enhancement tools could be implemented), making the duration and frequency of conservation contributions *major*. Overall, there would likely be a *major* beneficial contribution of Alternative 3 towards conservation objectives.

Given that Status Quo (Alternative 1) efforts have failed to reverse the decline, more ambitious measures as represented in Alternatives 3 and 4 have been developed. Relative to Status Quo, the contribution to conservation through Alternative 3 measures would be moderate in magnitude and intensity. The activities would occur throughout the species range such that the geographic extent/biological level would be major. Alternative 3 provides a variety of ways to conduct enhancement at any one time and the benefits are more likely to be long-term (because in any year it is likely that some suite of enhancement tools could be implemented) therefore considered *major* in terms of duration and frequency. Overall, the contribution of beneficial effects towards conservation objectives under Alternative 3 would be *major*.

4.7.1.20 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Direct and Indirect Mortality of Hawaiian Monk Seals Due to Research and Enhancement (Alternative 4, Enhanced Implementation)

Alternatives 3 and 4 are quite similar except for the approach to two-stage translocation. Under Alternative 4, NMFS would be permitted to move weaned pups born in the NWHI to the MHI. Since the level of allowable lethal takes are the same for Alternatives 3 and 4, the expected small changes in the population would likely amount to an equivocal change in population status, so that the magnitude and intensity of mortality effects would be moderate. Further, because the losses amount to a small number of individuals, the geographic extent/biological level of the impacts would be minor. The allowable lethal takes are moderate frequency (no more than a few per year being likely) and would occur with moderate duration (5 year permit cycle), such that the duration and frequency would be moderate. As discussed under Alternatives 1 and 3, the levels of take specified in the alternatives present the maximum number possible and likely would not be reached under any alternative, including Alternative 4. Therefore, the overall direct and indirect effects of mortality would likely be minor to moderate adverse under Alternative 4, considering this represents the exceptionally high-impact simulation scenario and risks must be balanced with the potential gains from the contribution towards conservation objectives summarized below.

Direct and Indirect Reproductive Effects of Research and Enhancement on Hawaiian Monk Seals (Alternative 4, Enhanced Implementation)

The same logic applied in analysis of Alternatives 1 and 3 reproductive effects, would also apply to Alternative 4. Thus, Alternative 4 reproductive effects would be negligible as in the other alternatives.

Contribution to Conservation Objectives for Hawaiian Monk Seals (Alternative 4, Enhanced Implementation)

The distinction between Alternatives 3 and 4 becomes apparent when considering the potential benefits to conservation of two-stage translocation. Under Alternative 4, while many of the benefits described under Alternative 3 would be the same, there would be potential to yield greater results given the additional option of moving seals from the NWHI to the MHI as discussed here.

Given recent survival rates, the potential benefits associated with two-stage translocation of weaned pups from French Frigate Shoals to the MHI, an option which is unique to Alternative 4, are greater than those likely to result from a within-NWHI translocation (Alternative 3). The mean final abundance at French Frigate Shoals increased from 93 seals (baseline) to 104-112 seals with translocation. Similarly, the number of mature females increased from 26 at the end of the ten year baseline projection, to 36-43 with translocation, giving an increase in V_{pop} from 165 newborn equivalents (baseline) to 221-263 newborn equivalents. Survivorship to age 4 yr (l_4) for the translocatees increased from 0.123 to 0.434 with translocation and no survival decrements, giving λ_{trans} = 0.991 for the lifetable associated with the translocated seals.

Table 4.7-2. Results of simulated translocations from French Frigate Shoals to MHI (10 female pups per year for five consecutive years). Result columns are: N = mean final abundance at French Frigate Shoals (5% and 95% tails in parentheses); V_{pop} = population reproductive value in year 10 of the ten year simulation (5% and 95% tails in parentheses); Nf_{mature} = mean final number of mature females (age 5-20 yrs); l_{x-4} = survivorship of translocated seals to age 4 yrs; and λ_{trans} = intrinsic growth rate of modified life table applicable only to the translocated seals (see Table 4.7-2).

Table 4.7-2 Results of Simulated Translocations form French Frigate Shoals to MHI (10 Female Pups per Year for 5 Consecutive Years)

Scenario	Survival Decrements*	N	V_{pop}	Nf_{mature}	l_4	λ_{trans}
Baseline	NA	93 (61,131)	165 (100, 244)	26	0.123	0.916
No decrements	1.00, 1.00	112 (78, 151)	263 (169, 375)	43	0.434	0.991
Nursery decrement only	0.90, 1.00	111 (77, 151)	252 (162, 360)	41	0.391	0.985
Return decrement only	1.00, 0.71	105 (71, 144)	228 (144, 326)	37	0.310	0.969
Both decrements	0.90, 0.71	104 (71, 143)	221 (138, 325)	36	0.279	0.964

Note: Survival decrements for first year after initial release at nursery site, and first year after return to natal site. Tabulated values give proportion of mean survival rate as compared to resident (non-treatment) seals on site.

Conclusions for Conservation Objectives for Hawaiian Monk Seals (Alternative 4, Enhanced Implementation)

Alternative 4 would, to the highest potential degree, address all of the objectives of the Recovery Plan. The option to conduct two-stage translocation using the MHI as a temporary nursery site, would allow the maximal potential benefits, given current demographics, to be achieved. Also, the flexibility to adapt to potential future conditions that might make translocations from the NWHI to MHI even more beneficial, would allow NMFS to adapt strategies to a greater range of future scenarios. These considerations make the magnitude and intensity of Alternative 4 conservation benefits *major*. The activities would occur throughout the species range such that the geographic extent/biological level would be *major*.

As discussed above, implementing two-stage translocations from the NWHI to the MHI would be infeasible at this time. NWHI pups, if brought to the MHI, could become involved in fishery and other human interactions, just as has occurred among some seals born in the MHI. Capacity and techniques for monitoring translocated seals, and intervening to prevent and mitigate such interactions, must be further developed before this action can be conducted without risking failure as measured both in terms of seal survival and public attitudes toward monk seal conservation.

The effects of implementing Alternative 4 would, like Alternative 3, be quite immediate in that many enhancement activities could begin right away. Because this Alternative offers a variety of ways to conduct enhancement at any one time, the benefits are more likely to be long-term (because in any year it is likely that some suite of enhancement tools could be implemented), making the duration and frequency of conservation contributions *major*. Overall, there would likely be a *major* beneficial contribution of Alternative 4 towards conservation objectives. Again, the only difference between Alternative 4 and Alternative 3 is the provision for two-stage translocation of weaned pups from the NWHI to the MHI. Because that action has been deemed infeasible for the present and next several years, Alternative 4 would be equivalent to Alternative 3 in practical terms for at least several years.

Table 4.7-3 Simulation results for lethal takes for Alternatives 1 and Alternatives 3/4 (allowable lethal take is equivalent for Alternatives 3 and 4). Main cell entry is the mean value (over 500 simulations), with the 5% and 95% tails from the projections in parentheses. Details of number and types of take and simulation design are provided in the text.

Table 4.7-3 Simulation Results for Lethal Takes for Alternatives 1, 3, and 4

Scenario	Description	Total abundance	Realized growth rate
1	Baseline (no takes)	898 (773,1025)	0.985 (0.971, 0.998)
2	Alt. 1 Status Quo (unintentional mortality only)	889 (766,1019)	0.984 (0.970, 0.998)
3	Alt. 1 Status Quo (unintentional mortality and male removals)	887 (770,1014)	0.983 (0.970, 0.997)
4	Alt. 3-4 (unintentional mortality only)	874 (757,996)	0.982 (0.969, 0.996)
5	Alt. 3-4 (unintentional mortality and male removals)	864 (749,985)	0.981 (0.968, 0.994)

4.7.1.21 CUMULATIVE EFFECTS OF ALTERNATIVES ON HAWAIIAN MONK SEALS

Summary of Direct and Indirect Effects of the Alternatives on Hawaiian Monk Seals

Direct and indirect mortality and reproductive effects of research and enhancement activities may result from disturbance, capture, and handling. The alternatives vary by the levels of take permissible for research and enhancement and were evaluated in terms of the amount of mortality and reproductive effects that would occur under a given scope of research (Sections 4.7.1.15 through 4.7.1.18 and Appendix H, Take Tables). Table 4.7-4 summarizes the direct and indirect effects of the alternatives on monk seals.

Table 4.7-4 Summary of Direct and Indirect Effects of the Alternatives on Hawaiian Monk Seals

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Mortality	Minor adverse	Negligible	Minor to moderate adverse	Minor to moderate adverse
Reproduction	Negligible	Negligible	Negligible	Negligible
Contribution to Conservation Objectives	Moderate Beneficial	Major adverse	Major beneficial	Major beneficial

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Hawaiian Monk Seals

As described in detail in Section 3.3.1.3, Hawaiian monk seals are the most endangered pinniped species in U.S. waters and the second most endangered pinniped in the world. Hawaiian monk seals were listed as endangered in 1976 (41 FR 51611; November 23, 1976) due to a significant decline of over 70% since 1958 based on 2010 population estimates. The most recent published estimate of total abundance is 1,125 seals, declining at approximately 4.5% per year (Carretta *et al.* 2013). Table 4.7-5 presents past, present and future actions and events that may contribute to cumulative effects (beneficial and adverse) to the Hawaiian monk seal population.

Table 4.7-5 Hawaiian Monk Seal Cumulative Actions and Events

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, volcano, earthquake, hurricane	• Prey availability • Changes in habitat	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of entanglement and affects habitat suitability for molting, resting, and pupping areas	-
Climate change		• Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012).	-
Shark predation	• Mortality • Injury	• 1997 – 2006: 170 monk seal pups impacted by sharks at FFS (injured, confirmed and inferred deaths) • 2007 – 2012: 30 deaths due to shark predation at FFS	-
Male monk seal aggression		• 1980s and 1990s, injuries and deaths of female monk seals caused by multiple male aggression attacks inhibited population recovery at Laysan Island. Targeted translocations of adult males reduced this effect but this threat remains and is not unique to Laysan Island. Single male aggression toward pups remains a concern.	-
Disease	• Mortality • Reproduction	• Diseases such as morbillivirus could be devastating to monk seal survival or reproduction (see Section 3.3.1)	-
Scientific Research			
Research and enhancement permits issued since 2000 (HMS only)	• Education • Disturbance • Mortality • Injury	• 1982 – 1994: 23 seals died during rehabilitation. • 2003-2012: 2 mortalities due to research activities • While mortality has occurred, overall benefits of research and enhancement are beneficial for long term seal survival. • PIFSC - Permit 10137 HMS Research and Enhancement; MMHSRP - Permit 932-1905 ESA Species Emergency Response; Waikiki Aquarium – Permit 15453; Sea World – Permit 16124; Terrie Williams, Long Marine Laboratory – Permit 13602; Sea Life Park, Hawaii – Permit 17429; research on captive animals improves understanding of species for better management of wild populations and enhancement activities educate the public about the species' status	+
Cetacean research	• Disturbance	• Disturbance (*i.e.*, Level B harassment) due to interaction with vessels could occur but would be temporary and not result in injury or mortality.	-
Commercial Activities			

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Commercial Fisheries	• Mortality • Injury • Disturbance • Prey availability	• 1913 – 2002: fishing for trevally and amberjack. • 1930 – 2009: bottomfish fishery in NWHI. No current fisheries operating in NWHI • 1940s: Honolulu-based vessels fished lobsters, reef fish, inshore species, and turtles. • 1946: fishing companies used FFS as base for planes exporting scad and other species. • 1950s – 1991: longline for tuna (foreign fleet ended 1976; domestic fleet ended 1991). • 1970 – 1999: Hawaiian spiny lobster, Scaly slipper lobster. 11 million landed • 1965 – 1980: foreign vessels used tangle nets to harvest precious coral; Taiwanese vessels illegally poached 100 tons near Gardner Pinnacles and Lay • 1994, 2006, 2007 and 2010: 4 seals confirmed dead in nearshore gillnets • 1989 – 2010: 75 seals observed with embedded fish hooks in MHI • Hawaii State managed MHI nearshore fisheries a serious concern for seal injury and mortality seal-fishery interactions (NMFS 2012) • Past documentation of interactions between monk seals and Hawaii-based domestic pelagic longline fishery (NMFS 2002); although this fishery targets swordfish and tunas and does not compete with monk seals for prey (NMFS 2012).	-
Removal of marine debris from high entanglement zones	• Injury • Mortality	• 1982-2011: 323 entangled seals, 8 of which confirmed dead • 1994, 2006, 2007: Three seals found dead in gillnets (non-recreational) • 1995: seal found dead with hook lodged in its esophagus. • 1989-2009: 64 seals observed with embedded hooks in MHI • 2011: 9 seals observed hooked • 2012: 14 seals observed hooked (3 dead) • 2013: 3 deaths due to hookings or poor body condition (brought in under MMHSRP permit)	+
Entanglement of Hawaiian monk seals in marine debris or fishing gear			-
Inter-Island Transmission Cable	• Disturbance	• Disturbance (*i.e.*, Level B harassment such as noise) may occur during cable laying activities. • Long-term effects not anticipated as construction-related disturbance due to noise or human presence would be temporary and not result in injury or mortality.	-
Boat tours (*i.e.*, wildlife watching, snorkeling, parasailing, catamaran tours, etc.)		• Disturbance (*i.e.*, Level B harassment such as noise) may occur during tour activities.	-
Residential & Commercial construction (beach, near shore)	• Disturbance • Habitat degradation	• Disturbance (*i.e.*, Level B harassment due to noise) may occur during construction activities as well as once permanent coastal structures are in place (*i.e.*, increased exposure to humans). • Habitat may be permanently altered by coastal infrastructure.	-
Military Activities			

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**

Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS)	• Disturbance	• "Potential effects are expected to Level B harassment. Effects to impact rates of recruitment or survival on the associated marine mammal species and stocks not anticipated."
		• "Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) is minimal to negligible." The following permits are for different Navy vessels (US Navy 2012).
		  • File No. 18702: Level B harassment of 9 Hawaiian monk seals during training, testing, and military operations of LFA sonar in Hawaii North mission area; 4 monk seals in Hawaii South mission area.
		  • File No. 18703: Level B harassment of 9 Hawaiian monk seals during training, testing, and military operations of LFA sonar in Hawaii North mission area; 4 monk seals in Hawaii South mission area.
		  • File No. 18704: Level B harassment of 9 Hawaiian monk seals during training, testing, and military operations of LFA sonar in Hawaii North mission area; 4 monk seals in Hawaii South mission area.
		  • File No. 18705: Level B harassment of 9 Hawaiian monk seals during training, testing, and military operations of LFA sonar in Hawaii North mission area; 4 monk seals in Hawaii South mission area (Cody personal communication 2013)
			-

Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai`i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])		• Permit 15806 NMFS Incidental Harassment Authorization: Level B harassment not to exceed 110 monk seals annually. Expires January 5, 2014. • Permit 17860 NMFS Incidental Harassment Authorization: Level B harassment not to exceed 1 monk seals annually.	-
Permit 17860 US Navy Acoustic Technology Experiments			
Joint High Speed Vessel		• 2013: second trial of vessel; speed over 40 knots • Planned for use to get warfighters and equipment into combat as needed • Risk of collision leading to serious injury or mortality • Disturbance due to underwater noise	-
Other Activities			

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Monk seal harvest for meat, skins and shark bait	• Disturbance • Mortality • Injury	• Hunted to near extinction.	-
Introduction of invasive species or disease	• Competition for habitat or prey • Parasites • Indirect mortality	• Introduction to Laysan Island: rabbits, rats, common sandbur (*Cenchrus echinatus*) (weed) that inhibits regeneration of the primary nest substrate (Eragrostis variabilis) for Laysan finches (Morin and Conant 1998). • Insect and arachnids species (*e.g.*, beetles, weevils, grasshoppers, bees, wasps, spiders and ants), reptiles (*e.g.*, snakes, lizards) and mammals (*e.g.*, mice, rats, dogs, cats) could introduce disease or parasites to seals. • Mammals in particular may increase the risk of diseases such as morbillivirus. • Invasive fish species introduced through ballast water may cause changes in prey dynamics.	-
Removal of marine debris from high entanglement zones Entanglement of Hawaiian monk seals in marine debris or fishing gear	• Injury • Mortality	• 1982-2011: 323 entangled seals, 8 of which confirmed dead • 1994, 2006, 2007: Three seals found dead in gillnets (non-recreational) • 1995: seal found dead with hook lodged in its esophagus. • 1989-2009: 64 seals observed with embedded hooks in MHI • 2011: 9 seals observed hooked • 2012: 14 seals observed hooked (3 dead) • 2013: 3 deaths due to hookings or poor body condition (brought in under MMHSRP permit)	+ -
MMHSRP and other NMFS permits to disentangle, dehook and relocate seals away from harmful situations		• 2005 – 2012: 136 monk seals rescued, rehabilitated or assisted (Personal communication, Look 2013). • 1982 to 1994: 23 seals died during rehabilitation though it is likely these seals would have died from injuries regardless of intervention. • Two seals died in captivity when captured for translocation to mitigate male aggression.	+
Intentional shooting, maiming, injury or other harm	• Disturbance • Mortality • Injury	• 2009: 3 seals (including a pregnant female) shot and killed in MHI (Baker et al. 2010). • 2010 - 2012: 1 juvenile female seal and 4 adult seals were found dead due to multiple skull fractures caused by blunt force trauma on Kauai and Molokai.	-
Habitat protection , loss mitigation and restoration	• Habitat protection	• 1986: critical habitat designated at all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 10 fathoms (18.3 m) around Kure Atoll, Midway Islands (except Sand Island), Pearl & Hermes Reef, Lisianski Island, Laysan Island, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island in the NWHI (51 FR 16047; April 30, 1986). • 1988: critical habitat expanded to include Maro Reef and waters previously designated areas out to 20 fathoms (36.6 m) (53 FR 18988; May 26, 1988).	+

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural resource and species education and outreach	• Education	• 2009-2010: 10,000 people reached through partnerships with 30+ businesses, 50+ school presentations, 100+ schools • Promotes public understanding of monk seals and their habitat – increasing support for their survival	+
Hawaiian Monk Seal Rehabilitation Facility at Natural Energy Laboratory of Hawai`i Authority	• Survival • Reproduction	• 2.6-acre property at Keahole Point, Hawai`i for monk seal rehabilitation • Consists of a holding facility with two in-ground, custom-built fiberglass pools and two smaller in-ground pools designed specifically for monk seals.	+
Development and Maintenance			
Building islands using dredge and fill	• Contaminants • Habitat degradation • Disturbance • Injury • Stranding • Entanglement in debris	• Accumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in tissues through nursing or through diet. • Studies link contaminant exposure and detrimental health effects such as reproductive impairment, immune dysfunction, and cancer in several pinniped species (northern fur seals: Beckmen et al. 2003, harbor seals: De Swart et al. 1994; California sea lions: Ylitalo et al. 2005a; and DeLong et al. 1973). • Coastal projects, bridges, roads and other infrastructure likely have changed the quality and quantity of monk seal critical habitat.	-
LORAN station (NWHI)			-
Coastal Infrastructure and Development			-
Wai`anae Wastewater Treatment Plan Modification	• Contaminants • Water Quality	• Improvements in water treatment would likely decrease the level of contaminants and biological waste entering coastal waters.	+
Wailupe Stream Flood Control			
Advanced Wastewater Treatment Upgrade			
Waimanalo Treatment and Disposal System			
Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie			
Legislation			

Hawaiian Monk Seal Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Hawai'i Environmental Policy Act (HRS 343)	• General species and habitat protection	• Protection of Hawaiian natural resources through public disclosure process and government reviewed impact evaluation	+
Hawai'i Act 165	• Survival	• June 2010: Legislature passed Act 165 to increase penalties for taking (includes harassing or killing) a monk seal. Class C felony (up to 5 years imprisonment). Someone convicted under this law could face a fine of up to $50,000.	+

Hawaiian Monk Seal Cumulative Effects Conclusion

Cumulative Hawaiian Monk Seal Mortality

Table 4.7-6 summarizes cumulative take, including mortality, of Hawaiian monk seals for cumulative actions and events that can currently be quantified. The primary contributors to adverse cumulative effects on Hawaiian monk seal mortality include entanglement, predation, male seal aggression, infectious diseases, starvation (food limitation), habitat loss, fishery interactions, and other human interactions such as intentional killing.

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Table 4.7-6 Hawaiian Monk Seal Take (Including Mortality) Due to Cumulative Actions and Events

Type of Effect		PEIS Research and Enhancement Alternatives							Cumulative Actions & Events
		Alternative 1 Status Quo (annual seals permitted)	Alternative 2 No Action (annual seals permitted)	Alternative 3 Limited Translocation (annual seals permitted)	Alternative 4 Enhanced Implementation (annual seals permitted)	Past Actions			Reasonably Foreseeable Future Actions & Events External to Research & Enhancement
						2012 Permit Report	2003 - 2012 Permit Reports (total)	Activities External to Research & Enhancement	
Number of Seal "Takes[1]"	tagging	Up to 456	0 after 2014	Same as Alternative 1, more as needed[2]	Same as Alternative 1, more as needed[2]	118	1,560		
	monitoring (aerial-, vessel- or land-based)	1,440				421	5,227		
	retagging	Up to 100				18	157		
	bleaching	Up to 1315				453	5,374		
	epidemiology	Up to 100	0 after 2014	Same as Alternative 1, more as needed[2]	Same as Alternative 1, more as needed[2]	8	120		
	necropsies	As warranted				7	NA		
	deworming	Up to 200				48	NA		
	incidental harassment during research and enhancement	Up to 200	0 after 2014	> 200 as needed[2]	> 200 as needed[2]	7			US Navy Incidental harassment Permit 15806: 121 seals annually; US Navy Permit 17806 Incidental harassment (Level B) not to exceed 1 seal annually.
Mortality		Up to 10 males lethally removed over 5-year period.	0 after 2014	Same as Alternative 1	Same as Alternative 1	1	1	1997 – 2006: 170 seal pups injured or confirmed dead by sharks 2007-2012: 30 deaths due to shark predation 1982-2004: 23 deaths during research and enhancement 8 deaths since 2009 due to confirmed or suspected intentional killings 1982-2011: 8 entanglement deaths 1995, 2012, 2013: 3 deaths due to hookings; 2013: 1 death undetermined (poor body condition)	Unknown
Injury								1982-2011: 323 entangled seals	Unknown

Type of Effect		PEIS Research and Enhancement Alternatives							Cumulative Actions & Events
		Alternative 1 Status Quo (annual seals permitted)	Alternative 2 No Action (annual seals permitted)	Alternative 3 Limited Translocation (annual seals permitted)	Alternative 4 Enhanced Implementation (annual seals permitted)	Past Actions			Reasonably Foreseeable Future Actions & Events External to Research & Enhancement
						2012 Permit Report	2003 - 2012 Permit Reports (total)	Activities External to Research & Enhancement	
Contribution Towards Conservation Objectives	disentanglement and dehooking	As warranted (likely not to exceed 25/year)	0 after 2014	Research, development and implementation of methods.	Same as Alternative 3	6	117	2005 - 2012: 136 seals rescued, rehabilitated or assisted (MMHSRP Permit)	Continued outreach and education initiatives to foster public understanding for protection and conservation of Hawaiian monk seals
	translocation	Up to 71	0 after 2014	Same as Alternative 1, Up to 20 weaned pups annually (or total of 200 over 10-year period) only within NWHI or from MHI to NWHI	Same as Alternative 1, Up to 20 weaned pups annually (or total of 200 over 10-year period) anywhere within the Hawaiian Archepelago	13	239		
	mitigation of disease	Up to 30	0 after 2014	Same as Alternative 1 Research, development and implementation of methods	Same as Alternative 3				
	management of human-seal interactions	Not Authorized	No behavior modification to reduce human/seal interactions	Research, development and implementation of methods.	Same as Alternative 3				
	supplemental feeding	Not Authorized	Not Authorized	Supplement monk seal diet using feeding stations in NWHI locations where seals are released after being cared for in captivity.	Same as Alternative 3				

[1] - Personal Communication, Look 2012 and 2013.

[2] - For examples of the number of seal takes proposed on an 'as needed' basis under Alternatives 3 and 4, please refer to Appendix H.

In the long term, once the current permit expires in 2014, Alternative 2 (No Action) would contribute no mortalities. While direct mortality of research and enhancement would no longer be possible, indirect mortality associated with the cessation of beneficial activities such as moving seals away from harmful situations, could contribute to an adverse cumulative effect on seal survival.

Alternative 1 (Status Quo), assuming the maximum allowed mortality impact, would result in an estimated 11 fewer seals in the population at the end of 10 years. Compared to the number of mortalities caused by predation and starvation (6-11 pups per year eaten by sharks at French Frigate Shoals alone) combined with mortalities resulting from but not limited to entanglement, intentional lethal killings by humans and potential diseases in the future, the contribution of Alternative 1 to cumulative adverse effects from mortality would be minor and would therefore be unlikely to cause the population to decline. In addition, Alternative 1 would result in moderate benefits to survival through enhancement activities intended to promote survival.

Alternatives 3 (Limited Translocation, Preferred) and 4 (Enhanced Implementation), assuming the maximum allowed mortality impact, would result in an estimated 34 fewer seals in the population at the end of 10 years. This level of mortality would result in a minor adverse contribution to cumulative effects of mortality considering other causes of mortality shown in Tables 4.8-5 and 4.8-6. Importantly, other actions proposed under Alternatives 3 and 4 such as two-stage translocation to improve survival, protection against disease, removal of seals from harmful situations, and behavior modification to minimize interactions with fisheries would result in major beneficial contributions to recovery and promote better survival of the species.

Cumulative Reproductive Effects for Hawaiian Monk Seals

Disturbance from research and enhancement activities would likely result in negligible effects on reproduction as discussed in Sections 4.7.1.17 – 4.7.1.20. Other human disturbance such as recreation and coastal development may cause physical responses and physiological effects in monk seals as described in detail in Section 4.7.1. The intensity of response to a particular stress or disturbance and the ultimate effect on individual animals depends on many factors, including the nutritional and reproductive status of the animal at the time of the stress or disturbance.

Outward observable indications are that Hawaiian monk seals do not usually exhibit strong disturbance responses, and the consequences of other stressors can be difficult to attribute to reproductive effects alone. However, it is currently not possible to rule out that there may be unobserved deleterious effects on reproduction.

Many seals have become extremely habituated to people and choose to rest on beaches with hundreds of humans in proximity. Still, Baker and Johanos (2004) conducted aerial surveys of all MHI shorelines in 2000 and 2001, and found that most of the seals seen had chosen to land at beaches less frequented by people. This suggests that beach habitat selection of MHI monk seals may be influenced by human disturbance.

Actions and events likely to contribute to disturbance of seals (see Table 4.7-5) include commercial activities such as coastal development, tourism, research (other than seal-specific), military activities, and fisheries interactions. The combination of these actions with proposed research and enhancement alternatives may cause stress to the seals. While it is difficult to determine whether the cumulative effects of disturbance from these activities result in impacts to reproduction, the contribution of the alternatives would be negligible.

Cumulative Contribution to Conservation Objectives for Hawaiian Monk Seals

Section 3.3.1.3 and the 2007 Recovery Plan (NMFS 2007) describe numerous factors that influence the population dynamics of Hawaiian monk seals and many types of management actions that are likely to be necessary to promote the recovery of the population. The proposed alternatives were evaluated against the conservation objectives outlined by the Recovery Plan and, in essence, Alternatives 3 and 4 provide the most benefit to the species by providing major beneficial contributions to conservation while Alternative 2 would likely result in major adverse effects to conservation because research and enhancement actions would stop in 2014. Alternative 1 provides some conservation benefits however, the limitations described in Section 4.7.1.15 result in only moderate contribution to overall cumulative effects to conservation objectives.

Other factors contributing beneficially to conservation of the species include the MMHSRP (Permit 932-1905) responsible for disentanglement, dehooking and moving seals away from other harmful situations. The proposed Hawaiian Monk Seal Rehabilitation Facility at Natural Energy Laboratory of Hawai‘i at Keahole Point would also benefit the species through rehabilitation. Information from scientific research and benefits of enhancement activities on monk seals play a crucial role in making informed decisions about these regulations and management actions with the overall purpose of recovering the species.

4.7.2 *MARINE WATER QUALITY*

As described in Section 3.2.7, Marine Water Quality, the overall quality of Hawai‘i ’s coastal waters, based on the Water Quality Index, is 78% rated Good, 18% fair and 4% poor (EPA 2008).

Marine waters surrounding Hawai‘i are classified as either Class AA or Class A, based on protection of water quality (HAR Chapter 11-54). The open coastal waters around the NWHI are classified as Class AA waters (HAR Section 11-54-6[b][2][A][ix] and [x] from the shoreline to a depth of 183 meters or 600 feet). The

objective of Class AA waters is that they remain as nearly as possible in their natural pristine state, while Class A waters are maintained for multiple uses, with lower water quality standards applied to them.

Research and enhancement activities that could cause impacts to marine water quality in the near shore regions include spills and leaks of fuels and contaminants during vessel and small boat operations; introduction of biohazards from the use of drugs such as antibiotics, de-wormers, and vaccination research; introduction of heavy metals and other contaminates from external instruments deployed on animals; and effluent from maintenance of seals in shore-based temporary pens.

4.7.2.1 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON MARINE WATER QUALITY

Status Quo (Alternative 1) activities would have none to negligible adverse impacts on nearshore marine water quality. Researchers using small boats and large vessels would be required to follow protocols for boat operations and refueling prior to receiving approval to conduct the work under a Monument permit (PMNM-2011-001 presented in Appendix L). In the NWHI, boat emissions are controlled by the Monument proclamation and management requirements; and researchers are required to follow these requirements. Researchers would also follow these protocols for operations in the MHI.

In addition to permit conditions, there are several Monument Best Management Practices (BMP) that are designed to avoid, minimize or mitigate potential impacts to water quality (see Appendix L). Monument Permit PMNM-2011-001 specifies measures to minimize impacts on water quality due to boating:

- Tenders and small vessels mush be equipped with engines that meet EPA emissions requirements;
- Refueling of tenders and all small vessels must be done at the support ships and outside the confines of lagoons or nearshore waters; and
- Special Conditions and Rules for Small Boat Operations are required at Tern Island (Monument BMP #013), which mandate specific notification and operator training.

Under the Status Quo, small boats (less than 20 ft) used by NMFS researchers conducting Hawaiian monk seal research and enhancement activities include: Boston whalers, ridged hull Zodiacs, Zodiac and Achilles inflatables and personal watercraft. These small boats can be launched from larger ships to access the islands and conduct research or can be used for access between research locations. All small boats and the larger research vessels used by NMFS such as the NOAA R/V Oscar Elton Sette (224 ft), the R/V Searcher (97 ft), and the M/V Kahana (160 ft), would be required to follow all permit requirements, provisions, and BMPs to protect water quality when working in the Monument

and MHI. Thus, impacts to water quality from boat operations would be negligible.

For seals that are maintained in temporary pens in the NWHI, any seal effluent would not be expected to be substantially higher than that which naturally occurs in nearshore waters, as determined in previous NEPA documents (NMFS 2009b). The construction of temporary shoreline or land-based pens to hold seals temporarily (up to 2 weeks) for translocations would not be expected to impact water quality. A limited number of animals would be held at any given time, so feces and urine would not concentrate more than would from a natural aggregate of seals. Wastes would be diluted from currents and scats would be removed from the dry section of the pen before they could enter the water column (NMFS 2009b).

For the same reasons, the use of drugs in Hawaiian monk seals in the wild (*e.g.*, deworming medications, antibiotics) would likely result in diffuse, dilute and ephemeral environmental dispersal of the drugs, such that impacts on water quality and any non-target organisms in the water are expected to be extremely low (NMFS 2009b; NMFS 2010a).

External instruments deployed on monk seals for foraging and monitoring studies are sealed by plastic polymer resin. Therefore, no leakage of metals or other materials from batteries would occur in the water column or on haulout areas if researchers are not able to retrieve the instruments and they fall off when an animal molts.

Alternative 2 (No Action) would result in no additional effects on marine water quality once the current permit expires in 2014 as no research and enhancement activities for Hawaiian monk seal would be permitted.

Despite the additional activities and expanded scope and methods under Alternative 3, would still result in a negligible potential to impact water quality due to the use of small boats. Considering the strict guidelines described above for Alternative 1, which would also be in place under Alternative 3, the potential adverse effects of Alternative 3 on water quality would be negligible. Alternatives 3 (and 4) include the use of long acting antibiotics to treat abscesses and the initiation of vaccination studies, potentially on free-ranging Hawaiian monk seals. It is not likely that the antibiotics or viruses that would be shed due to vaccination would be encountered in high enough concentrations to affect water quality.

Alternative 4 may result in slightly greater use of boats due to potential increases in the number of translocations; however, the additional boats and research vessels to translocate weaned pups between NHWI and MHI would still not result in anything but negligible impacts to water quality particularly considering the controls and mitigation measures already in place.

4.7.2.2 *CUMULATIVE EFFECTS OF ALTERNATIVES ON MARINE WATER QUALITY*

Given that all of the Alternatives would result in negligible affects to marine water quality, no cumulative impacts are anticipated.

4.7.3 SEA TURTLES

This section addresses potential direct, indirect and cumulative effects of the alternatives on sea turtles in the NWHI and MHI. In general, there are two potential types of effects on sea turtles that could result from the alternatives:

- Disturbance of individual sea turtles in the nearshore environment; or
- Disturbance of individual sea turtles on beaches during nesting.

Based on these types of potential effects, Table 4.4-2 in Section 4.4.2 summarizes the criteria used to evaluate impacts of the alternatives on sea turtles. As indicated in the table, the geographic extent, magnitude, frequency, and intensity are used to evaluate the level of potential effects on sea turtles. While sonic tags (which would transmit signals up to 69 kHz) may also be used during research and enhancement activities, sea turtles have a hearing range from approximately 100 to 1000 Hz (Bartol *et al.* 1999; Ridgway *et al.* 1969), and also would not be affected by the sonic tag transmissions. Therefore, effects of sonic tags are not further evaluated here.

The alternatives could result in direct effects on individual sea turtles through vessels in the nearshore environment, or through human activity on beaches during ground surveys or other research and enhancement beach activities. Activities related to field camps (Section 3.3.1.9) may also disturb turtles. Adherence to the BMPs for Monument (Appendix L) would minimize potential adverse effects on turtles. These special conditions for field camps and research activities in the Monument are in place to ensure preservation of the NWHI native ecosystem, including turtles (PMNM 2008a).

Indirect effects on sea turtles could result from disturbance, and are evaluated here in terms of how potential indirect effects might ultimately impact turtle reproduction. Such effects would only occur if an alternative affects the monk seal population in the NWHI and MHI, and then the Hawaiian monk seal population, in turn, affects the sea turtle population. Even if the Hawaiian monk seal population increased substantially, it is unlikely that any seal interactions with sea turtles would result in population-level effects, as neither species is a major predator or competitor with the other. Therefore, effects discussed below focus on the potential for direct effects.

The research and enhancement could affect sea turtles if activities resulted in measurable effects including:

- Breeding and nesting success; and
- Disturbance of sea turtles.

The following discussion analyzes the potential for the alternatives to affect sea turtles through these two pathways.

4.7.3.1 *BREEDING AND NESTING SUCCESS OF SEA TURTLES*

Green sea turtles that are asleep and basking on the beach are generally unaware of unobtrusive human presence such as observing seals. However, some activities, such as small boat transits and landings, capturing a seal, and other research activities may waken basking turtles, causing them to flee into the water. To the extent that the research and enhancement activities in the NWHI or MHI could result in increased human presence near nesting beaches due to ground surveys, specimen collection, or other activities, up to 200 sea turtles nesting on beaches could be incidentally harassed annually. This disturbance could alter their breeding and nesting activities. The extent of these effects would depend on whether humans were present during nesting or breeding season, the proximity of activities to nesting areas, as well as the duration of the activity. Although green sea turtles nest throughout the Hawaiian Archipelago, over 90% nest at French Frigate Shoals in the NWHI (NOAA 1998). Thus, by minimizing human activities during green turtle nesting in specific areas such as French Frigate Shoals, potential effects could be avoided (NMFS 2009b; USFWS 2009c).

The USFWS requires BMPs are followed to minimize and avoid the unintentional disturbance of basking and/or nesting green sea turtles while conducting research or camping on various islands (USFWS 2009c). These measures include the following:

- Walking is prohibited on all beaches, from dusk to dawn, where adult turtles rest;
- All field camps will use maximum light control (shading, minimum wattage, etc.); and
- All field camps must avoid disorienting hatchling turtles.

4.7.3.2 *MORTALITY EFFECTS ON SEA TURTLES*

Sea turtles could be killed if vessels used during research and enhancement activities collided with individual sea turtles. To date, no collisions with sea turtles during Hawaiian monk seal research and enhancement activities have been documented. Additionally, if monk seal researchers encountered basking turtles on beaches, and the turtles subsequently moved away from their basking site, this could result in turtles entering the water making them more vulnerable to predation or collisions however this effects is difficult to document or measure. The threat of boat strikes would be minimized by operating small boats at a moderate speed while watching for objects in the water, including turtles. While the consequences of vessel collisions are high (*i.e.,* resulting in serious injury or mortality), the likelihood of this occurring is low (NMFS 2009b).

Researchers may enhance habitat for sea turtles when they remove marine debris during field activities. Marine debris affects turtles via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on sea turtles.

4.7.3.3 *DIRECT AND INDIRECT EFFECTS ON SEA TURTLES OF ALTERNATIVE 1 – STATUS QUO*

Negligible effects on sea turtles would be expected to occur under the Status Quo Alternative. Disruption of breeding and nesting activities or disturbance of individual turtles would not likely result in adverse effects on individuals or the population thus these effects would be negligible. Minor, short-term disturbance during nesting and breeding activities could occur, but with the implementation of BMPs required by Monument permits, these effects would be minimized to a negligible level. Similarly, the likelihood of collisions with vessels during research and enhancement are low due to Monument BMPs and associated mitigation measures described in Appendix L. Impacts to turtles are expected to be temporary disturbances, and no harm or mortality is anticipated (NMFS 2009b). Thus, mortality effects on turtles are considered negligible under Alternative 1.

4.7.3.4 *DIRECT AND INDIRECT EFFECTS ON SEA TURTLES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)*

Similar to Alternative 1, negligible effects on sea turtles would be expected to occur under Alternative 2. Though not likely, disruption of breeding and nesting or disturbance of individual turtles could occur as a result of research and enhancement activities on wild monk seals only until 2014. Once the current permit expires in 2014, no research or enhancement would occur that could result in disturbance.

4.7.3.5 *DIRECT AND INDIRECT EFFECTS ON SEA TURTLES OF ALTERNATIVE 3 (LIMITED TRANSLOCATION; PREFERRED ALTERNATIVE) AND ALTERNATIVE 4 (ENHANCED IMPLEMENTATION)*

Alternatives 3 and 4 do not differ in their potential effects on turtles thus they are described together here. Alternatives 3 and 4 could result in minor disruption of breeding and nesting activities on beaches due to human presence due to the potential for increased activity in the Hawaiian Islands.

Alternatives 3 and 4 would increase the level of ground, boat, and aerial Hawaiian monk seal surveys and beach activities; however, restrictions and mitigation measures for all new activities would be required by the MMPA, ESA, and NMFS to minimize disturbances from research and enhancement activities. In addition, requirements of the Monument and protocols established by the

USFWS would be in place to minimize adverse impacts of research activities (Appendix L, PMNM 2011-001; USFWS 2009c; USFWS 2014).

Minor short-term decreases in sea turtle survival and/or productivity could potentially result from disturbance of nesting and breeding, but with the implementation of procedures required by NMFS, these potential reproductive effects would be minimized to a negligible level.

Alternatives 3 and 4 could result in a small number of individual sea turtles being disturbed by vessels given the increase in activities such as translocation, but this effect would be expected to be very infrequent and of low magnitude, and would thus be negligible.

4.7.3.6 CUMULATIVE EFFECTS OF ALTERNATIVES ON SEA TURTLES

Sea turtles in the NWHI and MHI, including leatherback, loggerhead, olive ridley, hawksbill, and green sea turtles, are all listed as threatened or endangered under the federal ESA. Sea turtle populations have declined due to incidental take in fishing operations, direct harvest of turtles, entanglement in marine debris, ocean pollution, and disease (*e.g.*, fibropapillomatosis). While the green sea turtle population remains under stress due to these threats, the population is increasing (Section 3.3.2).

Direct and indirect mortality and reproductive effects of research and enhancement activities may result from disturbance or collision with vessels. Table 4.7-7 summarizes the direct and indirect effects of the alternatives on sea turtles.

Table 4.7-7 Summary of Direct and Indirect Effects of the Alternatives on Sea Turtles

	Alternative 1 Status Quo	**Alternative 2 No Action; No Permit After 2014**	**Alternative 3 Limited Translocation (Preferred Alternative)**	**Alternative 4 Enhanced Implementation**
Mortality	Negligible	Negligible	Negligible	Negligible
Reproduction	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Sea Turtles

Past, present and reasonably foreseeable future actions that may affect sea turtle survival or reproduction are summarized in Table 4.7-8.

Table 4.7-8 Effects of Past, Present and Reasonably Foreseeable Future Actions on Sea Turtles

Hawaiian Sea Turtle Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris	• Changes to habitat • Injury or mortality • Changes in prey due to ecosystem shift	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris, entanglement and affects habitat suitability for resting, and nesting areas	-
Climate Change		• Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish prey populations are affected by these changes and can be both beneficial and adverse.	- /+
Introduction of Invasive species or disease		• Insect and arachnids species (*e.g.*, beetles, weevils, grasshoppers, bees, wasps, spiders and ants), reptiles (*e.g.*, snakes, lizards) and mammals (*e.g.*, mice, rats, dogs, cats) could introduce disease or parasites to turtles. • Mammals in particular may increase the risk of diseases such as morbillivirus. • Invasive fish species introduced through ballast water may cause changes in prey dynamics.	-

Hawaiian Sea Turtle Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Scientific Research			
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) (6 missions)	• Education • Disturbance • Injury or mortality	• Direct effects on individual sea turtles through human activity and research; beach disturbance; collisions with vessels. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to fish prey and turtles. • Up to 200 sea turtles nesting on beaches could be incidentally harassed annually. • Marine debris affects turtles via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). • While mortality is possible, overall benefits of research and enhancement are beneficial for long term species survival.	**-/+**
Permit 10137 PIFSC Hawaiian Monk Seal Research and Enhancement			
Activities to Enhance Understanding of Hawaiian Monk Seal Foraging Ecology at Nihoa Island			
Genetic Surveys to Address the Level of Isolation Between Shallow and Deep Reef Ecosystems			
Bathymetric Mapping of the Intersection of Necker Ridge with the Hawaiian Ridge			
Permit 14097 NMFS Southwest Fisheries Science Center (SWFSC) pinniped, cetacean and sea turtle studies (Harass)			
Permit 14381 Sampling sea turtle bycatch in Hawaiian Longline Fisheries (Handle / Release)			
Permit 15685 Ocean capture research of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in the Hawaiian Islands (Capture/Handle/Release)			
Retrieval of Ecological Acoustic Recorders (EARs) in Deep Marine Areas			

Hawaiian Sea Turtle Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Commercial Activities			
Whale watching (Tour boats)	• Disturbance • Injury or mortality	• Potential for collisions between surface vessels and sea turtles. • Noise and movement of vessels can temporarily displace sensitive species in the offshore area, such as the sea turtles. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to sea turtles.	-
Military Activities			
Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai`i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Disturbance • Injury or mortality	• Possible TTS, injury, masking, harassment, contamination, collision, entanglement, and detonation impacts to sea turtles due to military training activities. • Airborne sound from low-flying helicopters or airplanes may be heard by sea turtles while at the surface or underwater. Responses by turtles could include hasty dives or turns, or decreased foraging (Soto et al., 2006). • Degradation or destruction of feeding habitat by underwater detonations and training activities. • Land-based training exercises may displace nesting or resting sea turtles, may damage nests. • Degradation or destruction of feeding habitat by underwater detonations and training activities. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to sea turtles.	-
Permit 17860 Acoustic Technology Experiments			
Joint High Speed Vessel			
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS); NOAA Incidental Harassment Permits 18702 - 18705			

Hawaiian Sea Turtle Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Other Activities			
Guano mining	• Mortality and Reproductive effects	• Direct disturbance to breeding and resting individuals during activities.	-
Feather poaching			
Turtle harvest		• 18th – 19th Centuries: Unregulated take of meat, eggs for consumption and shark bait. Direct disturbance to breeding and resting individuals during activities.	
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Disturbance • Mortality and Reproductive effects • Reduction in marine debris	• There are NO regulations as to when activities may occur, there are no stipulations with regards to protection of nesting or resting habitat.	-/+
Removal of marine debris from high entanglement zones	• Injury or mortality	• Researchers may enhance habitat for sea turtles when they remove marine debris during field activities. Marine debris affects turtles via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on sea turtles. • Federal regulations authorize Federal and state employees to aid stranded endangered (50 CFR 222.310) and threatened (50 CFR 223.206) sea turtles.	+
MMHSRP and other NMFS permits and authorizations to disentangle, dehook and relocate seals away from harmful situations; also includes activities for other marine mammals including: stranding networks; rehabilitation; responses/investigations of mortality events; biomonitoring; tissue/serum banking; and analytical quality assurance.			
Fishery Ecosystem Plan for the Hawai`i Archipelago			
Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan Revisions	• Habitat protection	• Sea Turtles may benefit from Habitat designations; feeding areas, breeding and resting areas.	+
Habitat protection , loss mitigation and restoration			
Natural resource and species education and outreach	• Education	• 2009-2010: 10,000 people reached through partnerships with 30+ businesses, 50+ school presentations, 100+ schools	+
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Disturbance • Injury or mortality	• Sea turtles may benefit from protection measures reducing disturbance and mortality due to ship collisions.	+

Hawaiian Sea Turtle Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Development and Maintenance			
Building islands using dredge and fill Inter-Island Transmission Cable LORAN station (NWHI) Residential & Commercial construction (beach, near shore)	• Contaminants • Habitat degradation • Disturbance • Injury • Stranding • Entanglement in debris	• Accumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in tissues through diet. • Contaminants left over from military use of the NWHI islands also continue to affect emergent land areas, especially at Midway and French Frigate Shoals (Keller et al. 2010). • Coastal projects, bridges, roads and other infrastructure likely have changed the quality and quantity of habitat. • Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to turtles may occur while laying the cable, including entanglement and mortality.	-
Wai`anae Wastewater Treatment Plan Modification Wailupe Stream Flood Control Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Contaminants • Water quality improvements	• Improvements in water treatment would likely decrease the level of contaminants and biological waste entering coastal waters.	+
Legislation			
Hawai'i Environmental Policy Act (HRS 343)	• General species and habitat protection	• Protection of Hawaiian natural resources through public disclosure process and government reviewed impact evaluation	+

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Cumulative Effects Conclusion for Sea Turtles

Turtles encounter orders of magnitude more people and boats in the MHI from non-Hawaiian monk seal related activities than under any of the proposed Alternatives. While green sea turtles are the turtle species most likely to overlap with Hawaiian monk seals, the contribution of the proposed research and enhancement activities are not likely to result in anything but negligible cumulative effects given the mitigation measures implemented during research and enhancement. In addition, the removal of marine debris by monk seal researchers would likely be beneficial for sea turtles.

4.7.4 CETACEANS

This section addresses potential direct, indirect and cumulative effects of the alternatives on cetaceans in the NWHI and MHI. As discussed in Section 3.3.3, humpback whales, spinner dolphins, bottlenose dolphins and false killer whales are the cetacean species most likely to be present in nearshore areas where Hawaiian monk seals and activities associated with the alternatives would occur. The impact discussion therefore focuses on potential effects of the alternatives on these species.

In general, there are two potential types of mechanisms for effects that could result from the alternatives:

- Disturbance due to vessel activities, aerial surveys or beach activities; or
- Collisions with vessels.

Table 4.4.3 in Section 4.4.2 summarizes the criteria used to evaluate effects of the alternatives on cetaceans. As indicated in the table, the geographic extent, magnitude, frequency, and intensity are used to evaluate the level of potential effects.

The alternatives could result in direct and indirect reproductive effects on spinner dolphins or bottlenose dolphins as a result of disturbance due to vessel or aircraft activity during surveys or transport Hawaiian monk seals. However, the disturbance that could occur would likely be short-term and not result in lasting effects on these species.

Spinner dolphins and bottlenose dolphins may alter their behavior in response to a small boat transiting within lagoons where research and enhancement activities may occur. The level of disturbance is temporary and dolphins typically approach researchers, versus showing avoidance behaviors. This disturbance is not likely to result in adverse effects on reproduction.

As summarized in the 2009 EA for NMFS Permit 10137 for monk seal research and enhancement, abundance of humpback whales for the entire North Pacific Ocean is estimated to be 18,302 individuals, with over 50% of the population (approximately 10,000) estimated to winter in Hawaiian waters (Calambokidis *et*

al. 2008). In 2012, the main Hawaiian Islands insular stock of false killer whales was listed as endangered. These animals could also occur near shore where aerial and boat surveys occur. Most aerial surveys would occur during summer months when humpback whales are not present, but vessel and aerial surveys and transporting seals by air and boat could occur year-round. Takes of humpback whales and false killer whales would be avoided by implementing mitigation measures described in the analysis of alternatives below.

The potential effects of sonic tags are included in the 2009 EA for NMFS Permit 10137 for Hawaiian monk seal research and enhancement (NMFS 2009b) and are summarized here. Sonic tags used during research and enhancement would transmit signals at 69 kHz. While spinner dolphins that occur in lagoon waters of French Frigate Shoals have an estimated auditory range of 150 Hz to 160 kHz (Southall *et al.* 2007), it is not likely that the presence of these tags on pups would have a measurable impact on dolphins. Therefore, under all alternatives, the potential effects of sonic tags are considered negligible.

While it is possible that collisions with vessels used during research and enhancement could result in mortality of humpback whales or dolphins, the likelihood of this occurring is very low. Mitigation measures and BMPs implemented by NMFS such as NAO 217-103 (Management of Small Boats) and Monument permit conditions presented in Appendix L. To date, there have been no documented incidents of collision with monk seal research and enhancement vessels.

4.7.4.1 *DIRECT AND INDIRECT EFFECTS ON CETACEANS OF ALTERNATIVE 1 – STATUS QUO*

Under Status Quo, Permit No. 10137 authorizes annual harassment of 500 spinner dolphins within the lagoon waters at four NWHI sites (Midway Atoll, Pearl and Hermes Reef, Kure Atoll, and French Frigate Shoals). Harassment would occur primarily during summer months but may occur year-round (NMFS 2009b). As described above, the presence of sonic tags on pups would have a negligible effect on dolphins under all alternatives.

Negligible effects on cetaceans would be expected to occur under Alternative 1 given that the interactions with cetaceans are not likely to cause disturbance that would result in reproductive effects and collisions are not anticipated. Mitigation would be incorporated as follows:

- Aerial surveys would be conducted above shoreline areas; in the event cetaceans were encountered near shore, researchers would fly to an altitude of 1000 feet to avoid harassment (NMFS 2009b); and
- If encountered by boat, researchers would maintain a distance of 50 yards (150 feet) for cetaceans other than humpback whales, and a distance of 300 feet if a humpback whale is encountered.

These approach distances are consistent with Federal Regulation (50 CFR 224.103) to avoid take if humpback whales are encountered and NMFS guidelines to avoid harassment of other cetaceans (NMFS 2009b).

4.7.4.2 *DIRECT AND INDIRECT EFFECTS ON CETACEANS OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)*

While there is potential for short-term disturbance or low probability of collisions with vessels under Alternative 2 while the permit is still valid, negligible effects on cetaceans would be expected under the No Action Alternative given that the magnitude of potential disturbance is not likely to cause reproductive effects and collisions would be extremely rare. Research and enhancement activities on wild monk seals would discontinue after the current permit expires in 2014.

4.7.4.3 *DIRECT AND INDIRECT EFFECTS ON CETACEANS OF ALTERNATIVE 3 LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE) AND ALTERNATIVE 4 ENHANCED IMPLEMENTATION*

Alternatives 3 and 4 could result in disturbance of up to 500 individual spinner dolphins and 20 bottlenose dolphins annually; however, these incidents are expected to be short-term and not result in long-term or population level effects on reproduction. Given the stringent BMPs (see Appendix L) and other permit conditions implemented by NMFS, there would be negligible effects on reproduction due to research and enhancement activities. As stated under Alternative 1 above, the presence of sonic tags on pups would have a negligible effect on dolphins under all alternatives (NMFS 2009b).

The same procedures and mitigation would be followed in Alternative 3 (Preferred) as that described under Alternative 1 to avoid takes of humpback whales. Aerial survey altitudes would be increased if cetaceans are encountered, and boat surveys would maintain distances to cetaceans consistent with NMFS regulations and guidelines.

While collisions with survey vessels may occur, the increased level of activity under Alternatives 3 and 4 are still not expected to result in mortalities of cetaceans. Vessel activities associated with the research and enhancement would not be frequent, and it is expected that individual dolphins or whales would move away from survey vessels in their vicinity. Although individual dolphins or whales could be injured during collisions, this would be an extremely rare occurrence, and the effect on the populations of humpback whales and spinner dolphins would be negligible.

4.7.4.4 *CUMULATIVE EFFECTS OF ALTERNATIVES ON CETACEANS*

Humpback whales are listed as endangered, under the ESA and depleted under the MMPA. Spinner dolphins in Hawai`i are not listed as threatened or

endangered under the ESA, nor are any of the Hawaiian Islands stocks depleted under the MMPA. Recent Stock Assessment Reports (SAR) indicate that Central North Pacific Stock of humpback whale (which winters in Hawaii) has been increasing in the 1990s and 2000s. Estimates of the rate of increase vary, but are generally between 4 and 9% (NMFS 2009). Despite recent concerns regarding potential adverse effects on spinner dolphins due to human interaction (see Section 4.5.2), interactions with monk seal researchers are managed through the stringent Monument permit process and are relatively infrequent compared to other interactions with humans throughout the Islands.

Direct and indirect mortality and reproductive effects of research and enhancement activities may result from disturbance or collision with vessels. Table 4.7-9 summarizes the direct and indirect effects of the alternatives on cetaceans.

Table 4.7-9 Summary of Direct and Indirect Effects of the Alternatives on Cetaceans

	Alternative 1 Status Quo	**Alternative 2 No Action; No Permit After 2014**	**Alternative 3 Limited Translocation (Preferred Alternative)**	**Alternative 4 Enhanced Implementation**
Mortality	Negligible	Negligible	Negligible	Negligible
Reproduction	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Cetaceans

Past, present and reasonably foreseeable future actions that may affect cetacean survival or reproduction are summarized in Table 4.7-10.

Table 4.7-10 Effects of Past, Present and Reasonably Foreseeable Future Actions on Cetaceans

Hawaiian Cetacean Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane	• Changes to habitat • Injury or mortality • Changes in prey due to ecosystem shift	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris, entanglement and affects habitat suitability for resting, and feeding areas	-
Japanese Tohoku earthquake and tsunami debris			
Climate Change		• Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish prey populations are affected by these changes and can be both beneficial and adverse.	- /+
Introduction of Invasive species		• Invasive fish species introduced through ballast water may cause changes in prey dynamics.	-
Scientific Research			
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) (6 missions)	• Education • Disturbance • Injury or mortality	• Direct effects on individuals through vessels and aircraft in the nearshore environment; collision, disturbance. • Humpbacks could be killed if vessels used during research and enhancement activities collided with individuals • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to cetaceans. • Various cetacean research permits as listed in Table 4.5-2. . Permit 14451 Assessing distribution and abundance of marine mammals on Navy operational area; surface vessel surveys, photo identification, videography, and acoustic recording (Harass)	-
Bathymetric Mapping of the Intersection of Necker Ridge with the Hawaiian Ridge			- /+
Genetic Surveys to Address the Level of Isolation Between Shallow and Deep Reef Ecosystems			
Cetacean research			
Retrieval of Ecological Acoustic Recorders (EARs) in Deep Marine Areas			-

Hawaiian Cetacean Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Commercial Activities			
Whaling	• Disturbance • Injury or mortality	• 19th Century subsistence activities. • Commercial whaling: nearly 600 whaling ships were based out of Hawaii in the mid-1800s (Bishop Museum 2013)	-
Whale and dolphin watching (Tour boats)		• Potential for collisions between surface vessels and cetaceans. • Noise and movement of vehicles can temporarily displace sensitive species in the offshore area, such as the cetaceans. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to cetaceans.	- /+
Military Activities			
Joint High Speed Vessel (JHSV)	• Disturbance • Injury or mortality	• Possible TTS, injury, masking, harassment, contamination, collision, entanglement, and detonation impacts to cetaceans due to military training activities. • Airborne sound from low-flying helicopters or airplanes may be heard by cetaceans while at the surface or underwater. Responses by cetaceans could include hasty dives or turns, or decreased foraging (Soto et al., 2006). • Degradation or destruction of feeding habitat by underwater detonations and training activities.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS); NOAA Incidental Harassment Permits 18702 - 18705			
Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])			
Permit 17860: US Navy Acoustic Technology Experiments.			
Other Activities			

Hawaiian Cetacean Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Disturbance • Mortality and Reproductive effects • Reduction in marine debris	• There are NO regulations as to when activities may occur, there are no stipulations with regards to protection of habitat or species	- /+
Removal of marine debris from high entanglement zones Fishery Ecosystem Plan for the Hawai`i Archipelago MMHSRP and other NMFS permits and authorizations to disentangle, dehook and relocate seals away from harmful situations; also includes activities for other marine mammals including: stranding networks; rehabilitation; responses/investigations of mortality events; biomonitoring; tissue/serum banking; and analytical quality assurance.	• Injury or mortality	• Researchers may enhance habitat for cetaceans when they remove marine debris during field activities. Marine debris affects cetaceans via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on cetaceans. • Response to stranded cetaceans may increase survival through rehabilitation or identify causes of mortalities.	+
Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan Revisions Habitat protection , loss mitigation and restoration	• Habitat protection	• Cetaceans may benefit from Habitat designations; feeding areas, breeding and resting areas.	+
Natural resource and species education and outreach	• Education	• 2009-2010: 10,000 people reached through partnerships with 30+ businesses, 50+ school presentations, 100+ schools	+
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Disturbance • Injury or mortality	• Cetaceans will benefit from protection measures reducing disturbance and mortality due to ship collisions.	+

Hawaiian Cetacean Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Development and Maintenance			
Building islands using dredge and fill	• Contaminants • Habitat degradation • Disturbance • Injury • Stranding • Entanglement in debris	• Accumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in tissues through diet. • Contaminants left over from military use of the NWHI islands also continue to affect emergent land areas, especially at Midway and French Frigate Shoals (Keller et al. 2010). • Coastal projects, bridges, roads and other infrastructure likely have changed the quality and quantity of habitat. • Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to cetaceans may occur while laying the cable, including entanglement and mortality.	-
Inter-Island Transmission Cable			
LORAN station (NWHI)			
Permit 17268 Honolulu Seawater AC (Incidental Take)	• Disturbance • Injury • Stranding	• Potential for collisions between surface vessels and cetaceans. • Noise and movement of vehicles during training can temporarily displace sensitive species in the offshore area, such as the cetaceans. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to cetaceans.	-
Wai`anae Wastewater Treatment Plan Modification	• Contaminants • Water quality improvements	• Improvements in water treatment would likely decrease the level of contaminants and biological waste entering coastal waters.	+
Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie			
Legislation			
Hawai`i Environmental Policy Act (HRS 343)	• General species and habitat protection	• Protection of Hawaiian natural resources through public disclosure process and government reviewed impact evaluation	+

Cumulative Effects Conclusion for Cetaceans

While there are several permits for research on cetaceans in the Hawaiian Islands, these authorized research activities are not expected to result in long-term negative impacts on cetacean populations and likely contribute to overall conservation of the species. There are few disturbances to spinner dolphins in the NWHI concurrent with research and enhancement activities, as a limited number of people are able to access the Monument via a permit issued by the Monument, and such permits would not authorize harassment of spinner dolphins unless a research and enhancement permit were issued. Permit No. 1007-1629-01 issued to Dr. Leszek Karczmarski, Marine Mammal Research Program, Texas A&M University, authorized research on spinner dolphins in the NWHI over a six-year period, and expired on August 31, 2007.

Future spinner dolphin management measures may result in time-area closures that would allow the species important protection from human disturbance during critical resting periods and therefore be beneficial to species survival and reproduction. Similarly, Hawaiian monk seal critical habitat designation would likely be beneficial for spinner dolphins due to overall habitat protection in bays shared by seals and dolphins.

Overall, Hawaiian monk seal research and enhancement under any of the alternatives is expected to result in a negligible contribution to cumulative effects on cetaceans. Effects are likely to be negligible due to the temporary duration of research and enhancement activities in the open ocean or nearshore environment. Also, the minimal amount of vessel and airplane activity from monk seal research and enhancement as compared to those associated with recreation, fishing, shipping and other human activities is not likely to result in anything but negligible cumulative effects on cetaceans.

4.7.5 FISH

This section addresses potential direct, indirect and cumulative effects of the alternatives on fish in the NWHI and MHI, by assessing the potential for increased predation from Hawaiian monk seals. Table 4.4.4 in Section 4.4.2 summarizes the criteria used to evaluate effects of the alternatives on fish. Potential effects on fish populations would be similar for Essential Fish Habitat, commercially harvested fish species, and nearshore fish species; thus, potential effects for these categories are discussed together.

As described in Section 3.3.1.5, Hawaiian monk seals are foraging generalists, with a wide variety of prey including several varieties of fish and multiple species of crab and lobster. There is also evidence of variation in diet among individuals, demographic groups (between juveniles and adults/sub adults) and locations (Iverson 2006); indicating that individual monk seal foraging preferences and capabilities play a role in selection of foraging habitat. In other words, diets differ considerably among individual seals.

4.7.5.1 *DIRECT AND INDIRECT EFFECTS OF ALL ALTERNATIVES ON FISH*

Given the wide variety of fish consumed by monk seals, the likelihood that seal predation on fish could cause a long-term decline in fish populations is unlikely. Therefore, none of the alternatives would result in any notable effect on fish populations as a result of monk seal predation. Nearshore activities such as vessel surveys are not likely to result in disturbance or mortality of fish and would be considered negligible under all alternatives.

Negligible effects on fish would be expected to occur under the Status Quo Alternative given that the Hawaiian monk seal population is projected to continue to decline despite research and enhancement covered under the existing permit. While this is not to say that predation on fish species by monk seals does not occur, the continuation of research and enhancement activities on seals would not result in dramatic changes in the levels of fish consumed by seals throughout the Hawaiian Islands. In fact, given the projected decline in Hawaiian monk seals under all alternatives, a potential decline in predation on fish over the next 10 years could be reasonably assumed.

The potential effects of sonic tags, which may transmit signals up to 69 kHz, are summarized in the 2010 EA for NMFS Permit 10137 for Hawaiian monk seal research and enhancement (NMFS 2009b) as summarized here. Many fish species hear outside of this frequency (A. Scholik, personal communication, March 31, 2009), with the exception of some clupeids (Popper *et al.* 2004). Only a few species of clupeids are found in Hawaiian waters (*e.g.,* the clupeid Spratelloides delicatulus is found from O`ahu to Kure), and if these fish can hear within the frequency emitted by the sonic tags it is highly unlikely that there would be any significant effects on these fish.

4.7.5.2 *DIRECT AND INDIRECT EFFECTS ON FISH OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE) AND ALTERNATIVE 4 – ENHANCED IMPLEMENTATION*

Alternatives 3 and 4 could result in a slight reduction in the decline of the numbers of Hawaiian monk seals. In other words, though the decline may slow, the population would still likely decrease (see Section 4.4.1). As described in more detail in Section 3.3.1.5, foraging competition may help explain differential survival rates of juvenile Hawaiian monk seals at various subpopulations between different habitat areas, but does not provide any indication that the monk seals would be more effective predators than other predators in the vicinity (*e.g.*, birds, sharks, large predatory fish).

Translocating a small number of juvenile monk seals (potentially 20 per year) between islands in the NWHI would not have a measurable effect on any fish species, as the number translocated would typically be small relative to the seal abundance at the recipient subpopulation and would likely represent a small segment of the large marine predator population, particularly when compared to

the numbers of predatory fish present in the NWHI (Sprague *et al.* 2013). Additionally, the predatory effect on fish resulting from the juvenile monk seals is likely to be the same whether it occurs at the original island or at the island where the juveniles are translocated. Effects of this alternative would be negligible.

It is unlikely that Hawaiian monk seals would have a predatory effect on fish populations that is measurably different than any other predatory effect of other species. Fish consumption by Hawaiian monk seals would be distributed across a wide variety of available prey species, and the effect of translocating Hawaiian monk seals (slowing their population decline) is not likely to be detectable.

4.7.5.3 CUMULATIVE EFFECTS OF ALTERNATIVES ON FISH

Fish populations have been affected by commercial fishing, ocean pollution, climate change, and habitat degradation. Direct and indirect mortality from research and enhancement activities is likely to be negligible. Table 4.7-11 summarizes the direct and indirect effects of the alternatives on fish species.

Table 4.7-11 Summary of Direct and Indirect Effects of the Alternatives on Fish

	Alternative 1 Status Quo	**Alternative 2 No Action; No Permit After 2014**	**Alternative 3 Limited Translocation (Preferred Alternative)**	**Alternative 4 Enhanced Implementation**
Mortality	Negligible	Negligible	Negligible	Negligible
Reproduction	Negligible	Negligible	Negligible	Negligible

<u>Past, Present and Future Actions and Events Contributing to Cumulative Effects on Fish</u>

Past, present, and reasonably foreseeable future actions that may affect fish survival or reproduction are summarized in Table 4.7-12.

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Table 4.7-12 Effects of Past, Present and Reasonably Foreseeable Future Actions on Fish

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane	• Changes to habitat • Injury or mortality • Changes in prey due to ecosystem shift	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris, entanglement and affects habitat suitability	-
Japanese Tohoku earthquake and tsunami debris			
Climate Change		• Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish prey populations are affected by these changes and can be both beneficial and adverse. However, future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011).	-/+
Introduction of Invasive species or disease		• Parasites have been shown to be significant stressors in many species. Reif et al. (2006). • Invasive fish species introduced through ballast water may cause changes in fish population dynamics.	-
Predation by apex predatory fish nearshore (30m depth)	• Mortality	• Apex predatory fish consume a minimum of 66,000 kg/day (146,000 lb/day) approximately 50 times more than a Hawaiian monk seal (Sprague et al. 2013).	-/+
Predation by Hawaiian monk seals nearshore (30m depth)	• Mortality	• Estimated predation by 200 monk seals in MHI is approximately 1,300 kg per day (2,900 lb per day) (Sprague et al. 2013)	-/+
Scientific Research			

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) (6 missions)	• Education • Disturbance • Injury or mortality	• Direct effects on individual fish through human activity and research. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to fish. • While mortality is possible, overall benefits of research and enhancement are beneficial for long term species survival.	**-/+**
Activities to Enhance Understanding of Hawaiian Monk Seal Foraging Ecology at Nihoa Island			
Bathymetric Mapping of the Intersection of Necker Ridge with the Hawaiian Ridge			
Genetic Surveys to Address the Level of Isolation Between Shallow and Deep Reef Ecosystems			
Incidence and Effects of Coral and Fish Disease within Shallow Water Reefs			
Tuna Tagging			
Commercial Activities			

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Commercial Fisheries (bottomfish and pelagic)	• Mortality • Injury	• 1882: Sea cucumber harvest • 1913 – 2002: fishing for trevally and amberjack. • 1930 – 2010: bottomfish fishery. Following WWII, Honolulu-based vessels had fishery for bottomfish, lobsters, reef fish, inshore species, and turtles. • 1946: fishing companies used FFS as base for planes exporting scad and other species. • 1950s – 1991: longline for tuna (foreign fleet ended 1976; domestic fleet ended 1991). • 1970 – 1999: Hawaiian spiny lobster, Scaly slipper lobster. 11 million landed • 1965 – 1980: foreign vessels used tangle nets to harvest precious coral; Taiwanese vessels illegally poached 100 tons near Gardner Pinnacles and Lay • 1948 – 1978: number of trips per year per fishermen increased and has remained about 8 trips per year between 1980 and 2004. Data suggest there are more fishermen catching fewer fish. • Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006). • 1996-2006: Increased fishing effort with number of hooks set increasing four-fold. Catch rates for apex predators such as blue shark, bigeye and albacore tunas, shortbill spearfish, and striped marlin declined from 3 to 9% per year while catch rates for mahimahi, sickle pomfret, escolar, and snake mackerel, increased by 6 to 18% per year (Polovina 2009). • 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). Decreased catch rates for large fishes has continued through at least 2011 (Polovina 2011). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013).	-

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Recreational and Subsistence Fisheries	• Mortality • Injury	• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • Limited data on subsistence harvest of fish species in Hawaii make estimating harvest levels difficult. • 2013: daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) • Widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander et al. 2004).	-
			-
Military Activities			
Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Disturbance • Injury or mortality	• Possible TTS, injury, contamination, collision, entanglement, and detonation impacts to fish due to military training activities. • Degradation or destruction of feeding habitat by underwater detonations and training activities.	-
Permit 17860 US Navy Acoustic Technology Experiments			
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS); NOAA Incidental Harassment Permits 18702 - 18705		• Navy's impact analysis expects effects on recruitment or survival to be negligible. • Potential for injury to fish is negligible. • Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to fish is expected to be minimal.	
Other Activities			

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Disturbance • Mortality and Reproductive effects • Reduction in marine debris	• There are NO regulations as to when activities may occur, there are no stipulations with regards to protection of nesting or feeding habitat.	**-/+**
Removal of marine debris from high entanglement zones Fishery Ecosystem Plan for the Hawai`i Archipelago	• Injury or mortality	• Researchers may enhance habitat for fish when they remove marine debris during field activities. Marine debris affects fish via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on fish.	**+**
Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan Revisions Hawaiian monk seal critical habitat designation	• Habitat protection	• Fish may benefit from Habitat designations; feeding areas, breeding and resting areas.	**+**
Hawaiian Spinner Dolphin Human Interaction Protection Measures	•	• Fish populations may benefit from dolphin protection measures due to potential time-area closures in bays around the MHI; potential additional protection of habitat; added recruitment could benefit fish populations.	**+**
Natural resource and species education and outreach	• Education	• 2009-2010: 10,000 people reached through partnerships with 30+ businesses, 50+ school presentations, 100+ schools	**+**
SEIS Measures to End Bottomfish Overfishing in the Hawaiian Archipelago Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006) Final EIS Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region (2005)	• Mortality • Habitat protection	• Fish may benefit from habitat protection and cessation of overharvesting.	**+**
Development and Maintenance			

Hawaiian Fish Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Building islands using dredge and fill Inter-Island Transmission Cable LORAN station (NWHI)	• Contaminants • Habitat degradation • Disturbance • Injury • Stranding • Entanglement in debris	• Accumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in tissues through diet. • Contaminants left over from military use of the NWHI islands also continue to affect emergent land areas, especially at Midway and French Frigate Shoals (Keller et al. 2010). • Coastal projects, bridges, roads and other infrastructure likely have changed the quality and quantity of habitat. • Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to fish may occur while laying the cable, including entanglement and mortality.	-
Wai`anae Wastewater Treatment Plan Modification Wailupe Stream Flood Control Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Contaminants • Water quality improvements	• Improvements in water treatment would likely decrease the level of contaminants and biological waste entering coastal waters.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices also widely impact coral reef habitat. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013).	-
Legislation			
Hawai`i Environmental Policy Act (HRS 343)	• General species and habitat protection	• Protection of Hawaiian natural resources through public disclosure process and government reviewed impact evaluation	+

Cumulative Effects Conclusion for Fish

The contribution of the proposed monk seal research and enhancement activities to cumulative effects on fish are expected to be negligible. A maximum current population of 200 Hawaiian monk seals in the MHI is liberally estimated to consume approximately 1,300 kg per day (2,900 lb per day); this is an average of about 15 lb per day per seal. In comparison, Sprague et al. (2013) conservatively estimate that apex predatory fish (sharks and jacks present in just the nearshore waters out to 30 m depth in the MHI) consume a minimum 66,000 kg/day (146,000 lb/day). The estimate of commercial catch of species occurring within nearshore (up to 30 m depth) habitats (that is, after excluding mostly pelagic species that account for 95% of commercial landings), is 1,676 kg (3,969 lb) per day.

Natural environmental processes such as climate also drive long-term dynamics that affect fish populations. Variability in fish prey populations are affected by these changes and can be both beneficial and adverse. Future climate change is projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011).

Other actions including species habitat protection such as monk seal critical habitat designation and spinner dolphin protection measures could result in better recruitment of fish species in the nearshore environment around Hawaii due to potential restrictions on types of activities or time-area closures that may disrupt fish.

4.7.6 BIRDS

4.7.6.1 DIRECT AND INDIRECT EFFECTS ON BIRDS OF ALTERNATIVE 1 – STATUS QUO

Under Alternative 1, the current NMFS Research and Enhancement Permit (10137) would continue until its expiration in 2014, and subsequent permits would be issued to continue research and enhancement activities according to the scope and methods currently permitted. For a complete description of research and enhancement activities allowed under Alternative 1, please refer to Section 2.7, Alternative 1 Status Quo, and Table 2.10-1.

Seabirds

Alternative 1 would result in minor, adverse short-term effects on productivity of seabird species identified in Table 3.6-6. Seabirds that nest in proximity to areas where monk seals haul out could be disturbed by researchers' presence on beaches. Accidental crushing of eggs, chicks, or nest burrows, blockage of access to nest sites with gear, thermal stress, increased predation of chicks, and elevated

stress levels in birds are examples of impacts that are possible each time a human or humans enter a nesting seabird colony (PMNM 2008). Thermal stress could occur to eggs and/or very young chicks if adult seabirds are flushed from the nest and kept away for more than 3 minutes (PMNM 2008). In addition, if adult seabirds are flushed from nests, unattended eggs or hatchlings are more vulnerable to predation. Stress reactions (elevated heart rate, elevated levels of corticosterone, and behavioral responses) have also been documented in several species of nesting seabirds as a result of human activities in nesting colonies (PMNM 2008).

All reasonable precautions would be implemented to avoid take of seabirds incidental to research and enhancement activities and nesting seabirds on beaches would be avoided. To mitigate impacts, USFWS gives research and enhancement field researchers a briefing on appropriate mitigation to avoid take of seabirds in the NWHI (USFWS 2010a). Mitigation includes:

- Looking for nests or for adults flushing from inconspicuous nests when approaching seabird colonies;
- Not disturbing any colonies of ground-nesting sooty terns, gray-backed terns or brown noddies with chicks 2-7 days old (before scapular feathers have erupted);
- Planning activities to avoid displacing adults from eggs or chicks for longer than 3 minutes;
- Never leaving string or line anywhere in nesting colonies;
- Planning work when the fewest birds are in the area;
- Extinguishing all ship lights except for running lights or anchor lights when operating in proximity to seabird colonies;
- Traveling on marked trails to avoid subsurface nests; and
- Digging out shearwaters or petrels if nests are stepped on (PMNM 2008).

Alternative 1 would result in minor periodic, adverse short-term effects on survival of seabirds. There is limited risk that seabirds, particularly albatross that require a long straight-line ground trajectory to become airborne, could fly into fencing associated with shoreline or inland pens with resultant injury.

Temporary pens for Hawaiian monk seals were seasonally maintained by researchers at Kure Atoll, Midway Atoll, and French Frigate Shoals for ten years during summer months with no incidents of seabirds becoming entangled in the fence. However, during a three-month period in 2006, a single Laysan albatross flew into fencing associated with a temporary pen at French Frigate Shoals and was injured, but not killed (USFWS 2014).

In order to minimize hazards from shoreline pens for birds, including short tail albatross, researchers would increase monitoring on windy days and would dismantle the pen after use, which would typically not exceed two weeks for holding seals (USFWS 2014).

Airplane flight activities could also have minor adverse effects on birds due to the increased noise disturbance and potential risk for birds being hit by aircraft. Noise disturbance results in an energetic cost to the bird although the energetic cost of response may not equate to reduced survival or productivity.

The millions of seabirds in the NWHI make aircraft flights to the islands potentially hazardous to both the birds and the aircraft personnel. At Tern Island and French Frigate Shoals, the species most commonly killed during aircraft operations is the sooty tern, but occasionally wedge-tailed shearwaters, great frigate birds, and both species of albatross are also hit (PMNM 2008). Both Laysan and black-footed albatross use the runway at Midway as a soaring area on their way to feed during the day (PMNM 2008). However, bird use of the airport runways declines dramatically at night, so night flights have a greatly reduced chance of hitting birds.

Requirements of the Monument would be in place to ensure the overall effects of air strikes on birds is minimal (PMNM 2008).

Requirements of the Monument include:

- Night flights for most of the year at Midway;
- Vegetation management along the runways to modify bird flight and nesting behavior;
- Flight path advisories given to pilots; and
- Runway clearing of birds and other wildlife by personnel prior to landing and takeoffs (PMNM 2008).

As described above and in Section 3.3.1.9, field camps in the NWHI are typically supplied and staffed using vessels, rather than aircraft. While the use of aircraft may occur under special circumstances (at Midway Islands or French Frigate Shoals), this is expected to be infrequent, thereby further minimizing the potential for these effects to occur.

Alternative 1 would result in minor localized effects on habitat for seabirds, which could be short or long-term depending on the extent or type of damage to the physical environment. The NWHI or the islets off the MHI are particularly vulnerable to the introduction of invasive species. Invasive plants and introduced mammals (*e.g.*, rats) are a primary threat to nesting seabirds, both indirectly by altering the ecosystem (plants) and directly by eating eggs and chicks (mammals).

For example, the invasive plant golden crownbeard (*Verbesina encelioides*) displaces almost all native vegetation in some nesting areas at Kure, Midway, and Pearl and Hermes Atolls. This plant causes entanglement of albatross adults and chicks and increases chick mortality due to heat stress by reducing the birds' ability to use convective cooling for thermoregulation (PMNM 2008). BMPs for Monument Special Conditions for Moving between Islands and Atolls and packing for field camps would be in place to ensure preservation of the NWHI

native ecosystem, and temporary field camps are established primarily during summer months only (PMNM 2008).

Researchers may enhance habitat for birds when they remove marine debris during field activities. Marine debris affects seabirds via ingestion of anthropogenic materials (*e.g.,* plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would result in a beneficial impact for birds.

Activities to be undertaken by researchers in the MHI are not likely to have a measurable impact to the environment relative to those activities that already exist (*e.g.,* recreational boating and fishing, aerial tour operations, use of beaches by tourists), and no permanent damage to the physical environment (*e.g.,* construction) is expected. Thus, the analysis of potential effects of the research and enhancement alternatives focuses on potential effects in the NWHI.

Shorebirds

Alternative 1 is expected to have minor or negligible effects on shorebirds. The only nesting shorebird in the Hawaiian Archipelago is the endangered Hawaiian Stilt. This species breeds in the MHI and large coastal wetlands and ephemeral playas, not beaches, are important habitats for this species.

Large numbers of overwintering shorebirds occur throughout the Hawaiian Archipelago, but negligible effects on their productivity or survival are expected from research and enhancement activities associated with Alternative 1. Overwintering shorebirds may be temporarily displaced from foraging areas during research and enhancement activities on the beach (ground surveys, holding pens, etc.), but these are expected to be brief, temporary disturbances with no measurable effects on shorebirds.

Minor risk from aircraft collisions is possible, but requirements of the Monument would be in place to ensure the overall effects of air strikes on birds is minimal. Requirements of the Monument are the same as described above. As described above and in Section 3.3.1.9, field camps in the NWHI are typically supplied and staffed using vessels, rather than aircraft, and any aircraft use is expected to be infrequent, minimizing the potential for these effects to occur.

Protected Bird Species

Most nesting seabirds and commonly occurring shorebirds that occur in the Hawaiian Archipelago (Table 3.3-5) are considered Species of Greatest Conservation Need (SGCN) by the State of Hawai'i. Thus, effects from Alternative 1 on the altered survival or productivity and habitat alteration for SGCN species are identical to the effects identified for seabirds and shorebirds in the above sections.

Components of Alternative 1 with the greatest potential to affect protected Birds of Conservation Concern (BCC) (Laysan and black-footed albatross) would be

the same as those described in Section 3.3.6.1 for seabirds. Because albatross species require long runways for takeoffs, they are the protected species most likely to collide with aircraft or holding pens. However, Monument requirements for the use of aircraft and of the USFWS for holding pens would be in place to ensure the overall effects of air strikes on birds is minimal (Appendix L, PMNM 2011-001).

ESA-listed seabird and shorebirds and all bird species occurring in the NWHI include:

- Short-tailed albatross;
- Laysan duck;
- Nihoa millerbird;
- Laysan finch, Nihoa finch;
- Hawaiian petrel;
- Newell's shearwater;
- Band-rumped storm petrel (candidate species); and
- Hawaiian stilt (USFWS 2010a).

Alternative 1 is not likely to affect the Hawaiian stilt, Hawaiian petrel, Newell's shearwater, band-rumped petrel and Nihoa finch. These species occur outside of the Project Area and would rarely, if ever, come into contact with NMFS personnel, equipment or activities.

Short-tailed Albatross

Alternative 1 may have short-term, minor effects on short-tailed albatross. Short-tailed albatross nest at Midway Atoll and have attempted to nest at Kure Atoll and Laysan Island (USFWS personal communication 2011d; 2011e,f; DLNR personalcommunication 2011). Although short-tailed albatross typically nest on sloping grassy terraces further inland, the active nest at Midway Atoll is approximately 20 m from the beach where Hawaiian monk seal surveys will occur. NMFS personnel will strictly adhere to island-specific USFWS protocols for short-tailed albatross to minimize effects to this species. No holding pens will be placed in the vicinity of short-tailed albatross or their nests (USFWS 2014). Monument requirements for the use of aircraft and of the USFWS for holding pens will also be in place to ensure the overall effects of air strikes on short-tailed albatross are minimal (Appendix L, PMNM 2011-001; USFWS 2014).

Laysan Duck

Alternative 1 may have short-term minor effects on the Laysan duck. Laysan ducks use all available habitats, including the field camp at Laysan Island and coastal habitats at both Laysan Island and Midway Atoll (USFWS 2009e). It is possible that non-breeding Laysan ducks in coastal areas may be disturbed by NMFS personnel, but these are expected to be brief, temporary disturbances with no measurable effects on Laysan ducks.

Some Laysan ducks, including ducklings, selectively use the camp area for foraging and resting and may be affected by NMFS personnel conducting camp activities. NMFS personnel must be cautious in their use of pesticides and monitor the effects of water use and discharge on the island's aquifer (USFWS 2009e). Hens that nest in or near camp may lead ducklings into camp; therefore, NMFS personnel should always be aware of ducks in camp and be careful not to disturb or fragment broods (USFWS 2009e).

Laysan ducks may also inadvertently fly into or run into Hawaiian monk seal holding pens. However, this is unlikely because: 1) Laysan ducks are most active at night when Hawaiian monk seal activities are minimal (USFWS 2009e); 2) Laysan ducks are more likely to walk rather than fly (USFWS 2009e); and 3) when foraging Laysan ducks tend to freeze rather than flush when startled (USFWS 2009e). In addition, NMFS personnel would strictly adhere to USFWS requirements for holding pens to ensure the overall effects on Laysan ducks due to Hawaiian monk seal activities are minimal (Appendix L, PMNM 2011-001; USFWS 2014).

Nihoa Millerbird

Alternative 1 may have short-term, minor effects on Nihoa Millerbirds at Laysan Island. Although Millerbirds are not typically found in beach habitats where monk seal activities will occur, both NMFS and USFWS maintain field camps at Laysan Island. Unintentional disturbance of Nihoa Millerbirds is possible as NMFS personnel transit from beach areas to field camps and conduct activities around field camps. Millerbirds often stay hidden in dense vegetation when not singing, so their contact with humans is anticipated to be minimal. Monk seal research personnel will adhere to strict procedures mandated by USFWS to avoid injury or death to Laysan Finch USFWS 2009c; USFWS 2014), and these procedures protect Millerbirds as well. Campsites at Laysan Island will be inspected regularly for potential hazards to birds (USFWS 2009c; USFWS 2014).

Laysan Finch

Alternative 1 may moderately affect Laysan finches (USFWS 2009c; USFWS 2014). Both NMFS and USFWS maintain field camps at Laysan Island, and NMFS maintains field camps at Pearl and Hermes Reef (see Section 3.3.1.9). Laysan finches are tame to human presence, thereby entering these field camps in search of food and water. Unintentional mortality or serious injury of Laysan finches is possible given their high activity level and curious nature. Despite efforts to prevent mortality, finches have drowned in camp containers that filled with rainwater when researchers were away from camp, or have become trapped in camp gear. In 2010, one Laysan finch died at Laysan Island when it got into a sink bucket that was left open, and one died at Pearl and Hermes due to unknown causes. In 2011, five Laysan finches died at Pearl and Hermes during a single incident after a lid was left off a pallet tub and then accumulated rainwater. In response to these unfortunate incidences, the HMSRP has reviewed its training protocols for

staff working at Laysan Island and Pearl and Hermes, and placed a renewed emphasis on use of avoidance and minimization measures. There were no lethal takes of Laysan finches in 2012. Furthermore, the HMSRP has developed new notification procedures to ensure that the news of any lethal takes is immediately transmitted to the Director of the Pacific Islands Fisheries Science Center and USFWS. Mitigation required by the Monument and USFWS would minimize impacts to Laysan finch (PMNM 2008; USFWS 2009c; USFWS 2014).

Conclusions for Direct and Indirect Effects of Alternative 1 on Birds

Overall, Alternative 1 is expected to have minor or negligible effects on seabird and shorebird productivity, survival, and habitat. Because beaches in the Hawaiian Archipelago are not used by nesting shorebirds, they are much less likely to be affected by human disturbance. Alternative 1 would also have minor or negligible short-term adverse effects on productivity or survival of SGCN-listed seabirds and shorebirds and BCC listed albatross species. Alternative 1 may have minor, short term effects on the Laysan Duck, Nihoa Millerbird, and short-tailed albatross. Alternative 1 may have moderate adverse effects on Laysan Finch. Although possible, it is not expected that the finches would become entangled in shoreline net pens. Carcasses of any dead birds would be frozen and notification given to USFWS within 5 days. While the deaths in 2011 represented an increase over previous mortalities in a given year, this did not exceed the estimated take over the 5 year period of Permit No. 10137. The HMSRP expects not to exceed 10 unintentional mortalities of Laysan finches over a 5-year permit period.

BMPs and protocols of the Monument and USFWS would be in place to ensure preservation of the NWHI ecosystem and the resources it holds (PMNM 2008; USFWS 2009c; USFWS 2014). USFWS gives monk seal field researchers a briefing on appropriate mitigation to avoid take of nesting seabirds and BMPs are in place by the Monument to reduce incidental take of birds by collisions with aircraft and holding pens, to prevent the spreading of disease or introduced species and to minimize human effects on endangered land birds. Therefore, Alternative 1 would result in minor effects on bird productivity, survival, and habitat.

4.7.6.2 DIRECT AND INDIRECT EFFECTS ON BIRDS OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Alternative 2, the No Action Alternative, would only allow for status quo research and enhancement activities on Hawaiian monk seals to continue until the current permit (10137) expires in 2014. When the existing permit expires, all research and enhancement activities that require a permit (except under the separate MMHSRP permit) would cease. For a complete description of research and enhancement activities allowed under Alternative 2, please refer to Section 2.8, Alternative No Action, and Table 2.10-1.

Seabirds

Effects from potential disturbance, altered survival and/or productivity, and habitat alteration from Alternative 2 mirror the effects described for seabirds Alternative 1 (Status Quo) but would occur for a shorter timeframe. Hawaiian monk seal ground surveys and beach activities would cease after 2014, resulting in fewer disturbances to seabirds by monk seal research personnel, fewer chances of collisions by seabirds with airplanes and Hawaiian monk seal holding pens, fewer opportunities for the introduction of exotic species. Therefore, effects from Alternative 2 would be less likely to impact seabirds than those outlined for Alternative 1. It is possible that seabirds may be affected by monk seal research activities until 2014, and thus implementation of Alternative 2 may result in minor short-term decreases in survival or productivity in seabirds

Once the current permit expires in 2014, potential effects on birds are likely to be negligible as no research or enhancement activities would occur on wild Hawaiian monk seals under Alternative 2; however, the beneficial removal of marine debris by monk seal researchers would also cease.

Shorebirds

Effects from potential disturbance, altered survival, and habitat alteration from Alternative 2 mirror the effects described for Alternative 1 for shorebirds but would occur for a shorter timeframe. Overwintering shorebirds may be temporarily displaced from foraging areas during research and enhancement activities on the beach (ground surveys, holding pens, etc.), but these brief, temporary disturbances with no measurable effects on shorebirds would cease after 2014. Implementation of Alternative 2 is not likely to have any measurable effects on shorebird survival and is unlikely to cause adverse short or long-term localized effects on habitat.

Protected Bird Species

Effects from potential disturbance, altered survival or productivity, and habitat alteration from Alternative 2 mirror the effects described for the protected species in Alternative 1 but would occur for a shorter timeframe. Hawaiian monk seal ground surveys and beach activities would cease after 2014, resulting in fewer disturbances to protected species by monk seal research personnel, fewer chances of collisions of birds with airplanes and Hawaiian monk seal holding pens, and fewer opportunities for the introduction of exotic species.

It is possible that protected birds may be affected by research activities prior to 2014, and thus, Alternative 2 may result in minor, short-term decreases in survival and/or productivity in SGCN-listed seabirds and shorebirds. However, requirements of the Monument and protocols established by the USFWS would be in place to minimize effects to protected seabirds and shorebirds. Alternative 2 may also have minor, short term effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate effects on the Laysan Finch prior to 2014. To

mitigate effects to Laysan finch, MMRP personnel adhere to strict procedures mandated by USFWS to avoid injury or death to this species. Campsites at islands where Laysan finches occur would be inspected regularly for presence of hazards to the birds.

Conclusions for Direct and Indirect Effects of Alternative 2 on Birds

Effects from potential disturbance, altered survival and/or productivity, and habitat alteration from Alternative 2 mirror the effects described for seabirds under Alternative 1 (Status Quo) except research activities would cease to occur after 2014.

It is possible that birds may be affected by monk seal research activities prior to 2014, and thus implementation of Alternative 2 may result in minor short-term decreases in survival and/or productivity in birds. Alternative 2 may also have short term, minor effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate adverse effects on Laysan finches. However, requirements of the Monument would be in place to ensure preservation of the NWHI ecosystem and the resources it holds. USFWS gives monk seal field researchers a briefing on appropriate mitigation to avoid take of nesting seabirds and BMPs are in place by the Monument to reduce incidental take of birds by collisions with aircraft and holding pens, to prevent the spreading of disease or introduced species, and to minimize human effects on endangered land birds. Once the current permit expires in 2014, potential effects on birds are likely to be negligible as no research or enhancement activities would occur on wild Hawaiian monk seals under Alternative 2; however, the beneficial removal of marine debris by researchers would also cease.

4.7.6.3 DIRECT AND INDIRECT EFFECTS ON BIRDS OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)

Under Alternative 3, all activities currently permitted would continue, and new permissions would be granted with expanded scope and methods. For a complete description of research and enhancement activities allowed under Alternative 3, please refer to Section 2.9, Alternative 3 Limited Translocation, and Table 2.10-1.

Seabirds

Potential effects from Alternative 3 on seabirds are identical to the effects described under Status Quo (Alternative 1), but their likelihood of occurrence would be slightly increased due to the additional ground, boat, and aerial surveys and beach activities (*e.g.,* remote camera installations, increased capturing and translocation of Hawaiian monk seals, increased use of shore pens, use of unmanned aerial flights) that may be authorized under this alternative. Increased field activities would also correlate to increased removal of marine debris for Hawaiian monk seals by researchers, which indirectly results in a beneficial impact to birds. In addition, once remote cameras are installed, fewer

Hawaiian monk seal ground surveys would be needed, thereby reducing effects on nesting seabirds overall. Restrictions and mitigation measures would be required by the USFWS and Monument to minimize disturbances caused by all new and existing monk seal research and enhancement activities. Thus, Alternative 3 is expected to have minor short-term adverse effects on seabird productivity and/or survival.

Potential effects from Alternative 3 on seabird habitat are identical to the effects described under Status Quo (Alternative 1), but their likelihood of occurrence would be slightly increased due to the additional research and camp activities that may occur under this alternative. Alternative 3 would result in minor localized effects on habitat for seabirds if fire, disease, or introduced species are spread through research or field camp activities. Habitat effects could be short or long-term depending on the extent or type of damage to the physical environment. However, BMPs would be in place by the Monument for camp protocols and to prevent the spreading of disease or introduced species (PMNM 2008).

Shorebirds

Potential effects from Alternative 3 on shorebirds are identical to the effects described for Alternative 1 (Status Quo) but their likelihood of occurrence would slightly increase due to the additional ground, boat, and aerial surveys and beach activities (*e.g.*, remote camera installations, increased capturing of Hawaiian monk seals) that may be authorized under Alternative 3. However, restrictions and mitigation measures would be required by the Monument and USFWS to minimize disturbances caused by all new research and enhancement activities. Thus, Alternative 3 is expected to have minor short-term adverse effects on shorebird survival and/or adverse short or long-term localized effects on shorebird habitats.

Protected Bird Species

Potential effects from Alternative 3 on SGCN protected seabird and shorebird species are identical to the effects described for Status Quo (Alternative 1), but their likelihood of occurrence would slightly increase due to the additional ground, boat, and aerial Hawaiian monk seal surveys and beach activities that may be authorized under this alternative. However, restrictions and mitigation measures for all new activities would be required by the Monument and USFWS to minimize disturbances by research and enhancement activities. Alternative 3 may thus result in minor short-term decreases in survival and/or productivity and/or adverse short or long-term localized effects on habitats. Alternative 3 may also have minor, short term effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate adverse effects on Laysan finches. To mitigate effects to Laysan finch, monk seal researchers adhere to strict procedures mandated by USFWS to avoid injury or death to this species.

Campsites at islands where Laysan finches occur will be inspected regularly for presence of hazards to the birds (USFWS 2009c; USFWS 2014).

Conclusions for Direct and Indirect Effects of Alternative 3 on Birds

Potential effects from Alternative 3 on birds are identical to the effects described under Status Quo (Alternative 1), but their likelihood of occurrence would be slightly increased due to the additional ground, boat, and aerial Hawaiian monk seal surveys and beach activities that may be authorized under this alternative. Implementation of Alternative 3 may result in minor short-term decreases in survival and/or productivity in birds and/or short or long-term localized effects on bird habitats. Alternative 3 may also have minor, short term effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate adverse effects on Laysan finches (USFWS 2014). However, requirements of the USFWS (USFWS 2014) and Monument would be in place to ensure preservation of the NWHI ecosystem and the resources it holds. USFWS gives monk seal field researchers a briefing on appropriate mitigation to avoid take of nesting seabirds and BMPs (PMNM 2008) are in place by the Monument to reduce incidental take of birds by collisions with aircraft and holding pens, to prevent the spreading of disease or introduced species, and to minimize human effects on endangered land birds.

4.7.6.4 DIRECT AND INDIRECT EFFECTS ON BIRDS OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

The Enhanced Implementation Alternative would encompass all the activities permitted under Alternative 3, with the addition of the option for temporary translocation of weaned pups from the NWHI to the MHI. For a complete description of research and enhancement activities allowed under Alternative 4, please refer to Section 2.10, Alternative 4 Enhanced Implementation, and Table 2.10-1.

Seabirds

Potential effects from Alternative 4 on seabirds are identical to the effects described under Alternative 3. Requirements of the Monument and protocols established by the USFWS would be in place to minimize adverse effects of monk seal research and enhancement activities on nesting seabirds. Overall, Alternative 4 is expected to have minor short-term adverse effects on seabird productivity, survival, or habitat.

Shorebirds

Potential effects from Alternative 4 on shorebirds are identical to the effects described under Alternative 3. Requirements of the Monument and protocols established by the USFWS would be in place to minimize adverse effects of research activities (Appendix L, PMNM 2011-001). Thus, Alternative 4 is expected to have minor short-term adverse effects on shorebird survival and

could result in adverse short or long-term localized effects on shorebird habitats depending on the extent or type of damage to the physical environment.

Protected Species

Potential effects from Alternative 4 on SGCN-protected seabird and shorebird species are identical to the effects described under Alternative 3. Requirements of the Monument and protocols established by the USFWS would be in place to minimize adverse effects of MMRP activities. Overall, Alternative 4 would have minor short-term decreases in survival and/or productivity and/or adverse short or long-term localized effects on habitats for SGCN-protected seabirds and shorebirds. Alternative 4 may also have minor, short term effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate adverse effects on Laysan finches. To mitigate effects to Laysan finch, monk seal personnel adhere to strict procedures mandated by USFWS to avoid injury or death to this species. Campsites at islands where Laysan finches occur will be inspected regularly for presence of hazards to the birds (USFWS 2014).

Conclusions for Direct and Indirect Effects of Alternative 4 on Birds

Potential effects from Alternative 4 on birds are identical to the effects described in Alternative 3. Implementation of Alternative 4 may result in minor short-term decreases in survival or productivity in birds and/or short or long-term localized effects on bird habitats. Alternative 4 may also have minor, short term effects on short-tailed albatross, Laysan Duck, and Nihoa Millerbird, and moderate adverse effects on Laysan finches. However, requirements of the Monument and USFWS would be in place to ensure preservation of the NWHI ecosystem and the resources it holds. USFWS gives MMRP field researchers a briefing on appropriate mitigation to avoid take of nesting seabirds and BMPs are in place by the Monument to reduce incidental take of birds by collisions with aircraft and holding pens, to prevent the spreading of disease or introduced species, and to minimize human effects on endangered land birds.

4.7.6.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON BIRDS

Direct and indirect mortality and reproductive effects of research and enhancement activities may result from disturbance or collision with vessels. Table 4.7-13 summarizes the direct and indirect effects of the alternatives on birds.

Table 4.7-13 Summary of Direct and Indirect Effects of the Alternatives on Birds

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Mortality	Negligible to Minor adverse (Moderate adverse for Laysan finch)	Negligible	Negligible to Minor adverse (Moderate adverse for Laysan finch)	Negligible to Minor adverse (Moderate adverse for Laysan finch)
Reproduction	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects

Past, present and reasonably foreseeable future actions that may affect bird survival or reproduction are summarized in Table 4.7-14.

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Table 4.7-14 Effects of Past, Present and Reasonably Foreseeable Future Actions on Birds

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane	• Changes to habitat • Injury or mortality • Changes in prey due to ecosystem shift	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris, entanglement and affects habitat suitability for resting, and nesting areas	-
Japanese Tohoku earthquake and tsunami debris			
Climate Change		• Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish prey populations are affected by these changes and can be both beneficial and adverse.	+/-
Introduction of invasive species or disease		• Introduction to Laysan Island: rabbits, rats, common sandbur (*Cenchrus echinatus*) (weed) that inhibits regeneration of the primary nest substrate (Eragrostis variabilis) for Laysan finches (Morin and Conant 1998). • Insect and arachnids species (*e.g.*, beetles, weevils, grasshoppers, bees, wasps, spiders and ants), reptiles (*e.g.*, snakes, lizards) and mammals (*e.g.*, mice, rats, dogs, cats) could introduce disease or parasites to birds. • Mammals in particular may increase the risk of diseases such as morbillivirus. • Invasive fish species introduced through ballast water may cause changes in prey dynamics.	-
Scientific Research			
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) (6 missions)	• Education • Disturbance • Injury or mortality	• Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) to birds.	-
Genetic Surveys to Address the Level of Isolation Between Shallow and Deep Reef Ecosystems		• Direct effects on individual birds through vessels in the nearshore environment, or through human activity on beaches during ground surveys or other research and enhancement beach activities. • While mortality has occurred, overall benefits of research and enhancement are beneficial for long term seal survival.	-/+
Long term monitoring Laysan & black footed albatross			
Monitoring of Red-footed, Brown, and Masked Boobies from Midway Atoll and French Frigate Shoals			
Military Activities			

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
US Navy Hawaii Range Complex Permit 15806 Letter of Authorization for marine mammal take: U.S. Navy Training - Hawai`i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Disturbance • Injury or mortality • Habitat destruction	• Potential effect on night-flying birds flying into lighted towers or buildings. • Downed birds near the new towers or antennas. • Noise from launches, ricocheting projectiles, mine neutralization activities and beach activities may startle / disturb nearby wildlife and cause flushing behavior in birds. • The potential ingestion of toxins, such as the small amount of propellant or simulant remaining in the spent boosters or on pieces of missile debris, by birds is possible but unlikely. Birds flying through an exhaust plume may be exposed to concentrations of hydrogen chloride that could irritate eye and respiratory membranes (Federal Aviation Administration, 1996). • The potential for main-beam (airborne) exposure thermal effects on birds exists. • Activities related to beach training exercises may also disturb habitat and nesting or resting birds. • Possible loss of individual migratory seabirds to GUNEX training in the designated impact area. • Contaminants left over from military use of the NWHI islands also continue to affect emergent land areas, especially at Midway and French Frigate Shoals (Keller et al. 2010). • Potential strike or mortality by training activities.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS); NOAA Incidental Harassment Permits 18702 - 18705		• Birds could be killed by collisions with vessels used during research and enhancement activities during night hours, *e.g.*, unshielded lights. • "Potential for non-injurious effects (TTS, masking, modification of biologically important behavior) is minimal to negligible." (US Navy 2012)	
Permit 17860 US Navy Acoustic Technology Experiments			
Other Activities			

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Guano mining	• Injury or mortality • Reproductive effects	• Direct disturbance to breeding and resting individuals during activities.	-
Feather poaching			
Seabird harvest activities		• 1842 – 1915: Unregulated take of seabirds by consumption, egg harvest, nest loss to guano harvest, introduced species, chick mortality due to removal of adults; direct disturbance to breeding and resting individuals during activities.	
State of Hawai'i DLNR. Clearing of rivers, streams, beach areas	• Disturbance • Mortality and Reproductive effects • Reduction in marine debris	• No regulations as to when activities may occur, there are no stipulations with regards to protection of nesting or feeding habitat.	-/+
Removal of marine debris from high entanglement zones	• Injury or mortality	• Marine debris affects seabirds via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on sea birds. • Mortality in longline fisheries is a global threat to most albatross and large petrel species (Gilman 2004). Hundreds of thousands of seabirds, including tens of thousands of albatrosses, are caught annually in longline fisheries worldwide (Gilman 2004).	+
Fishery Ecosystem Plan for the Hawai'i Archipelago			
Hawaiian Islands Humpback Whale National Marine Sanctuary Management Plan Revisions	• Habitat protection	• Birds may benefit from Habitat designations; feeding areas, nesting and resting areas.	+
Habitat protection , loss mitigation and restoration			
Natural resource and species education and outreach	• Education	• 2009-2010: 10,000 people reached through partnerships with 30+ businesses, 50+ school presentations, 100+ schools	+
Building islands using dredge and fill	• Contaminants • Habitat degradation • Disturbance • Injury • Stranding • Entanglement in debris	• Accumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in tissues through diet. • Coastal projects, bridges, roads and other infrastructure likely have changed the quality and quantity of habitat.	-
LORAN station (NWHI)			

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Wai`anae Wastewater Treatment Plan Modification	• Contaminants • Water quality improvements	• Improvements in water treatment would likely decrease the level of contaminants and biological waste entering coastal waters.	+
Wailupe Stream Flood Control			
Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie			
Legislation			
Hawai`i Environmental Policy Act (HRS 343)	• General species and habitat protection	• Protection of Hawaiian natural resources through public disclosure process and government reviewed impact evaluation	+

Since the arrival of the first humans to the Hawaiian Archipelago, more than half of the islands' 140 native bird species have become extinct (Hawaiian invasive species.org). Today, 31 Hawaiian bird species are endangered. Past threats to birds within the Project Area include habitat loss (MHI), bird poaching, seabird bycatch from longline fisheries, invasive species, marine debris, habitat loss, and contaminants.

Current threats are outlined below.

- Mortality in longline fisheries is a global threat to most albatross and large petrel species (Gilman 2004). Hundreds of thousands of seabirds, including tens of thousands of albatrosses, are caught annually in longline fisheries worldwide (Gilman 2004).
- Invasive species spread disease, destroy habitat, and indirectly and directly kill Hawaiian birds. Rats, mongoose, ants, mosquitoes (carrying bird pox and bird malaria), cats, and the golden crownbeard have been some of the most damaging invasive species for nesting seabirds in the Hawaiian Archipelago.
- Marine debris affects seabirds via ingestion of anthropogenic materials (*e.g.,* plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). In addition, debris from the tsunami that occurred in Japan in March 2011 could have significant impacts on wildlife, including seabirds, throughout the Pacific (Ocean Conservancy 2012). Tsunami debris that goes north of the Hawaiian Islands is predicted to primarily collect in the Northern Pacific Gyre where it will mix with common debris. This mixture of debris will then turn up in the NWHI again as currents carry debris from the Gyre to the NWHI (Maximenko and Hafner 2012). Tsunami debris is thus expected to continue to litter NWHI coastlines for many years to come (Maximenko and Hafner 2012).
- Contaminants left over from military use of the NWHI islands also continue to affect emergent land areas, especially at Midway and French Frigate Shoals (Keller *et al.* 2010).
- Global climate change factors are already affecting the NWHI ecosystem and will have widespread effects. Global mean sea levels have risen an estimated 3.1 ± 0.7 mm yr-1 from 1993-2003, an amount higher than any other 10-year period since 1950 (Keller *et al.* 2010). Habitat loss from sea level rise may be devastating to seabird populations that depend on these low islands for survival (Baker *et al.* 2006, Reynolds *et al.* 2012).

Avian mortality or reduced survival/reproductive success from RFFAs is identified for wind farms, residential and commercial construction (beach, nearshore), commercial fishing, scientific research activities on land, natural events, introduction of invasive species, tourism and recreation, and marine

pollution. Particularly in the MHI, all of the mortality factors except bird poaching identified in the previous section may continue to occur within the Project Area in the future. Some of the greatest sources of human-caused bird mortality from the past include the introduction of invasive species, habitat loss, and commercial fishing. However, effects of global climate change may become the largest threat to seabirds, especially in the NWHI, in the future.

Components of climate change most likely to affect seabirds in the NWHI include sea level rise, changing storm intensity and frequency (causing erosion), sea surface temperature rise and acidification (Keller *et al.* 2010). Habitat loss from sea level rise may be devastating to seabird populations that nest at or near sea level. Models predict that sea level will continue to rise. In addition, there is the potential for further habitat degradation with the release of contaminants contained in landfills as the islands are eroded or flooded from sea level rise (Reynolds et al 2012). As sea surface temperature increases, seabird prey species may move to deeper, cooler water, thereby decreasing food availability for foraging birds, or requiring birds to fly further north in the Pacific to obtain food resources.

Cumulative Effects Conclusion for Birds

Birds, especially nesting seabirds, of the Hawaiian Archipelago are susceptible to future human-caused mortality factors. The contribution from Hawaiian monk seal research and enhancement activities, however, is considered minor or negligible on birds. Activities to be undertaken by researchers in the MHI are not likely to have a measurable impact to the environment relative to those activities that already exist (*e.g.,* recreational boating and fishing, aerial tour operations, use of beaches by tourists), and no permanent damage to the physical environment (*e.g.,* due to construction) is expected. Thus, the contribution of any alternatives to cumulative effects on birds in the MHI is considered negligible.

Because Best Management Practices and protocols in place for the NWHI minimize human disturbance to birds, the direct and indirect effects associated with Alternative 1 are minimized, and research and enhancement activities would contribute negligible to minor cumulative effects on bird species. Alternative 2 would involve even less disturbance to birds from research and enhancement activities because activities would cease in 2014, thus contributing even less to the overall cumulative effects on birds. Compared to status quo (Alternative 1) Alternatives 3 and 4 would involve additional human disturbance associated with increased research and enhancement ground activities or aerial surveys than Alternative 1. However, the magnitude, intensity and duration of these effects are still considered minor given the low likelihood of interacting with these species and the temporary nature of the disturbance. Overall, the contribution to an adverse cumulative effect from any of the alternatives is considered negligible to minor.

4.7.7 CORALS

As described in Section 3.3.7, Coral, the Hawaiian Islands contain about 6,700 square miles of coral reef habitats, consisting of both shallow water species inhabiting waters less than 98 ft (30 m) and deep water species found in waters greater than 98 ft (30 m) (NMFS 2008b). NOAA has proposed listing three species of shallow water reef building corals in Hawaii as threatened under the Endangered Species Act: *Montipora patula/verrilli*, *Montipora dilitata/flabellata/turgescens*, and *Acroproa paniculata*. All three of these species occur in the Northwestern Hawaiian Islands, and *Montipora patula/verrilli* and *Montipora dilitata/flabellata/turgescens* occur in the Main Hawaiian Islands. These species are proposed as threatened due to a number of threats, with the most significant identified as ocean warming, coral disease, and ocean acidification as a result of climate change.

4.7.7.1 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON CORALS

Status Quo (Alternative 1) activities would have negligible adverse impacts on shallow water corals due to the strict protocols described for entering the NWHI under a Monument permit. Vessel anchors and chains have the potential to destroy corals and live rock. To mitigate this type of damage, mooring buoys are used in areas where frequent or extended anchoring is necessary. In addition, Monument regulations, codified under 40 CFR Part 404, prohibit anchoring on corals.

In order to conduct monk seal research and enhancement activities in the Monument, NMFS must obtain a permit from the Co-Trustees. The Monument permit (PMNM-2011-001 presented in Appendix L) dictates certain mitigation measures that are standard practice for NMFS when working in the area and also in the MHI. In addition to permit conditions and as described in Section 3.3.10.1 Monument Permitted Activities, there are several Monument BMPs that are designed to avoid, minimize or mitigate potential impacts (see Appendix L).

Monument Permit PMNM-2011-001 specifies measures to minimize impacts on corals due to boating:

- Anchoring of authorized vessels is allowed on non-coral substrate only, and anchors must be lowered slowly and carefully
- All vessels, engines, and anchor lines must be free of introduced species prior to entry into the monument
- Tenders and small vessels must be equipped with engines that meet EPA emissions requirements
- Specific measures are required for boat operations and diving activities to reduce or eliminate adverse effects on protected marine species (Monument BMP #004); and

- Special Conditions and Rules for Small Boat Operations are required at Tern Island (Monument BMP #013), which mandate specific notification and operator training.

Under the Status Quo, small boats (less than 20 ft) used by NMFS researchers conducting Hawaiian monk seal research and enhancement activities in areas with shallow corals include: Boston whalers, ridged hull Zodiacs, Zodiac and Achilles inflatables and personal watercraft. These small boats can be launched from larger ships to access the islands and conduct research or can be used for access between research locations. All small boats and the larger research vessels used by NMFS such as the NOAA R/V Oscar Elton Sette (224 ft), the R/V Searcher (97 ft), and the M/V Kahana (160 ft), would be required to follow all permit requirements, provisions, and BMPs to protect coral when working in the Monument. In the MHI, researchers do not anchor small boats. Thus, impacts to shallow or deep water corals under the status quo would be expected to result in negligible effects.

Alternative 2 (No Action) would result in no additional effects once the current permit expires in 2014 as no research and enhancement activities for Hawaiian monk seal would be permitted.

Alternative 3 (Preferred), which adds new activities with expanded scope and methods, has a slightly greater potential to impact shallow water corals as compared to Alternative 1 due to increased research activity and use of small boats. However, considering the strict guidelines described above for Alternative 1, which would also be in place under Alternative 3, the potential adverse effects of Alternative 3 on the corals would be negligible.

Alternative 4 will have a slightly greater potential impact than Alternative 3, again due (in part) to the additional use of small boats and possibly larger research vessels to translocate weaned pups between NHWI and MHI. However, any potential adverse effects on coral would likely be negligible due to the controls and mitigation measures already implemented by NMFS.

4.7.7.2 CUMULATIVE EFFECTS OF ALTERNATIVES ON CORALS

Considering that there would only be negligible direct and indirect effects are anticipated under any of the Alternatives, there would be no contribution of monk seal research and enhancement activities to a cumulative impact on coral species.

4.7.8 INVASIVE SPECIES

The Hawaiian Archipelago is home to many rare and endemic species of plants and animals, many of which are formally listed as endangered (under the ESA), protected (MMPA) and/or listed as a species of concern under various federal, state or international laws or agreements. Endemic species are particularly vulnerable to harm from the introduction of non-native species, for example,

through competition for resources (such as food and habitat), disease or predation.

The introduction of non-native species could have effects on plant and animal species endemic to the islands and atolls used for Hawaiian monk seal research and enhancement activities. The Hawai'i Invasive Species Council (HISC) identifies 46 high-profile invasive species/categories, of which only hull fouling species, algae and mussels, are of concern within the MHI (HISC 2010d). In the NWHI, there is special concern over the introduction and proliferation of non-native seeds, insects or other alien species such as snakes, rodents, dogs, cats and so forth, as wells as hull-fouling species (algae and mussels). Section 3.3.9 provides more detail on invasive species in the Hawaiian Archipelago relative to the proposed action and associated Project Area.

4.7.8.1 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON INTRODUCTION OF INVASIVE SPECIES

Research and enhancement on Hawaiian monk seals would likely result in minor or negligible effects pertaining to introduction of invasive species for the following reasons. Any increase in activity, especially within the NWHI, does increase the potential to introduce alien species. However, access to the Monument is limited and is contingent on the express permission of the Co-Trustees through the permitting process. Strict adherence to the special permit conditions and rules for the prevention of introduction of non-native species, as described in Appendix L of the Monument Permit, PMNM 2011-001, Attachment 13 *Disease and Introduced Species Prevention Protocol for Permitted Activities in the Marine Environment.* The Monument permit General Terms and Conditions sets out protocols and procedures to reduce the risk of the spread of non-native (invasive) species including the assurance that "…all vessels are inspected for potential introduced species prior to departing the last port before entering the Monument". In addition, NOAA Administrative Order (NAO) 216-6, Section 7.03 addresses the integration of EO 13112, Invasive Species, in the NOAA Decision-making process, requiring the agency to "…use authorities to prevent introduction of invasive species, respond to and control invasions in a cost effective and environmentally sound manner".

NMFS closely follows these precautions when conducting any research and enhancement activities in the NWHI, thus the potential for vessels or personnel to introduce non-native species would likely be minor, particularly given that field camps in the NWHI are seasonal, typically staffed between April to August. Camps are rarely re-supplied during the field season thereby further reducing the potential introduction of invasive species. Research and enhancement activities in the MHI are not likely to result in the spread of invasive species relative to numerous other activities in the region including recreation, fishing, ecotourism and general habitation of the area.

Alternative 1 (Status Quo) activities would not likely result in the spread of invasive species due to the strict protocols described for entering the NWHI under a Monument permit however the possibility still exists. Given the high population and level of ecotourism, recreation, fishing, and other human activities that have the potential to spread non-native species, the research and enhancement activities proposed would be expected to result in negligible effects as the introduction of invasive species because while it may be possible for research activities to introduce invasive species, the likelihood of this occurring is extremely low.

Alternative 2 (No Action) would result in negligible effects once the current permit expires in 2014 as no research and enhancement on wild monk seals would be permitted.

Alternative 3, which adds new activities with expanded scope and methods, has a slightly greater potential to introduce non-native species than Alternative 1 due to increased activity. Specifically, the translocation of seals from MHI to NWHI may increase the probability that alien species already established in MHI could be transferred to the Monument. However, considering the strict guidelines described above, the potential adverse effects of Alternative 3 on the spread of invasive species would be negligible because, as with Alternative 1, while it may be possible for research activities to introduce invasive species, the likelihood of this occurring is extremely low.

Alternative 4 could have only a slightly greater potential effect than Alternative 3, due to the potential increased transport between the MHI and NWHI. Still, the likelihood of cross-region transport would also be negligible because of the strict quarantines that apply and the fact that while it may be possible to introduce invasive species, the likelihood of this occurring is extremely low.

4.7.8.2 CUMULATIVE EFFECTS OF ALTERNATIVES ON INTRODUCTION OF INVASIVE SPECIES

Since none of the Alternatives would result in measurable introduction or spread of invasive species in Hawaii, no cumulative impacts on are anticipated.

4.8 Social And Economic Environment

4.8.1 COMMERCIAL FISHING

This section analyzes potential direct, indirect and cumulative effects of the alternatives on commercial fishing. The area of analysis focuses on nearshore areas surrounding the MHI. As discussed in Section 4.4.3 Impact Criteria for Socioeconomic Resources, given the restrictions on commercial fishing due to the Monument, effects of the alternatives on commercial fishing are unlikely in the NWHI. Therefore, this analysis focuses on the MHI.

Best available data for analyzing impacts of fisheries

The analysis of the effects of alternatives on fishing relies heavily upon a recently published report (Sprague et al. 2013). This publication evaluates nearshore fish biomass, monk seal biomass, monk seal consumption of fish, fishery landings and degree of overlap between monk seal prey selection and species targeted by fishers in the MHI. The analysis is primarily focused on shallow (up to 30 m depth) coral reef habitat. Sprague et al. (2013) used the best available data to estimate a reasonable mean or range for parameters such as biomass and consumption rates. In cases where there was considerable doubt or uncertainty, and hence a broad range of plausible values, the authors erred on the side of *over*-estimating the potential monk seal impacts (*e.g.*, population size or consumption rate), while *under*-estimating the available resources and human impacts (*e.g.*, available biomass or fishery landings). This approach ensures that conclusions represent a maximum estimate of potential monk seal impacts. This is particularly useful for the PEIS analysis in that it provides a worst-case scenario for impacts.

As mentioned above, analysis of potential impacts of alternatives on fishing was limited to nearshore areas. Monk seals forage almost entirely on the ocean floor in waters 200 m or shallower. However, information for estimating biomass of fishes potentially consumed by seals exists only for waters <30 m deep. As such, for this impact analysis, total estimated prey consumption of seals (foraging at all depths) is compared to fish biomass in waters < 30 m, which comprises only about 12% of the total habitat in which seals feed. As such, the estimated proportion of fish consumed by monk seals is greatly overestimated. For this and several other reasons explained in Sprague et al. (2013), conclusions about the impacts of seals on fisheries are exaggerated. It is also worth noting that some 95% of fishery landings in Hawaii are pelagic fishes and monk seals are not known to consume any of the fish species targeted by pelagic fisheries.

Details of the analysis can be found in Sprague et al. (2013), but the basic approach was to estimate and compare the following:

- Biomass of fish (at various levels of the food web- apex predatory fish, secondary consumers, herbivores, planktivore) in nearshore hard-bottom coral reef habitat to a depth of 30 m
- Biomass of monk seals in the MHI
- Rate at which monk seals of various age groups consume prey
- Rate at which apex predatory fish consume prey
- Commercial and recreational fishery

A liberal estimate of the total prey biomass consumed by an assumed population of 200 monk seals in the MHI is a maximum of 1,300 kg per day (2,900 lb per day); this is an average of about 15 lb per day per seal. In comparison, Sprague et al. (2013) conservatively estimate that apex predatory fish…consume a minimum of 66,000 kg/day (146,000 lb/day). Thus, these apex predatory fish consume at least 50 times more fish than the entire population of monk seals in the MHI.

landings
- Relative overlap between families of fish found in monk seal diet and caught in fisheries

Examples of how Sprague et al. (2013) systematically overestimated absolute and relative potential impacts of seals on fisheries include, but are not limited to:

- Available fish biomass estimate did not account for several areas, in particular, Penguin Bank, a submerged former shield volcano off the west end of Moloka'i (depth generally ranging from 40-100 m) that is frequently used by monk seals for foraging
- Monk seals are known to forage in depths beyond 30 m. The analysis considered only hard bottom coral reef out to 30 m depth, representing just 12% of the area over which monk seals may forage. The estimate of prey biomass is therefore much smaller than is actually available in the monk seal's MHI foraging range.
- The estimates of biomass density only measured fin fish density, although monk seals and other apex predatory fish are known to also consume invertebrates, and invertebrate biomass may be many times that of fin fishes.
- Values for monk seal prey consumption were inflated in several ways to account for uncertainty
- Using current methods, monk seal diet is only determined to the taxonomic level of family, rather than to species. So, while Sprague et al. (2013) report that both fishermen and monk seals may target certain *families* of fishes, it is possible that the actual *species* consumed by each within those families may not overlap. Furthermore, even when fisheries and monk seals consume the same species, there may be differences in the size of the prey, the area, and the depth over which those species are taken.

Effects of Alternatives on commercial fishing

Effects on commercial fishing could be anticipated if an action were to result in a change in profits for the commercial fishermen. A change in profits could not only affect fishermen's well-being and quality of life, but could have a larger effect on the economy of the area. Given that profit is a function of revenue and cost, profits for fishermen could decrease or increase if the cost associated with fishing increases or decreases and/or the revenue derived decreases or increases, respectively. Potential effects on costs associated with fishing are considered in terms of lost or damaged fish, lost or damaged gear, and lost fishing time and fuel costs (if vessels relocate to other fishing areas) due to the alternatives. This analysis addresses potential changes in revenues for commercial fishermen as a consequence of the alternatives. The indicator used to assess this change is the potential variation in commercial catch, both in terms of quantity and value, due to the alternatives, as presented in Table 4.4-6 in Section 4.4.3 Impact Criteria for Socioeconomic Resources.

The alternatives are not anticipated to result in any direct effects on commercial fishing. However, depending on the extent to which Hawaiian monk seals may prey on and reduce the population of certain fish species that are commercially viable, indirect effects on commercial fishing may be possible if an alternative results in a change in the MHI Hawaiian monk seal population, and that change in population, in turn, affects either cost to the commercial fishery or affects revenue through the level of commercial catch. On the other hand, some fish species may increase in population if Hawaiian monk seals consume predators or competitors of those species. These possible effects on commercial fishing revenues and costs are examined below.

Among commercial fisheries in Hawaii, the pelagic fishery is the largest and most valuable, accounting for about 95% of commercial landings with 26.6 million pounds of pelagic fish caught commercially in 2010 (WPacFin 2011). Monk seals are benthic (bottom) foragers and there is no evidence that they eat the species targeted by pelagic fisheries (see Section 3.3.1.5). Thus, it appears that there is no potential for monk seals to impact 95% of commercial fishery landings.

Sprague et al. (2013) report the following. Hawaiian monk seals are liberally estimated to consume 4% of body mass (adults), 6% (sub-adults), and 8% (juveniles) per day. A liberal estimate of the total biomass of prey consumed by a maximum current population of 200 monk seals in the MHI is approximately 1,300 kg per day (2,900 lb per day); this is an average of about 15 lb per day per seal. In comparison, Sprague et al. (2013) conservatively estimate that apex predatory fish (sharks and jacks present in just the nearshore waters out to 30 m depth in the MHI) consume a minimum 66,000 kg/day (146,000 lb/day). Thus, near-shore predatory fish alone consume at least 50 times more fish than does the entire assumed population of MHI monk seals.

Commercial fishery landings from 2003-2009 were reported by Sprague et al. (2013) and are reproduced here in Table 4.8-1 (adapted from DLNR commercial catch reports). A conservative estimate of commercial catch of species occurring within nearshore (up to 30 m depth) habitats (that is, after excluding mostly pelagic species that account for 95% of commercial landings), is 1,676 kg (3,969 lb) per day.

Total minimum estimated biomass of reef fish in the shallow water coral reef habitats of the MHI is 16,600,000 kg (36,600,000 lb) (Sprague et al. 2013). Thus, the daily consumption of the entire MHI monk seal population amounts to a *maximum* of 0.009% of the estimated available prey biomass. Because assumptions erred on the side of overestimating monk seal impacts, the true value is likely considerably even smaller.

Finally, Sprague et al. (2013) report that only 27% of reported commercial fishery landings (by weight, excluding pelagic species) are in the same fish families also found in monk seal diet. Or conversely, 73% of commercial nearshore landings

are from families of fish not eaten by monk seals and therefore not likely to be impacted by any increase in monk seal consumption. When pelagic commercial species are included, landings in fish families also eaten by monk seals only accounted for 1.3% of the total commercial catch.

For alternatives that are anticipated to result in an increase in Hawaiian monk seal population in the MHI, either through translocation or because of the long-term success of the enhancement actions, additional fish consumption by seals may occur. However, as noted above, only about 27% of the commercial nearshore landings are from the same families of fish eaten by Hawaiian monk seals. Further, a commercially viable fish that a monk seal may eat would not necessarily be available to fishermen. For example, those fish may instead be eaten by predatory fish (which, as noted above, conservatively consume at least 50 times more fish than the entire monk seal population). Seabirds and other marine mammals also may take such commercially targeted prey. Further, Hawaiian monk seals forage over a much wider range of areas than accounted for in the Sprague et al. (2013) analysis. Given these considerations, the percentage of commercial catch that might be consumed by seals present in the MHI due to research and enhancement activities would be even smaller than indicated by the above calculations.

Table 4.8-1. Commercial fishery landings reported to the State of Hawai'i DLNR from 2003 to 2009. All are sea landings reported in pounds (lbs). Families marked as "excluded" were not included in the analysis of biomass consumption relative to monk seals.

Family	Common Name	2003	2004	2005	2006	2007	2008	2009	Annual Average (lbs)	Daily Average (lbs)	Daily Average (kg)
Acanthuridae	Surgeonfishes	102,703	88,448	90,018	71,984	76,637	81,094	41,095	78,854	216	98
Albulidae	Bonefish	3,057	2,002	3,344	5,175	9,822	11,308	8,531	6,177	17	8
Balistidae	Triggerfishes	62	113	61	8	236	812	2,015	472	1	1
Carangidae	Akule/opelu	847,465	1,002,718	887,225	867,448	1,094,462	620,770	617,268	848,194	2,324	1,054
Carangidae	Jacks/ulua	82,304	84,383	58,442	39,480	70,828	61,079	58,347	64,980	178	81
Cephalopod	Octopods & squid	25,864	23,108	20,956	20,434	18,290	31,305	34,335	24,899	68	31
Crustacean	Crabs, lobsters, prawn	40,138	26,159	150,892	36,589	52,190	57,557	155,842	74,195	203	92
Elopidae	Ladyfish tarpon	823	430	581	1,106	1,407	408	1,642	914	3	1
Holocentridae	Squirrelfishes & soldierfishes	34,548	29,629	35,367	24,041	36,049	59,171	52,508	38,759	106	48
Kuhliidae	Flagtail	2,995	1,893	2,250	1,266	1,670	4,182	4,180	2,634	7	3
Kyphosidae	Sea chub	19,503	19,349	19,639	35,616	26,773	21,597	14,479	22,422	61	28
Labridae	Wrasses	6,532	6,094	3,761	4,965	4,611	6,026	7,645	5,662	16	7

Family	Common Name	2003	2004	2005	2006	2007	2008	2009	Annual Average (lbs)	Daily Average (lbs)	Daily Average (kg)
Lutjanidae	Snappers	1,789	3,387	1,851	2,381	2,645	3,460	4,223	2,819	8	4
Monacanthidae	Filefishes	906	3,590	407	741	595	454	0	956	3	1
Mugilidae	Mullet	9,239	8,171	7,785	8,369	11,329	9,740	8,560	9,028	25	11
Mullidae	Goatfishes	62,201	68,994	39,703	40,348	35,499	38,055	54,193	48,428	133	60
Muraenidae	Moray eels	59	124	85	101	250	483	1,864	424	1	1
Pomacentridae	Damselfishes	908	1,745	2,131	2,085	1,240	1,867	1,882	1,694	5	2
Priacanthidae	Bigeyes	3,209	14,117	5,541	2,987	4,842	3,843	2,752	5,327	15	7
Scaridae	Parrotfishes	35,506	32,049	32,573	30,387	40,094	44,806	50,475	37,984	104	47
Scorpaenidae	Scorpionfishes	3,348	2,972	3,279	2,713	2,303	2,053	3,641	2,901	8	4
Serranidae	Groupers, basslets, & anthias	49,052	44,292	48,214	31,443	29,203	23,226	25,742	35,882	98	45
Sphyraenidae	Barracuda	2,929	2,973	1,787	1,619	1,467	3,925	1,591	2,327	6	3
-	Misc. inshore fishes (incl. moi, mu, awa)	6,872	7,644	5,906	5,895	11,751	15,325	16,746	10,020	27	12
Subtotal		1,342,012	1,474,384	1,421,798	1,237,181	1,534,193	1,102,546	1,169,556	1,325,953	3,633	1,648

Family	**Common Name**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Annual Average (lbs)**	**Daily Average (lbs)**	**Daily Average (kg)**
EXCLUDED											
Family	Common Name										
Istiophoridae & Xiphiidae	Billfishes & swordfishes	3,029,870	2,294,177	4,655,440	4,038,122	5,470,247	6,406,085	5,967,862	4,551,686	12,470	5,656
Scombridae	Tunas	14,055,058	13,315,002	14,596,986	12,618,034	18,660,259	18,908,288	15,229,305	15,340,419	42,029	19,064
-	Corals	0	0	0	0	3,775	0	0	539	1	1
Lutjanidae, Serranidae, Berycidae, Carangidae	Deep bottomfishes	585,235	642,258	523,538	477,503	508,708	509,027	473,573	531,406	1,456	660
-	Misc. pelagic fishes	4,107,385	4,633,532	4,405,774	4,269,982	4,711,822	4,847,981	5,231,456	4,601,133	12,606	5,718
-	Other animals (*e.g.*, sea cucumber, limpet)	11,730	8,441	7,231	10,246	7,499	10,517	22,649	11,188	31	14
-	Seaweeds and limu	13,304	16,906	10,184	5,102	5,741	9,900	10,402	10,220	28	13
-	Sharks	203,253	142,289	193,450	177,205	370,349	337,043	297,078	245,810	673	305
-	Unclassified or misc	10,058	12,267	15,605	57,603	5,821	17,216	5,129	17,671	48	22
Subtotal		22,015,893	21,064,872	24,408,208	21,653,797	29,744,221	31,046,057	27,237,454	25,310,072	69,343	31,453
TOTAL		**23,357,905**	**22,539,256**	**25,830,006**	**22,890,978**	**31,278,414**	**32,148,603**	**28,407,010**	**26,636,025**	**72,975**	**33,101**

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If an alternative results in a change in the Hawaiian monk seal population in the MHI, indirect effects on commercial fishing may also include changes in costs due to the nature and number of interactions between fisheries and seals. Costs from such interactions can arise from: 1) damaged catch from depredation (*i.e.*, seals eating fish off fishing lines or hooks) by Hawaiian monk seals; 2) increased loss or damage of fishing equipment such as hooks; and 3) actions taken by commercial fishing to reduce interactions and harm to Hawaiian monk seals. For example, efforts to reduce interactions can result in increased fuel costs if fishermen relocate to avoid monk seals. In addition, if a fisherman brings gear aboard and stops fishing efforts to avoid a seal interaction, fishing time could be reduced (with potential associated reductions in catch).

The data available on the above interactions types between commercial fishing and Hawaiian monk seals are limited to NOAA observer reports from the NWHI and the MHI, as well as published studies from the 1990s in the NWHI. The NOAA bottomfish observer reports from the MHI from 2003 to 2005 did not record any interactions between Hawaiian monk seals and commercial fishing vessels (NOAA Fisheries Service, Pacific Islands Regional Office, Observer Program, Hawaii Bottomfish Quarterly and Annual Status Reports, 2003, 2004, 2005; accessed online at: http://www.fpir.noaa.gov/OBS/obs_hi_bf_rprts.html). Similarly, NOAA longline observer reports from 1994 to 2011 did not record any interactions between Hawaiian monk seals and commercial fishermen (Nitta and Henderson, 1993).

However, bottomfish observer reports from the NWHI in the early 1990s indicate that bottomfish-monk seal interactions occurred, on average, at a rate of one interaction per 34.4 hours fishing, with no recordings of damaged fish from interactions (Hale and Coon 1993, Nitta and Henderson 1993). A study of commercial bottomfish fishing in the NWHI did present evidence of damaged fish by Hawaiian monk seals. This study reported that the mean incident rate for fish damaged by NWHI monk seals was 0.45 damaged fish per 1,000 landed fish, or less than 0.05% of catch (Kobayashi and Kawamoto 1995). The study also estimated that NWHI monk seals may have stolen approximately 12.15 fish per 1,000 landed fish, with estimated gear costs for each fish lost of approximately $7.50 (in 2012 dollars).

While the data from the NWHI indicate that Hawaiian monk seals did interact with commercial bottomfish fishing in the 1990s, there are no observer data in the MHI documenting such interactions. The Hawaiian monk seal population in the NWHI during the 1990s was much larger than the current MHI seal population. That difference, and the lack of data on interactions in the MHI, suggest interactions between commercial fishing vessels and monk seals in the MHI resulting in costs to the fishery are likely rare.

4.8.1.1 *DIRECT AND INDIRECT EFFECTS ON COMMERCIAL FISHERIES OF ALTERNATIVE 1 – STATUS QUO*

Alternative 1 (Status Quo) entails the continuation of the current NMFS Research and Enhancement Permit (10137) until it expires in 2014. Following this date, subsequent permits would be issued to continue the research and enhancement activities that are currently permitted. For a complete description of permitted research under Alternative 1, please refer to Section 2.6 Alternatives Carried Forward for Analysis.

Alternative 1 is not anticipated to have any direct effects on commercial catch in the MHI. Under Alternative 1 (and all other alternatives), the Hawaiian monk seal population in the MHI is anticipated to increase due to the apparent favorable conditions for continued growth as evidenced by the demographics of the Hawaiian monk seal population (Baker *et al.* 2011*a*) independent of actions taken by NMFS. While this natural growth may be enhanced by Alternative 1 activities such as de-hooking, disentanglement, and weaned pup translocation measures, the contribution of Alternative 1 activities to any increase in the monk seal population would be marginal.

As discussed above, effects on commercial fishing could stem from changes in the quantity of fish, value of commercial catch, and costs to the fishery related to commercial fishing/Hawaiian monk seal interaction.

Indirect effects of Alternative 1 on commercial fishing could be possible if there were marked changes in the availability of commercially fished species and, consequently, the quantity of commercial catch, due to an increase in the Hawaiian monk seal population. Furthermore, commercial fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 1 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the nearshore MHI, and
- Only a fraction (27%) of that consumption potentially overlaps with commercially fished species, and
- Apex predatory fish likely consume over 50 times more prey than the entire monk seal population

Given those findings, any marginal increase in Hawaiian monk seal population due to Alternative 1 activities are anticipated to have negligible effects on commercial fishing.

Conclusion for Direct and Indirect Effects on Commercial Fisheries from Alternative 1 (Status Quo)

None of the research and enhancement activities permitted under Alternative 1 would directly affect commercial fishing in MHI. Therefore, direct effects are likely to be negligible. Given the small relative consumption rate of the entire Hawaiian monk seal population, the limited overlap between prey consumed by seals and species targeted by commercial fisheries, and the lack of data on interactions with the commercial fishing industry in the MHI, under Status Quo (Alternative 1) a marginal increase in the growth rate of the Hawaiian monk seal population that is already naturally increasing in the MHI is likely to result in negligible indirect adverse effects on commercial fishing.

4.8.1.2 DIRECT AND INDIRECT EFFECTS ON COMMERCIAL FISHERIES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Alternative 2 (No Action) entails the continuation of existing research as permitted under the existing permit (10137) until 2014. Once expired, these research and enhancement activities would cease. Unlike the activities under some other alternatives, there would be no field research to monitor populations, implement de-worming, or translocation.

Alternative 2 is not anticipated to have any direct effects on commercial fishing in the MHI. As noted above, demographic data suggest that the Hawaiian monk seal population in the MHI is anticipated to continue to increase regardless of the proposed alternatives. Under Alternative 2, given that most monk seal research and enhancement activities would cease after 2014, potential effects on commercial fishing under Alternative 2 would not likely occur.

Indirect effects of Alternative 2 on commercial fishing could be possible if there were marked changes in the availability of commercially fished species and, consequently, the quantity of commercial catch, due to increased Hawaiian monk seal population. Furthermore, commercial fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

Because most monk seal research and enhancement activities would cease after 2014 under Alternative 2, any increases to the monk seal population due to Alternative 2 would be even smaller than under Alternative 1. Thus, for all the reasons presented in the analysis of Alternative 1 above, the effects of Alternative 2 are anticipated to be negligible.

Conclusion for Direct and Indirect Effects on Commercial Fisheries from Alternative 2 (No Action)

Alternative 2 is not anticipated to either directly or indirectly affect commercial fishing in MHI. The overall effects of Alternative 2 are expected to be negligible.

4.8.1.3 *DIRECT AND INDIRECT EFFECTS ON COMMERCIAL FISHERIES OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

Alternative 3 entails the expansion of research and enhancement activities currently permitted, most of which are focused on improving the population status in the NWHI. The Alternative 3 expanded activities most relevant to the MHI are a vaccination program and behavioral modification activities. Vaccination could prevent Hawaiian monk seal population declines in the MHI if a disease outbreak occurs for which a safe and effective vaccine is available, and if a significant portion of the Hawaiian monk seal population can be vaccinated. Also, emergency response to a disease outbreak is already mandated under provisions of the MMPA's Marine Mammal Health and Stranding Response Program (MMHSRP) (Title IV, 16 U.S.C. 1421) and the permit held by the MMHSRP. Behavioral modification may also lead to marginal increases in the MHI monk seal population if seals with undesirable behaviors are able to remain in the wild. This would be expected to involve only very few seals. Importantly, behavioral modification is in part intended to reduce habitual seal interactions with fishing operations. If this effort succeeds, then Alternative 3 may *reduce* potential effects on fishing by minimizing interactions. Alternative 3 is not anticipated to have any direct effects on commercial fishing in the MHI.

> *Importantly, behavioral modification is in part intended to reduce habitual seal interactions with fishing operations. If this effort succeeds, then Alternative 3 may reduce potential effects on fishing by minimizing interactions.*

Indirect effects of Alternative 3 on commercial fishing could be possible if there were marked changes in the availability of commercially fished species and, consequently, the quantity of commercial catch, due to increased Hawaiian monk seal population. Furthermore, commercial fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 3 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the nearshore MHI, and

- Only a fraction (27%) of that consumption potentially overlaps with commercially fished species, and
- Apex predatory fish likely consume over 50 times more prey than the entire monk seal population

While Alternative 3 activities may marginally increase the Hawaiian monk seal population, behavioral modification activities may succeed in reducing seal interactions with fisheries. Given the findings of Sprague et al. (2013) coupled with the potential reduction in seal/fishery interactions, any marginal increase in the seal population due to Alternative 3 activities are anticipated to have negligible effects on commercial fishing.

Conclusion for Direct and Indirect Effects on Commercial Fisheries from Alternative 3 (Preferred Alternative)

None of the research and enhancement activities permitted under Alternative 3 would directly affect commercial fishing in MHI. Therefore, direct effects are likely to be negligible to none. A marginal increase in the MHI Hawaiian monk seal population growth rate due to Alternative 3, especially coupled with potentially reduced seal/fishery interactions due to behavioral modification, is not likely to result in an indirect adverse effect on commercial fishing. Therefore, this effect would likely be negligible.

4.8.1.4 DIRECT AND INDIRECT EFFECTS ON COMMERCIAL FISHERIES OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Alternative 4 entails expanded research and enhancement activities, most of which, as under Alternative 3, are focused on improving the population status in the NWHI. The Alternative 4 expanded activities most relevant to the MHI are potential two-stage translocation involving temporarily moving juvenile seals from the NWHI to the MHI, a vaccination program, and behavioral modification activities. It is anticipated that the benefit of Alternative 4 would primarily manifest as a reduction in the rate of decline in the NWHI as opposed to making significant contributions to the increase in MHI population growth that is naturally occurring (*i.e.,* without NMFS intervention). The proportion of seals temporarily translocated to the MHI under Alternative 4 would constitute a small proportion of the already naturally increasing seal population. Further, should the option to translocate seals from the NWHI to the MHI (allowed only under this alternative) be exercised, there would only be a temporary increase in the MHI population of monk seals due to that action because any translocated seals would be returned to the NWHI once they reached 2 or 3 years of age. Alternative 4 is not anticipated to result in any direct effects on commercial fishing in the MHI.

Indirect effects of Alternative 4 on commercial fishing could be possible if there were marked changes in the availability of commercially fished species and, consequently, the quantity of commercial catch, due to increased Hawaiian

monk seal population. Furthermore, commercial fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

Under this alternative, a maximum of 20 weaned pups per year could be translocated to the MHI from NWHI for the five-year permit period. Each group of monk seals would be returned to the NWHI once they reached 2 or 3 years of age. The maximum number of additional seals that would be present in a single year is 60 seals if it is assumed that:

- the maximum allowed number of juvenile monk seals per year (20) are translocated for at least 3 consecutive years;
- all of these are translocated from the NWHI to the MHI and not vice versa; and
- there is no mortality of translocated seals for three years;

While it is important to consider this scenario in order to understand what might happen if all of these seals survived, that would be very unlikely. A more realistic estimate of the maximum number of translocated monk seals in the MHI is derived by applying the survival rates of native-born MHI monk seals to translocated seals. Retaining the first two assumptions in the preceding bullets, this results in a projected maximum number of 51 additional seals. Again, while this analysis acknowledges that an additional 60 seals in these years would be unlikely, it uses this number (60) in order to present the greatest potential impact scenario for the purposes of evaluating potential effects on commercial fish in the MHI under Alternative 4.

Based upon the liberal consumption rates in Sprague et al. (2013) juvenile monk seals eat approximately 5 kg (11 lb) of prey per day. Therefore, the additional 60 juvenile monk seals that could potentially occur temporarily in the MHI under Alternative 4 would consume at most 60 x 5 = 300 kg (662 lb) of prey per day. This represents at most 0.0018% of the estimated standing biomass of reef fish in the nearshore habitats of the MHI. Furthermore, apex fish predators are estimated to consume at least 220 times as much as would these 60 potential juvenile monk seals. Interactions between the translocated seals and commercial fisheries could increase under Alternative 4, although as noted above, documentation of such interactions is lacking and they are likely to be very rare. However, as under Alternative 3, behavioral modification activities under Alternative 4, if successful, could mitigate fishery interactions with both translocated and seals native to the MHI. Given the exceedingly small potential increase in prey consumption, only part of which would potentially overlap with commercially targeted species, and the potentially marginal increase in fishery interactions (though mitigated by behavioral modification), overall Alternative 4 activities are anticipated to have negligible effects on commercial fishing.

Conclusion for Direct and Indirect Effects on Commercial Fisheries from Alternative 4 (Enhanced Implementation)

None of the research and enhancement activities permitted under Alternative 4 would directly affect commercial fishing in the MHI. Therefore, direct effects are likely to be negligible. A temporary and only marginal Hawaiian monk seal population increase within the MHI due to Alternative 4, combined with the implementation of behavioral modification tools, is not likely to result in an indirect adverse effect on commercial fishing. Therefore, this effect would likely be negligible.

4.8.1.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON COMMERCIAL FISHERIES

This section presents the cumulative effects on commercial fishing in the context of past actions and the RFFAs listed in Tables 4.5-1 and 4.5-2 respectively.

Summary of Direct and Indirect Effects on Commercial Fisheries

The alternatives are not anticipated to result in any *direct* effects on commercial fishing, given that the actions proposed (such as vaccinations, de-worming, translocation) will not likely occur in locations popular for fishing. However, *indirect* effects on commercial fishing may be possible if an alternative results in a change in Hawaiian monk seal population in the MHI, and the Hawaiian monk seal population, in turn, affects the commercial catch because Hawaiian monk seals may potentially prey on and reduce the population of certain fish species that are commercially viable. On the other hand, some fish species may increase in population if Hawaiian monk seals consume predators or competitors of those species.

Indirect effects on commercial fishing may be possible if an alternative results in a change in the Hawaiian monk seal population in the MHI, which, in turn, results in an increase in the number of seal-commercial fisheries interactions. However, the analysis suggests that the indirect effects of the alternatives on commercial fishing are likely to be negligible due to the marginal increase in the monk seal population expected, and implementation of behavioral management tools.

Direct and indirect effects of monk seal research and enhancement activities on commercial fisheries are evaluated in terms of potential increases or decreases in commercial catch. Table 4.8-2 summarizes the direct and indirect effects of the alternatives on commercial fisheries.

Table 4.8-2 Summary of Direct and Indirect Effects of the Alternatives on Commercial Fisheries

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Commercial Fisheries	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Commercial Fisheries

Past, present and reasonably foreseeable future actions that may affect commercial fisheries are summarized in Table 4.8-3.

Table 4.8-3 Effects of Past, Present and Reasonably Foreseeable Future Actions on Commercial Fisheries

Commercial Fisheries Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris	• Changes to fish habitat • Injury or mortality to fish • Changes in prey due to ecosystem shift • Changes in fish age class recruitment	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris by fish and affects habitat suitability.	-
Climate Change		• Subtropical Pacific ecosystem changes evident although modest relative to changes from increased fishing effort. However, future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011). • Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish populations are affected by these changes and can be both beneficial and adverse.	+/-
Introduction of Invasive species		• Parasites have been shown to be significant stressors in many species. Reif et al. (2006). • Invasive fish species introduced through ballast water may cause changes in fish population dynamics.	-
Predation by apex predatory fish nearshore (30m depth)	• Mortality of fish	• Apex predatory fish consume a minimum of 66,000 kg/day (146,000 lb/day) approximately 50 times more than a Hawaiian monk seal (Sprague et al. 2013).	-/+
Predation by Hawaiian monk seals nearshore (30m depth)	• Mortality of fish	• Estimated predation by 200 monk seals in MHI is approximately 1,300 kg per day (2,900 lb per day) (Sprague et al. 2013)	-/+
Military activities			

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Mortality of fish • Fish habitat destruction • Temporary or permanent area restrictions to fishing during training	• Possible yet unlikely temporary threshold shift (TTS) impact to fish sensory systems due to sonar and explosive detonations. • Potential strike or contamination by torpedo and ship training activities. • Possible entanglement of fish in parachute assemblies, remote. • Detonation and explosive ordinance impacts to fish (*i.e.*, mortality). • Detonation impacts of buoys and RIMPAC and USWEX to fish. • Impacts to fish to include TTS injury and mortality. • Degradation or destruction of feeding habitat by underwater detonations and training activities. • Possible, however unlikely, TTS impact to fish due to sonar and explosive detonations. • Potential strike or mortality by training activities. • Potential closure or fisheries restrictions in areas where training activities occur.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS)			
Commercial			
Unregulated fishing (1913 - 2002)	• Mortality of fish • Reproductive effects on fish	• Unregulated take, reducing long term sustainability of populations for future fisheries. • Long-term catch trends suggest that there has been approximately an 80 percent decline in the nearshore stocks this century. Overfishing is partially due to an increase in population, improved fishing technology, improved gear, and failure to recognize or follow traditional conservation practices. Additionally, the number of commercial permits issued to collect reef fish increased by 39 percent between 1995 and 1998 (NOAA 2013).	-
Sea cucumber harvest (1882)			
Black-lipped oyster harvest (1928-1930)			
Lobster harvest (1970-1999)			

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Commercial bottomfish fisheries	• Changes in fisheries catch/landings • Overharvest • Fish mortality or injury	• 1948 – 1978: number of trips per year per fishermen increased and has remained about 8 trips per year between 1980 and 2004. Data suggest there are more fishermen catching fewer fish. • Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006).	-
Commercial pelagic fisheries		• 1996-2006: Increased fishing effort with number of hooks set increasing four-fold. Catch rates for apex predators such as blue shark, bigeye and albacore tunas, shortbill spearfish, and striped marlin declined from 3 to 9% per year while catch rates for mahimahi, sickle pomfret, escolar, and snake mackerel, increased by 6 to 18% per year (Polovina 2009). • 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). Decreased catch rates for large fishes has continued through at least 2011 (Polovina 2011). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013).	-/+
Recreational and subsistence fisheries		• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • Limited data on subsistence harvest of fish species in Hawaii make estimating harvest levels difficult. • 2013: daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) • Widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander et al. 2004).	
Inter-Island Transmission Cable	• Disturbance to fishing vessels	• Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to fish may occur while laying the cable, including entanglement and mortality.	-

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Special Coral Reef Ecosystem Fishing Permit to Kampachi Farms, LLC	• Aggregation of pelagic fish	• Culture and harvest a coral reef ecosystem management unit fish species kampachi (Seriola rivoliana, marketed as Kona Kampachi[supreg]) in a floating pen moored about 5.5 nm off the west coast of the Island of Hawaii in about 6,000 ft of water. A 132m [supcaret] 3 (approximately 21 feet in diameter) brass-link mesh aquapod (CuPod) tethered to a moored, 28-ft feed vessel would be used for harvesting. • Fishermen would be able to fish around the array. The small size of the array is not expected to have a large adverse impact on catches by other fishermen in the ocean in west Hawaii.	-
Wai`anae Wastewater Treatment Plan Modification Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Water quality improvements	• Wastewater treatment plant improvements would generally be expected to reduce contaminants and biological waste streams entering the coastal ecosystem. Thus, minimizing exposure of fish species to contaminants and biological waste would result in improvements in habitat and would likely be beneficial for fish.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices also widely impact coral reef habitat. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013).	-
Other Government Activities			
Hawai`i Environmental Justice Bill: Senate Bill 2145 EO 12898: Environmental Justice	• Protection of minority interests in fisheries	• To the extent that minority populations rely on fisheries (commercial, subsistence or recreational) for income or for food, protection of minorities from projects that may cause disproportionate impacts would result in benefits to these groups.	+

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	• Closed fishery	• 2006: regulations prohibited commercial fishing, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). • 2009 remaining permit holders surrendered permits to NMFS in exchange for compensation from Federal Government and fishery was closed. Total NWHI bottomfish catch in 2009 was 29 metric tons.	-
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Habitat protection for fish • Redistribution of fishing activities to other areas	• No new fishing regulations would result from designating potential time-area closures for human activities such as wildlife viewing, swimming, boating, or fishing. Fishing activities may move to other areas where no time-area closures are in effect though overall this is not expected to reduce fish catch. • Fish populations may benefit from spinner dolphin protection measures due to potential time-area closures in bays around the MHI; potential additional protection of habitat; added recruitment could benefit fisheries.	+
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Reduction in marine debris	• Reduction in marine debris could reduce mortality or entanglement of fish. • Marine debris affects fish via ingestion (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). • Potential reduction in debris entanglement in commercial fishery nets.	+
Removal of marine debris from high entanglement zones	• Mortality • Injury		
Hawaiian Monk Seal Critical Habitat Designation	• Habitat protection	• No new fishing regulations would result from designating Hawaiian monk seal critical habitat. • Fish populations may benefit from Monk Seal Habitat designation due to the additional protection of habitat; added recruitment will benefit fisheries.	+

Hawaiian Bird Cumulative Actions and Events			
Action / Event	**Potential Effects**	**Description/Example**	**Effect**
Fishery Ecosystem Plan for the Hawai`i Archipelago	• Mortality • Prey availability	• Fishery plan may promote more stable prey resources. • Researchers may enhance habitat for fish when they remove marine debris during field activities. Marine debris affects fish via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on fish.	+ / -
Measures to End Bottomfish Overfishing in the Hawaiian Archipelago	• Indirect mortality • Prey availability	• Fishery plan may promote more stable prey resources.	+
Bottomfish and Seamount Groundfish Fisheries Management Plan (2005)	• Indirect mortality • Prey availability	• Fishery plan promotes more sustainable management of stocks and promotes stable prey resources.	+
Pilot Aquaculture Project (Tuna cultivation)	• Mortality • Disease • Genetic effects • Pollution	• Potential reduction in pressure on wild fish populations. • Escapement could impact native populations through disease and dilution of locally adaptive gene complexes, disrupt natural ecosystems and jeopardize recovery of depleted or endangered species. • Aquaculture facility can carry excessive nutrients, particulates, bacteria, other diseased organisms and polluting chemicals	+/-

Cumulative Effects Conclusion for Commercial Fisheries

The direct and indirect effects on commercial fisheries associated with the Hawaiian monk seal research and enhancement alternatives are negligible because proposed activities would not result in changes to landings. Thus, the contribution of monk seal research and enhancement to an overall cumulative effect from any of the alternatives is considered negligible.

Documented historical overfishing in the NWHI and MHI has adversely affected fish populations around Hawaii as shown in Table 4.7-11. The effects of ongoing subsistence and recreational fishing are not well understood due to lack of licensing requirements and reporting of catch. Though it is difficult to determine the level of catch for recreational and subsistence fisheries, Sprague et al (2013) reported that daily near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) compared to daily commercial nearshore catch of 1676 kg. In addition, Friedlander et al. 2004 stated that it is widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear. Based on these assumptions, there may be competition for fish between commercial and recreational/subsistence fisheries that may influence commercial landings. Notable fisheries management actions in the past have ended bottomfish overfishing in the MHI and FEPs for various fisheries would be expected to have beneficial effects on fish populations and therefore, could result in beneficial indirect effects on commercial catch.

Fisheries regulations, such as plans to end bottomfish overfishing in the Hawai‘i Archipelago, could indirectly affect recreational fishing, as commercial bottomfish fishermen will seek alternatives to supplement their incomes. This could result in changes in the populations of other fish species, including those popular for recreational fishing. The management measures considered in the "Draft Supplemental Environmental Impact Statement – Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region – Measures to End Bottomfish Overfishing in the Hawai‘i Archipelago" (March 2006), which supplements the May 2005 Final Environmental Impact Statement, target a 15% or greater reduction in bottomfish fishing mortality in the MHI (except for the no action alternative). Alternatives include area closures, seasonal closures, catch limits, and combinations of the three.

In addition to this, the Western Pacific Regional Fishery Management Council is implementing "ecosystem-based" approaches to fishery management in the Hawaiian Archipelago. This is a move from the "species-based' approach. Notable RFFAs in this context are "Fishery Ecosystem Plan for the Hawaiian Archipelago" (September 2009) and "Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region" (December 2005). Examples of

implementation measures under these plans include, among others, ecosystem boundaries, area closures, size restrictions, seasonal closures, gear restrictions, etc. In 2012, WPFMC approved a 6% increase in bottomfish quota due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2012).

Effects of development, pollution, and human modifications of the coastal environment have all had adverse effects on fish populations and, thus, fisheries due to changes in overall fish habitat conditions. The local and global economic recession in recent years resulted in a reduction of fish exports by commercial fishermen, leading to reduced commercial catch. As the economy is beginning to recover, commercial catch is trending upwards and more tourists are visiting the MHI, which may increase recreational and subsistence fishing pressure.

Other ongoing federal government management actions to protect and enhance monk seal populations and other protected species such as spinner dolphins in the nearshore environment around Hawaiʻi could result in limited access to certain nearshore fisheries though this cannot be confirmed at this time as management measures are still being developed by NMFS. That said, designation of Hawaiian monk seal habitat is not anticipated to result in changes to fishing regulations. Protection of monk seal habitat may result in benefits to nearshore fish species through improved overall habitat protection and better recruitment. Whether this would be of benefit to commercial fisheries cannot be determined at this time.

Similar benefits could result from spinner dolphin protection measures such as time-area closures. Time-area closures however could result in limiting access to specific areas in bays around Hawaii. However, these potential spinner dolphin measures would not preclude fishermen from fishing in other areas where there were no closures thus the potential adverse effects of closures would likely be minimal.

Actions listed in Table 4.8-3 provide some overall perspective on actions and events that have had or could have effects (direct, indirect or cumulative) on commercial fisheries. While the net effects on subsistence fishing from past and future actions are not known, Hawaiian monk seal research and enhancement actions are not likely to result in anything but negligible direct, indirect or cumulative effects on commercial fisheries.

4.8.2 SUBSISTENCE FISHING

This section addresses the potential direct, indirect and cumulative effects of the alternatives on subsistence fishing. The analysis focuses on the nearshore areas surrounding the MHI. Sprague et al. (2013, see also Section 3.4.4 Subsistence Fishing) noted that in Hawaiʻi the line between recreational and subsistence fishing is blurred, and there is little collection of data to differentiate between the two. There is no saltwater fishing license for recreational or subsistence fishing,

and no requirement to report recreational catch in the State of Hawai'i. As a result, the data on recreational fishery landings are very limited, voluntarily reported and are often considered biased or incomplete, representing a minimum estimate of extraction. Despite these data shortcomings, effects on subsistence fishing are nevertheless evaluated separately from recreational fishing (Section 4.8.3) because the types of effects may be different, owing to the intent of these non-commercial fishing activities (for subsistence versus for recreation).

Fish are an important part of the diet for the people of Hawai`i, with about 90 pounds per capita consumed annually, over twice the national average. Some fish species also have cultural significance for Native Hawaiians. Effects on subsistence fishing could be expected if an action results in changes in fish consumption by Hawaiian residents and, therefore, affects not only their well-being and quality of life, but also has a larger effect on their way of life and identity. As per Table 4.4-6 in Section 4.4.3, these effects are measured through looking at any changes in the quantity of fish consumed.

One factor that could potentially affect consumption is change in access to fishing areas, especially for onshore and nearshore fishing, as many Hawaiians tend to fish close to their homes for subsistence purposes. None of the alternatives propose any area closures or other seasonal or catch restrictions. Another factor that may result in altering fish consumption is change in the amount of fish caught due to less fish available. This is examined in more detail below.

The alternatives are not anticipated to result in any direct effects on subsistence fishing. However, indirect effects on subsistence fishing may be possible if an alternative results in a change in Hawaiian monk seal population in the MHI, and the Hawaiian monk seal population, in turn, affects the quantity of fish caught for subsistence purposes because Hawaiian monk seals may potentially prey on and reduce the population of certain fish species that are consumed by subsistence fishers. On the other hand, some fish species may increase in population if Hawaiian monk seals consume predators or competitors of those species.

It is widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander *et al.* 2004). Consistent with this, Sprague et al. (2013) obtained recreational (and subsistence, because there is no formal distinction between these in the available data) landings summaries from the Hawaii Marine Recreational Fishing Survey from 2003 to 2011. They considered only landings from shore or from within 3 miles of shore (in order to exclude pelagic fishes) and excluded pelagic species and sharks caught within 3 mi of shore, thereby excluding 90% of the reported recreational fishery catch. While daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Table 4.8-

3). Sprague et al. (2013) note that commercial fishery landings data come from mandatory reports of daily fishing activity, while subsistence/recreational fishery landings data are from voluntary surveys. Both methods may underreport the actual catch, but there is likely greater accuracy in the commercial data. In particular, reported near-shore recreational landings from spear-fishing and shoreline fishing may not be as well-represented as boat-based landings. Fish families found in the monk seal diet accounted for only 39% of reported recreational/subsistence fishery landings (by weight, excluding pelagic species). Or conversely, 61% of nearshore landings are from fish families not eaten by monk seals and therefore not likely to be impacted by any increase in monk seal consumption. Sprague et al. (2013) note that with better information on the actual (versus reported) fishery catch, this estimate over monk seal dietary overlap with fisheries could be refined in the future.

The uncertainty in data on subsistence fishery landings makes it more difficult to assess the potential impacts of the alternatives. However, even the likely underestimated amount of fish (2178 kg per day) extracted by nearshore subsistence and recreational fishing is considerably higher than the relatively reliable estimate (1676 kg) of nearshore fish extracted by commercial fisheries. It is clear, then, that the amount of fish eaten by Hawaiian monks seals is relatively smaller when compared to the subsistence/recreational catch than when compared to the commercial catch. Therefore, the analyses in Section 4.8.1, which found negligible impacts of alternatives on commercial fishing as a result of potential increases in the rate of MHI monk seal population growth, are likewise applicable to subsistence fishing.

As described in Section 4.8.1 for commercial fishermen, subsistence fishermen could be affected by Hawaiian monk seal interactions resulting from increased costs from damages to their catch or gear due to depredation of fishing lines or hooks by seals. Additionally, subsistence fishermen who fish from boats could bear additional costs resulting from idle time or additional fuel costs incurred from efforts to avoid interactions with seals. Thus, alternatives that may change the frequency of monk seal interactions could affect subsistence fishing.

Table 4.8-4. Recreational fishery landings reported in the Hawaii Marine Recreational Fishing Survey from 2003 to 2011 (from Sprague et al. 2013). All are landings from shore or from <3 miles from shore reported in pounds (lb). Families marked as "excluded" were not included in the analysis of biomass consumption.

Family	Common Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	Annual Average (lbs)	Daily Average (lbs)	Daily Average (kg)
Abulidae	Bonefishes	8,508	259,526	60,409	214,624	38,330	97,764	88,143	40,675	29,288	93,030	255	116
Acanthuridae	Surgeonfishes	135,661	73,859	158,062	87,556	7,676	7,906	23,473	85,519	111,922	76,848	211	96
Balistidae & Monacanthidae	Triggerfishes & filefishes	0	0	0	0	0	0	0	0	0	0	0	0
Carangidae	Jacks	605,420	863,082	873,702	1,696,371	334,223	716,651	407,169	489,651	562,817	727,676	1,994	904
Chaetodontidae	Butterflyfishes	0	0	0	0	0	0	0	0	0	0	0	0
Cirrhitidae	Hawkfishes	0	2,546	11,158	3,565	1,858	0	0	1,012	0	2,238	6	3
Clupeidae	Herrings	0	0	0	0	0	0	0	0	0	0	0	0
Elopidae	Tarpon	0	0	0	4,658	0	0	0	0	0	776	2	1
Engraulidae	Anchovies	8,433	503	0	0	0	0	0	0	0	1,117	3	1
Holocentridae	Squirrelfishes & soldierfishes	15,708	0	3,519	6,376	2,480	25,058	0	14,531	2,039	7,746	21	10
Kuhliidae	Flagtails	176,581	29,778	69,080	75,246	10,615	32,304	5,551	5,390	3,219	45,307	124	56
Kyphosidae	Sea chubs	587,756	4,751	8,684	1,274	0	0	0	0	13,543	68,445	188	85

Family	Common Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	Annual Average (lbs)	Daily Average (lbs)	Daily Average (kg)
Family	**Common Name**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Annual Average (lbs)**	**Daily Average (lbs)**	**Daily Average (kg)**
Labridae	Wrasses	137,096	226,437	186,500	86,192	22,002	529	0	41,469	18,402	79,847	219	99
Lutjanidae	Snappers	276,744	701,001	358,224	189,597	247,991	201,178	105,147	352,662	159,418	287,996	789	358
Mugilidae	Mullets	13,880	47,723	2,809	1,933	6,243	0	0	52,366	8,836	14,866	41	18
Mullidae	Goatfishes	250,189	360,749	75,621	189,917	134,687	70,610	32,950	77,173	14,630	134,058	367	167
Muraenidae, Ophichthidae, Ophidiidae, Congridae	Eels	0	0	0	0	0	0	0	0	0	0	0	0
Pleuronectidae	Flounders	0	0	0	0	0	0	0	0	0	0	0	0
Pomacentridae	Damselfishes	3,929	22,053	26,797	29,974	8,159	1,823	0	0	0	10,304	28	13
Scorpaenidae	Scorpionfishes	4,253	3,239	10,364	1,186	6,303	5,873	0	1,422	0	4,080	11	5
Serranidae	Sea basses	16,583	3,316	10,776	7,582	4,458	0	0	825	7,835	5,708	16	7
Sphyraenidae	Barracudas	15,130	45,349	26,599	1,894	0	9,319	4,850	2,996	2,518	12,073	33	15
Tetraodontidae	Puffers	0	0	0	0	0	0	0	0	0	0	0	0
-	Other fishes	1,232	197,979	1,225,586	94,192	7,485	5,313	11,713	35,428	45,219	180,461	494	224

Family	Common Name	2003	2004	2005	2006	2007	2008	2009	2010	2011	Annual Average (lbs)	Daily Average (lbs)	Daily Average (kg)
Subtotal		**2,257,103**	**2,841,890**	**3,107,888**	**2,692,139**	**832,511**	**1,174,328**	**678,997**	**1,201,119**	**979,687**	**1,752,576**	**4,802**	**2,178**
Family	**Common Name**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Annual Average (lbs)**	**Daily Average (lbs)**	**Daily Average (kg)**
EXCLUDED													
Coryphaenidae	Mahi mahi	757,212	274,801	310,547	416,585	313,067	240,116	223,562	85,976	117,023	304,321	834	378
Scombridae	Tunas & mackerels	4,195,789	932,788	1,071,461	656,714	458,733	558,609	774,013	880,979	481,632	1,112,302	3,047	1,382
-	Sharks	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal		4,953,001	1,207,589	1,382,008	1,073,299	771,800	798,725	997,575	966,955	598,656	1,416,623	3,881	1,760
TOTAL		**7,210,104**	**4,049,479**	**4,489,896**	**3,765,438**	**1,604,311**	**1,973,053**	**1,676,572**	**2,168,074**	**1,578,343**	**3,169,199**	**8,683**	**3,938**

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In contrast to commercial fisheries, for which there is little or no evidence of monk seal interactions in the MHI, seals frequently interact with non-commercial fisheries (subsistence and recreational). Unequivocal evidence of interactions includes the numerous seal hookings on non-commercial gear in recent years as well as entanglements in gillnets (laynets) (see Section 3.3.1.7). A minimum of 15 monk seals were hooked or entangled in gillnet in 2012 in a population of approximately 200 seals. From the perspective of the monk seal population, that is a relatively high rate of interaction, especially considering that many interactions that involve hooking or entanglement are likely not observed, not reported or not confirmed. The number of interactions that do not result in hooking or entanglement may be far greater.

In contrast, there are a relatively high number of subsistence fishermen compared to the MHI monk seal population of approximately 200 seals, so that the likelihood of any one fishermen experiencing interactions with seals is probably quite low. However, at meetings and through the public comment process, fishermen have reported that they believe monk seal interactions are becoming more frequent. This is not unexpected given that the MHI monk seal population is increasing naturally. Unfortunately, there are currently no data to indicate the frequency, nature, cost or outcome of monk seal interactions with subsistence fishing in the MHI. It is important to recognize that the current level of interactions or impact of monk seals is considered the baseline state, and the analysis below focuses specifically on the impact of the alternatives, rather than on the overall potential impact of monk seals on subsistence fishing. The MHI monk seal population is growing naturally, irrespective of any PEIS alternative. The crux of the analysis is whether the alternatives will be likely to increase or decrease any impacts on subsistence fishing beyond those that will occur regardless of the alternatives.

4.8.2.1 DIRECT AND INDIRECT EFFECTS ON SUBSISTENCE FISHING OF ALTERNATIVE 1 – STATUS QUO

Alternative 1 (Status Quo) entails the continuation of the current NMFS Research and Enhancement Permit (10137) until it expires in 2014. Following this date, subsequent permits would be issued to continue the research and enhancement activities that are currently permitted. For a description of permitted research under Alternative 1, please refer to Section 2.7.

Alternative 1 is not anticipated to have any direct effects on subsistence fishing in the MHI. Indirect effects of Alternative 1 on subsistence fishing could be possible if there were marked changes in the availability of species fished for subsistence and, consequently, the quantity of subsistence catch, due to increased Hawaiian monk seal population resulting from Alternative 1. Furthermore, subsistence fishing could be affected by Hawaiian monk seal interactions that could increase costs from damages to catch and gear. Additionally, fishermen could bear

additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 1 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the near-shore MHI, and
- Only a portion (39%) of that consumption potentially overlaps with fish families fished for subsistence, and
- Apex predatory fish likely consume over 50 times more prey than the entire monk seal population

Also, the nearshore subsistence/recreational catch is considerably larger than the nearshore commercial catch. Therefore, any hypothetical additional fish consumption by monk seals associated with marginal increases in the monk seal population due to Alternative 1, would likely represent a smaller portion of the subsistence catch compared to the commercial catch. Given all these findings, any marginal increase in Hawaiian monk seal population due to Alternative 1 activities are anticipated to have negligible effects on subsistence fishing.

Conclusion for Direct and Indirect Effects on Subsistence Fishing from Alternative 1 (Status Quo)

None of the research and enhancement activities permitted under Alternative 1 would directly affect subsistence fishing in MHI. Therefore, direct effects are likely to be negligible. Marginal increases in the Hawaiian monk seal population growth rate in the MHI could possibly have an indirect adverse effect on subsistence fishing due to possible decreases in fish caught for subsistence purposes or increases in interactions with monk seals that damage catch or gear. However, this effect is likely to be negligible.

4.8.2.2 DIRECT AND INDIRECT EFFECTS ON SUBSISTENCE FISHING OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Alternative 2 (No Action) entails the continuation of existing research as permitted under the existing permit (10137) until 2014. Once expired, these research and enhancement activities would cease. Unlike the activities under some other alternatives, there would be no field research to monitor populations, implement de-worming, or translocation.

The Hawaiian monk seal population in the MHI is anticipated to continue to increase regardless of the proposed alternatives. Under Alternative 2, given that most monk seal research and enhancement activities would cease after 2014, changes in the monk seal population due to Alternative 2 would be unlikely. Consequently, any potential indirect effects on subsistence fishing associated with Alternative 2 are also unlikely. As discussed above, indirect effects on

subsistence fishing could stem from changes in the quantity of fish caught for subsistence purposes, leading to modifications in the amount of fish consumed. Furthermore, effects on subsistence fishing could stem from a change in the number of interactions between subsistence fishing and Hawaiian monk seals.

Alternative 2 is not anticipated to have any direct effects on subsistence fishing in the MHI. Because Alternative 2 is not likely to result in more than extremely marginal changes in the MHI monk seal population, indirect effects of Alternative 2 on subsistence fishing due to either additional fish consumption by seals or additional seal interactions with the fishery, are expected to be negligible.

Conclusion for Direct and Indirect Effects on Subsistence Fishing from Alternative 2 (No Action)

Alternative 2 is not anticipated to directly or indirectly affect subsistence fishing in MHI. The overall effects of Alternative 2 are expected to be negligible.

4.8.2.3 DIRECT AND INDIRECT EFFECTS ON SUBSISTENCE FISHING OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)

Alternative 3 entails the expansion of research and enhancement activities currently permitted, most of which are focused on improving the population status in the NWHI. The Alternative 3 expanded activities most relevant to the MHI are a vaccination program and behavioral modification activities. Vaccination could prevent Hawaiian monk seal population declines in the MHI if a disease outbreak occurs for which a safe and effective vaccine is available, and if a significant portion of the Hawaiian monk seal population can be vaccinated. Also, emergency response to a disease outbreak is already mandated under provisions of the MMPA's Marine Mammal Health and Stranding Response Program (MMHSRP) (Title IV, 16 U.S.C. 1421) and the permit held by the MMHSRP. Behavioral modification may also lead to marginal increases in the MHI monk seal population if seals with undesirable behaviors are able to remain in the wild. This would be expected to involve only very few seals. Importantly, behavioral modification is in part intended to reduce habitual seal interactions with fishing operations. If this effort succeeds, then Alternative 3 may *reduce* potential effects on fishing by minimizing interactions. Alternative 3 is not anticipated to have any direct effects on subsistence fishing in the MHI.

Indirect effects of Alternative 3 on subsistence fishing could be possible if there were marked changes in the availability of species fished for subsistence and, consequently, the quantity of subsistence catch, due to increased Hawaiian monk seal population. Furthermore, subsistence fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 3 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the nearshore MHI, and
- Only a portion (39%) of that consumption potentially overlaps with species fished for subsistence, and
- Apex predatory fish likely consume over 50 times more prey than the entire monk seal population

Also, the nearshore subsistence/recreational catch is considerably larger than the nearshore commercial catch. Therefore, any hypothetical additional fish consumption by monk seals associated with marginal increases in the monk seal population due to Alternative 3, would likely represent a smaller portion of the subsistence catch compared to the commercial catch. Finally, while Alternative 3 activities may marginally increase the Hawaiian monk seal population, behavioral modification activities may succeed in reducing seal interactions with fisheries. Given all these findings, any marginal increase in Hawaiian monk seal population due to Alternative 3 activities are anticipated to have negligible effects on subsistence fishing.

Conclusion for Direct and Indirect Effects on Subsistence Fishing from Alternative 3 (Preferred Alternative)

None of the research and enhancement activities permitted under Alternative 3 would directly affect subsistence fishing in the MHI. Therefore, direct effects are likely to be negligible. A marginal increase in the Hawaiian monk seal population growth rate in the MHI due to Alternative 3 is not likely to result in an indirect adverse effect on subsistence fishing, especially coupled with actions designed to reduce fishery interactions. Therefore, this effect would likely be negligible.

4.8.2.4 DIRECT AND INDIRECT EFFECTS ON SUBSISTENCE FISHING OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Alternative 4 entails expanded research and enhancement activities, most of which, as under Alternative 3, are focused on improving the population status in the NWHI. The Alternative 4 expanded activities most relevant to the MHI are potential two-stage translocation involving temporarily moving juvenile seals from the NWHI to the MHI, a vaccination program, and behavioral modification activities. It is anticipated that the benefit of Alternative 4 would primarily manifest as a reduction in the rate of decline in the NWHI as opposed to making significant contributions to the increase in MHI population growth that is naturally occurring (*i.e.,* without NMFS intervention). The proportion of seals temporarily translocated to the MHI under Alternative 4 would constitute a small proportion of the already naturally increasing seal population. Further,

should the option to translocate seals from the NWHI to the MHI (allowed only under this alternative) be exercised, there would only be a temporary increase in the MHI population of monk seals due to that action because any translocated seals would be returned to the NWHI once they reached 2 or 3 years of age. Alternative 4 is not anticipated to result in any direct effects on subsistence fishing in the MHI.

Indirect effects of Alternative 4 on subsistence fishing could be possible if there were marked changes in the availability of species fished for subsistence and, consequently, the quantity of subsistence catch, due to increased Hawaiian monk seal population. Furthermore, subsistence fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

Under this alternative, a maximum of 20 weaned pups per year could be translocated to the MHI from NWHI for the five-year permit period. Each group of monk seals would be returned to the NWHI once they reached 2 or 3 years of age. The maximum number of additional seals that would be present in a single year is 60 seals if it is assumed that:

- the maximum allowed number of juvenile monk seals per year (20) are translocated for at least 3 consecutive years;
- all of these are translocated from the NWHI to the MHI and not vice versa; and
- there is no mortality of translocated seals for three years;

While it is important to consider this scenario in order to understand what might happen if all of these seals survived, that would be very unlikely. A more realistic estimate of the maximum number of translocated monk seals in the MHI is derived by applying the survival rates of native-born MHI monk seals to translocated seals. Retaining the first two assumptions in the preceding bullets, this results in a projected maximum number of 51 additional seals. Again, while this analysis acknowledges that an additional 60 seals in these years would be unlikely, it uses this number (60) in order to present the worst-case scenario for the purposes of evaluating potential effects on commercial fish in the MHI under Alternative 4.

Based upon the liberal consumption rates in Sprague et al. (2013) juvenile monk seals eat approximately 5 kg (11 lb) of prey per day. Therefore, the additional 60 juvenile monk seals that could potentially occur temporarily in the MHI under Alternative 4 would consume at most 60 x 5 = 300 kg (662 lb) of prey per day. This represents at most 0.0018% of the estimated standing biomass of reef fish in the nearshore habitats of the MHI. Furthermore, apex predatory fish are estimated to consume at least 220 times as much as would these 60 potential juvenile monk seals. Interactions between the translocated seals and subsistence fishing could increase under Alternative 4, although as noted above, data are

lacking to quantify the current level of interaction. Likewise, it is not possible to reliably predict how much those interactions might increase due to the potential temporary addition of 60 juvenile seals to the population. It is reasonable to expect that some of those additional seals would interact with fisheries, though the associated cost of those interactions to the fishermen is not known. However, as under Alternative 3, behavioral modification activities under Alternative 4, if successful, could mitigate fishery interactions with both translocated and seals native to the MHI. Given the exceedingly small potential increase in prey consumption, only part of which would potentially overlap with species fished for subsistence, and the potential increase in fishery interactions (though mitigated by behavioral modification), overall Alternative 4 activities are anticipated to have negligible effects on subsistence fishing.

Conclusion for Direct and Indirect Effects on Subsistence Fishing from Alternative 4 (Enhanced Implementation)

None of the research and enhancement activities permitted under Alternative 4 would directly affect subsistence fishing in the MHI. Therefore, direct effects are likely to be negligible. A temporary increase in the MHI monk seal population due to Alternative 4 is not likely to result in an indirect adverse effect on subsistence fishing. Therefore, this effect would likely be negligible.

4.8.2.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON SUBSISTENCE FISHING

This section presents the cumulative effects on subsistence fishing in the context of past actions and the RFFAs.

Summary of Direct and Indirect Effects on Subsistence Fishing

The alternatives are not anticipated to result in any direct effects on subsistence fishing, given that the actions proposed (such as vaccinations, de-worming, translocation) will not likely occur in locations popular for fishing. Indirect effects on subsistence fishing would be negligible because measurable changes in the fish caught by subsistence fishers are not likely. Hawaiian monk seals may potentially prey on and reduce the population of certain fish species that are popular among the subsistence fishers however, some fish species may actually increase in abundance if Hawaiian monk seals consume predators of those species. Likewise, changes in the rate of costly interactions with Hawaiian monk seals are expected to be negligible given the marginal increase in the population of MHI monk seals, and implementation of behavioral modification techniques.

Direct and indirect effects of monk seal research and enhancement activities on subsistence fisheries are evaluated in terms of potential increases or decreases in subsistence catch. Table 4.8-5 summarizes the direct and indirect effects of the alternatives on subsistence fisheries.

Table 4.8-5 Summary of Direct and Indirect Effects of the Alternatives on Subsistence Fishing

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Subsistence Fisheries	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Subsistence Fishing

Past, present and reasonably foreseeable future actions that may affect subsistence fisheries catch are summarized in Table 4.8-6.

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Table 4.8-6 Effects of Past, Present and Reasonably Foreseeable Future Actions on Subsistence Fishing

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris	• Changes to fish habitat • Injury or mortality to fish • Changes in prey due to ecosystem shift • Changes in fish age class recruitment	• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris by fish and affects habitat suitability.	-
Climate Change		• Subtropical Pacific ecosystem changes evident although modest relative to changes from increased fishing effort. However, future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011). • Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish populations are affected by these changes and can be both beneficial and adverse.	+/-
Introduction of Invasive species		• Parasites have been shown to be significant stressors in many species. Reif et al. (2006). • Invasive fish species introduced through ballast water may cause changes in fish population dynamics.	-
Predation by apex predatory fish nearshore (30m depth)	• Mortality of fish	• Apex predatory fish consume a minimum of 66,000 kg/day (146,000 lb/day) approximately 50 times more than a Hawaiian monk seal (Sprague et al. 2013).	-/+
Predation by Hawaiian monk seals nearshore (30m depth)	• Mortality of fish	• Estimated predation by 200 monk seals in MHI is approximately 1,300 kg per day (2,900 lb per day) (Sprague et al. 2013)	-/+
Military activities			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Mortality of fish • Fish habitat destruction • Temporary or permanent area restrictions to fishing during training	• Possible yet unlikely temporary threshold shift (TTS) impact to fish sensory systems due to sonar and explosive detonations. • Potential strike or contamination by torpedo and ship training activities. • Possible entanglement of fish in parachute assemblies, remote. • Detonation and explosive ordinance impacts to fish (*i.e.*, mortality). • Detonation impacts of buoys and RIMPAC and USWEX to fish. • Impacts to fish to include TTS injury and mortality. • Degradation or destruction of feeding habitat by underwater detonations and training activities. • Possible, however unlikely, TTS impact to fish due to sonar and explosive detonations. • Potential strike or mortality by training activities. • Potential closure or fisheries restrictions in areas where training activities occur.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS)			
Commercial			
Unregulated fishing (1913 - 2002)	• Mortality of fish • Reproductive effects on fish	• Unregulated take, reducing long term sustainability of populations for future fisheries. • Long-term catch trends suggest that there has been approximately an 80 percent decline in the nearshore stocks this century. Overfishing is partially due to an increase in population, improved fishing technology, improved gear, and failure to recognize or follow traditional conservation practices. Additionally, the number of commercial permits issued to collect reef fish increased by 39 percent between 1995 and 1998 (NOAA 2013).	-
Sea cucumber harvest (1882)			
Black-lipped oyster harvest (1928-1930)			
Lobster harvest (1970-1999)			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Commercial bottomfish fisheries	• Changes in fisheries catch/landings • Overharvest • Fish mortality or injury	• 1948 – 1978: number of trips per year per fishermen increased and has remained about 8 trips per year between 1980 and 2004. Data suggest there are more fishermen catching fewer fish. • Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006).	-
Commercial pelagic fisheries		• 1996-2006: Increased fishing effort with number of hooks set increasing four-fold. Catch rates for apex predators such as blue shark, bigeye and albacore tunas, shortbill spearfish, and striped marlin declined from 3 to 9% per year while catch rates for mahimahi, sickle pomfret, escolar, and snake mackerel, increased by 6 to 18% per year (Polovina 2009). • 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). Decreased catch rates for large fishes has continued through at least 2011 (Polovina 2011). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013).	-/+
Recreational and subsistence fisheries		• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • Limited data on subsistence harvest of fish species in Hawaii make estimating harvest levels difficult. • 2013: daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) • Widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander et al. 2004).	
Inter-Island Transmission Cable	• Disturbance to fishing vessels	• Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to fish may occur while laying the cable, including entanglement and mortality.	-

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Special Coral Reef Ecosystem Fishing Permit to Kampachi Farms, LLC	• Aggregation of pelagic fish	• Culture and harvest a coral reef ecosystem management unit fish species kampachi (Seriola rivoliana, marketed as Kona Kampachi[supreg]) in a floating pen moored about 5.5 nm off the west coast of the Island of Hawaii in about 6,000 ft of water. A 132m [supcaret] 3 (approximately 21 feet in diameter) brass-link mesh aquapod (CuPod) tethered to a moored, 28-ft feed vessel would be used for harvesting. • Fishermen would be able to fish around the array. The small size of the array is not expected to have a large adverse impact on catches by other fishermen in the ocean in west Hawaii.	-
Wai`anae Wastewater Treatment Plan Modification Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Water quality improvements	• Wastewater treatment plant improvements would generally be expected to reduce contaminants and biological waste streams entering the coastal ecosystem. Thus, minimizing exposure of fish species to contaminants and biological waste would result in improvements in habitat and would likely be beneficial for fish.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices also widely impact coral reef habitat. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013).	-
Other Government Activities			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Hawai`i Environmental Justice Bill: Senate Bill 2145 EO 12898: Environmental Justice	• Protection of minority interests in fisheries	• To the extent that minority populations rely on fisheries (commercial, subsistence or recreational) for income or for food, protection of minorities from projects that may cause disproportionate impacts would result in benefits to these groups.	+
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	• Closed fishery	• 2006: regulations prohibited commercial fishing, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). • 2009 remaining permit holders surrendered permits to NMFS in exchange for compensation from Federal Government and fishery was closed. Total NWHI bottomfish catch in 2009 was 29 metric tons.	-
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Habitat protection for fish • Redistribution of fishing activities to other areas	• No new fishing regulations would result from designating potential time-area closures for human activities such as wildlife viewing, swimming, boating, or fishing. Fishing activities may move to other areas where no time-area closures are in effect though overall this is not expected to reduce fish catch. • Fish populations may benefit from spinner dolphin protection measures due to potential time-area closures in bays around the MHI; potential additional protection of habitat; added recruitment could benefit fisheries.	+
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Reduction in marine debris	• Reduction in marine debris could reduce mortality or entanglement of fish. • Marine debris affects fish via ingestion (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). • Potential reduction in debris entanglement in commercial fishery nets.	+
Removal of marine debris from high entanglement zones	• Mortality • Injury		
Hawaiian Monk Seal Critical Habitat Designation	• Habitat protection	• No new fishing regulations would result from designating Hawaiian monk seal critical habitat. • Fish populations may benefit from Monk Seal Habitat designation due to the additional protection of habitat; added recruitment will benefit fisheries.	+

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Fishery Ecosystem Plan for the Hawai`i Archipelago	• Mortality • Prey availability	• Fishery plan may promote more stable prey resources. • Researchers may enhance habitat for fish when they remove marine debris during field activities. Marine debris affects fish via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on fish.	+ / -
Measures to End Bottomfish Overfishing in the Hawaiian Archipelago	• Indirect mortality • Prey availability	• Fishery plan may promote more stable prey resources.	+
Bottomfish and Seamount Groundfish Fisheries Management Plan (2005)	• Indirect mortality • Prey availability	• Fishery plan promotes more sustainable management of stocks and promotes stable prey resources.	+
Pilot Aquaculture Project (Tuna cultivation)	• Mortality • Disease • Genetic effects • Pollution	• Potential reduction in pressure on wild fish populations. • Escapement could impact native populations through disease and dilution of locally adaptive gene complexes, disrupt natural ecosystems and jeopardize recovery of depleted or endangered species. • Aquaculture facility can carry excessive nutrients, particulates, bacteria, other diseased organisms and polluting chemicals	+/-

Cumulative Effects Conclusion for Subsistence Fishing

The direct and indirect effects on subsistence fisheries associated with the Hawaiian monk seal research and enhancement alternatives are negligible because proposed activities would not result in changes to recreational fishing catch. Therefore, the contribution of monk seal research and enhancement to an overall cumulative effect from any of the alternatives is considered negligible.

Documented historical overfishing in the NWHI and MHI has adversely affected fish populations around Hawaii as shown in Table 4.8-7. The effects of ongoing subsistence and recreational fishing are not well understood due to lack of licensing requirements and reporting of catch. Notable fisheries management actions in the past include efforts to end bottomfish overfishing in the MHI and the FEPs for the various fisheries which would be expected to have beneficial effects on fish populations.

Subsistence fishing in Hawai`i is not regulated therefore, it is difficult to determine the level of catch for these fisheries though Sprague et al (2013) reported that near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013). In addition, Friedlander et al. 2004 stated that it is widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear . Fisheries regulations, such as plans to end bottomfish overfishing in the Hawai`i Archipelago, could indirectly affect recreational fishing, as commercial bottomfish fishermen will seek alternatives to supplement their incomes. This could result in changes in the populations of other fish species, including those popular for recreational fishing. The management measures considered in the "Draft Supplemental Environmental Impact Statement – Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region – Measures to End Bottomfish Overfishing in the Hawai`i Archipelago" (March 2006), which supplements the May 2005 Final Environmental Impact Statement, target a 15% or greater reduction in bottomfish fishing mortality in the MHI (except for the no action alternative). Alternatives include area closures, seasonal closures, catch limits, and combinations of the three.

In addition to this, the Western Pacific Regional Fishery Management Council is implementing "ecosystem-based" approaches to fishery management in the Hawaiian Archipelago. This is a move from the "species-based' approach. Notable RFFAs in this context are "Fishery Ecosystem Plan for the Hawaiian Archipelago" (September 2009) and "Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region" (December 2005). Examples of implementation measures under these plans include, among others, ecosystem

boundaries, area closures, size restrictions, seasonal closures, gear restrictions, etc.

Effects of development, pollution, and human modifications of the coastal environment have all had adverse effects on fish populations and, thus, fisheries due to changes in overall fish habitat conditions. The local and global economic recession in recent years resulted in a reduction of fish exports by commercial fishermen, leading to reduced commercial catch. Consequently, there was possibly more fish available for recreational purposes. Another effect of the global recession on recreational fishing was decrease in tourism, leading to lesser non-local recreational fishermen in the MHI and possibly consequently more fish available for local subsistence fishermen, as well as for recreational and commercial fishing. However, as the economy is beginning to recover, commercial catch is trending upwards and more tourists are visiting the MHI, which may increase recreational and subsistence fishing pressure.

There are other ongoing federal government management actions to protect and enhance monk seal populations and other protected species such as spinner dolphins in the nearshore environment around Hawai'i. Designation of Hawaiian monk seal habitat is not anticipated to result in changes to fishing regulations. Protection of monk seal habitat may result in benefits to nearshore fish species through improved overall habitat protection. While it is difficult to determine these effects definitively at this time, improvements in habitat could result in better recruitment and increases in fish populations. Whether this would be of benefit to subsistence fisheries cannot be determined at this time. Similar benefits could result from spinner dolphin protection measures such as time-area closures. Time-area closures however could result in limiting access to specific areas in bays around Hawaii. However, these potential spinner dolphin measures would not preclude fishermen from fishing in other areas where there were no closures thus the potential adverse effects of closures would likely be minimal.

Actions listed in Table 4.8-6 provide some overall perspective on actions and events that have had or could have effects (direct, indirect or cumulative) on subsistence fisheries. While the net effects on subsistence fishing from past and future actions are not known, Hawaiian monk seal research and enhancement actions are not likely to result in anything but negligible direct, indirect or cumulative effects on fisheries.

4.8.3 RECREATIONAL FISHING

The potential direct, indirect and cumulative effects of the alternatives on recreational fishing are analyzed in this section. The analysis focuses on the nearshore areas surrounding the MHI. Sprague et al. (2013, see also Section 3.4.5 Recreational Fishing) noted that in Hawai'i the line between recreational and subsistence fishing is blurred, and there is little collection of data to differentiate between the two. There is no saltwater fishing license for recreational or

subsistence fishing, and no requirement to report recreational catch in the State of Hawai'i. As a result, the data on recreational fishery landings are very limited, voluntarily reported and are often considered biased or incomplete, likely representing a minimum estimate of extraction.

Fishing is popular with both the residents and tourists visiting Hawai'i. A quarter of Hawai'i's population participates in some form of fishing at least once a year (U.S. Department of the Navy 2008a). Effects on recreational fishing could be expected if an action results in changing the recreational experience of locals and tourists through either affecting the quantity or type of fish caught for recreational purposes, or the enjoyment derived from the natural beauty of their surroundings and wildlife. As per Table 4.4-6 in Section 4.4.3, these effects are measured through looking at any changes in the number of recreational fishing trips.

One factor that could potentially affect recreational fishing trips is the experience recreational fishermen derive from enjoying their surroundings. Alternatives that can potentially enhance that experience, such as those resulting in additional Hawaiian monk seals to view in the area, would have a positive effect on recreational fishing trips. It is acknowledged that some fishers may not derive a positive experience from viewing more seals. However, given the temporary and marginal change in the Hawaiian monk seal population in the MHI attributable to any of the alternatives, this effect on recreational fishing trips is considered negligible. Another factor considered here is whether there would be any change in the number of recreational fishing trips or a change in the amount of fish caught due to less fish being available. This is examined in more detail below.

The alternatives are not anticipated to result in any direct effects on recreational fishing. Indirect effects on recreational fishing, such as changes in the number of fishing trips or the quantity of fish caught for recreational purposes, are not likely under any of the alternatives. Hawaiian monk seals are not expected to reduce the population of certain fish species that are popular with recreational fishermen.

As described in Section 4.8.1 for commercial fishermen, recreational fishermen could be affected by Hawaiian monk seal interactions resulting from increased costs from damages to their catch or gear due to depredation of fishing lines or hooks by seals. Additionally, recreational fishermen who fish from boats could bear additional costs resulting from idle time or additional fuel costs incurred from efforts to avoid interactions with seals. Thus, alternatives that may change the frequency of monk seal interactions could affect recreational fishing.

It is widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander *et al.* 2004). Consistent with this, Sprague et al. (2013) obtained recreational (and subsistence, because there is no formal distinction between these in the available data) landings summaries from

the Hawaii Marine Recreational Fishing Survey from 2003 to 2011. They considered only landings from shore or from within 3 miles of shore (in order to exclude pelagic fishes) and excluding pelagic species and sharks caught within 3 mi of shore, thereby excluding 90% of the reported catch. Whereas daily commercial nearshore catch was estimated to be 1676 kg, the recreational and subsistence catch was estimated to be 2178 kg (Table 4.8-2). Sprague et al. (2013) note that commercial fishery landings data come from mandatory reports of daily fishing activity, while subsistence/recreational fishery landings data are from voluntary surveys. Both may significantly underreport the actual catch, but there is likely greater accuracy in the commercial data. In particular, reported near-shore recreational landings from spear-fishing and shoreline fishing may not be as well-represented as boat-based landings. Only 39% of reported recreational/subsistence fishery landings (by weight, excluding pelagic species) were from fish families also found in monk seal diet. Or conversely, 61% of nearshore landings are from fish families not eaten by monk seals and therefore not likely to be impacted by any increase in monk seal consumption. Sprague et al. (2013) note that with better information on the actual (versus reported) fishery catch, this estimate over monk seal dietary overlap with fisheries could be refined in the future.

The uncertainty in data on recreational fishery landings makes it more difficult to assess the potential impacts of the alternatives. However, even the likely underestimated amount of fish (2178 kg per day) extracted by nearshore recreational/subsistence fishing is considerably higher than the relatively reliable estimate (1676 kg) extracted by commercial fisheries. It is clear, then, that the amount of fish eaten by Hawaiian monks seals is relatively smaller when compared to the recreational/subsistence catch than when compared to the commercial catch. Therefore, the analyses in Section 4.8.1, which found negligible impacts of alternatives on commercial fishing as a result of potential increases in the rate of MHI monk seal population growth, are likewise applicable to recreational fishing.

In contrast to commercial fisheries, for which there is little or no evidence of monk seal interactions in the MHI, seals frequently interact with non-commercial (including recreational) fisheries. Unequivocal evidence of interactions includes the numerous seal hookings on non-commercial gear in recent years as well as entanglements in gillnets (laynets) (see Section 3.3.1.7). A minimum of 15 monk seals were hooked or entangled in gillnet in 2012 in a population of only approximately 200 seals. From the perspective of the monk seal population, that is a relatively high rate of interaction, especially considering that many interactions that involve hooking or entanglement are likely not observed, not reported or not confirmed. The number of interactions that do not result in hooking or entanglement may be far greater.

In contrast, there are a relatively high number of recreational fishermen compared to a maximum MHI monk seal population of approximately 200 seals,

so that the likelihood of any one fishermen experiencing interactions with seals is probably quite low. However, at meetings and through the public comment process, fishermen have reported that they believe monk seal interactions are becoming more frequent. This is not unexpected given that the MHI monk seal population is increasing naturally. Unfortunately, there are currently no data to indicate the frequency, nature, cost or outcome of monk seal interactions with recreational fishing in the MHI. It is important to recognize that the analysis below focuses specifically on the impact of the alternatives, rather than on the overall potential impact of monk seals on recreational fishing. The MHI monk seal population is growing naturally, irrespective of any PEIS alternative. The crux of the analysis is whether the alternatives will be likely to increase or decrease any effects on recreational fishing beyond those that will occur regardless of the alternatives.

4.8.3.1 DIRECT AND INDIRECT EFFECTS ON RECREATIONAL FISHING OF ALTERNATIVE 1 – STATUS QUO

Alternative 1 (Status Quo) entails the continuation of the current NMFS Research and Enhancement Permit (10137) until it expires in 2014. Following this date, subsequent permits would be issued to continue the research and enhancement activities that are currently permitted. For a description of permitted research under Alternative 1, please refer to Section 2.7.

Alternative 1 is not anticipated to have any direct effects on recreational fishing in the MHI. Indirect effects of Alternative 1 on recreational fishing could be possible if there were marked changes in the availability of species fished for recreational and, consequently, the quantity of recreational catch, due to increased Hawaiian monk seal population resulting from Alternative 1. Furthermore, recreational fishing could be affected by Hawaiian monk seal interactions that could increase costs from damages to catch and gear. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 1 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the nearshore MHI, and
- Only a portion (39%) of that consumption potentially overlaps with fish families fished for recreation, and
- Apex predatory fish likely consume over 50 times more prey than the entire monk seal population

Also, the nearshore recreational/subsistence catch is considerably larger than the nearshore commercial catch. Therefore, any hypothetical additional fish consumption by monk seals associated with marginal increases in the monk seal

population due to Alternative 1, would likely represent a smaller portion of the recreational catch compared to the commercial catch. Given all these findings, any marginal increase in Hawaiian monk seal population due to Alternative 1 activities are anticipated to have negligible effects on recreational fishing.

Conclusion for Direct and Indirect Effects on Recreational Fishing from Alternative 1 (Status Quo)

None of the research and enhancement activities permitted under Alternative 1 would directly affect recreational fishing in MHI. Therefore, direct effects are likely to be negligible. Marginal increases in the Hawaiian monk seal population growth rate in the MHI could possibly have an indirect adverse effect on recreational fishing due to possible decreases in fish caught for recreational purposes or increases in interactions with monk seals that damage catch or gear. However, this effect is likely to be negligible.

4.8.3.2 DIRECT AND INDIRECT EFFECTS ON RECREATIONAL FISHING OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Alternative 2 (No Action) entails the continuation of existing research as permitted under the existing permit (10137) until 2014. Once expired, these research and enhancement activities would cease. Unlike the activities under some other alternatives, there would be no field research to monitor populations, implement de-worming, or translocation.

The Hawaiian monk seal population in the MHI is anticipated to continue to increase regardless of the proposed alternatives. Under Alternative 2, given that most monk seal research and enhancement activities would cease after 2014, changes in the monk seal population due to Alternative 2 would be unlikely. Consequently, any potential indirect effects on recreational fishing associated with Alternative 2 are also unlikely. As discussed above, indirect effects on recreational fishing could stem from changes in the quantity of fish caught for recreational purposes, leading to modifications in the amount of fish consumed. Furthermore, effects on recreational fishing could stem from a change in the number of interactions between recreational fishing and Hawaiian monk seals.

Alternative 2 is not anticipated to have any direct effects on recreational fishing in the MHI. Because Alternative 2 is not likely to result in more than extremely marginal changes in the MHI monk seal population, indirect effects of Alternative 2 on recreational fishing due to either additional fish consumption by seals or additional seal interactions with the fishery, are expected to be negligible.

Conclusion for Direct and Indirect Effects on Recreational Fishing from Alternative 2 (No Action)

Alternative 2 is not anticipated to directly or indirectly affect recreational fishing in MHI. The overall effects of Alternative 2 are expected to be negligible.

4.8.3.3 *DIRECT AND INDIRECT EFFECTS ON RECREATIONAL FISHING OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

Alternative 3 entails the expansion of research and enhancement activities currently permitted, most of which are focused on improving the population status in the NWHI. The Alternative 3 expanded activities most relevant to the MHI are a vaccination program and behavioral modification activities. Vaccination could prevent Hawaiian monk seal population declines in the MHI if a disease outbreak occurs for which a safe and effective vaccine is available, and if a significant portion of the Hawaiian monk seal population can be vaccinated. Also, emergency response to a disease outbreak is already mandated under provisions of the MMPA's Marine Mammal Health and Stranding Response Program (MMHSRP) (Title IV, 16 U.S.C. 1421) and the permit held by the MMHSRP. Behavioral modification may also lead to marginal increases in the MHI monk seal population if seals with undesirable behaviors are able to remain in the wild. This would be expected to involve only very few seals. Importantly, behavioral modification is in part intended to reduce habitual seal interactions with fishing operations. If this effort succeeds, then Alternative 3 may *reduce* potential effects on fishing by minimizing interactions. Alternative 3 is not anticipated to have any direct effects on recreational fishing in the MHI.

Indirect effects of Alternative 3 on recreational fishing could be possible if there were marked changes in the availability of species fished for recreation and, consequently, the quantity of recreational catch, due to increased Hawaiian monk seal population. Furthermore, recreational fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear due to depredation. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

The Hawaiian monk seal population is anticipated to increase in the MHI regardless of the alternatives, but some activities under Alternative 3 may marginally enhance this growth. Sprague et al. (2013) estimated that

- An entire population of 200 monk seals consumes a maximum of 0.009% of the estimated available prey biomass in the nearshore MHI, and
- Only a portion (39%) of that consumption potentially overlaps with fish families fished for recreation, and
- Apex predator fish likely consume over 50 times more prey than the entire monk seal population

Also, the nearshore recreational/subsistence catch is considerably larger than the nearshore commercial catch. Therefore, any hypothetical additional fish consumption by monk seals associated with marginal increases in the monk seal population due to Alternative 3, would likely represent a smaller portion of the recreational catch compared to the commercial catch. Finally, while Alternative 3 activities may marginally increase the Hawaiian monk seal population,

behavioral modification activities may succeed in reducing seal interactions with fisheries. Given all these findings, any marginal increase in Hawaiian monk seal population due to Alternative 3 activities are anticipated to have negligible effects on recreational fishing.

Conclusion for Direct and Indirect Effects on Recreational Fishing from Alterative 3 (Preferred Alternative)

None of the research and enhancement activities permitted under Alternative 3 would directly affect recreational fishing in the MHI. Therefore, direct effects are likely to be negligible. A marginal increase in the Hawaiian monk seal population growth rate in the MHI due to Alternative 3 is not likely to result in an indirect adverse effect on recreational fishing, especially coupled with actions designed to reduce fishery interactions. Therefore, this effect would likely be negligible.

4.8.3.4 DIRECT AND INDIRECT EFFECTS ON RECREATIONAL FISHING OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Alternative 4 entails expanded research and enhancement activities, most of which, as under Alternative 3, are focused on improving the population status in the NWHI. The Alternative 4 expanded activities most relevant to the MHI are potential two-stage translocation involving temporarily moving juvenile seals from the NWHI to the MHI, a vaccination program, and behavioral modification activities. It is anticipated that the benefit of Alternative 4 would primarily manifest as a reduction in the rate of decline in the NWHI as opposed to making significant contributions to the increase in MHI population growth that is naturally occurring (*i.e.,* without NMFS intervention). The proportion of seals temporarily translocated to the MHI under Alternative 4 would constitute a small proportion of the already naturally increasing seal population. Further, should the option to translocate seals from the NWHI to the MHI (allowed only under this alternative) be exercised, there would only be a temporary increase in the MHI population of monk seals due to that action because any translocated seals would be returned to the NWHI once they reached 2 or 3 years of age. Alternative 4 is not anticipated to result in any direct effects on recreational fishing in the MHI.

Indirect effects of Alternative 4 on recreational fishing could be possible if there were marked changes in the availability of species fished for subsistence and, consequently, the quantity of recreational catch, due to increased Hawaiian monk seal population. Furthermore, recreational fishing could be affected by Hawaiian monk seal interactions that could increase their costs from damages to their catch and gear. Additionally, fishermen could bear additional costs resulting from idle time and fuel costs in an effort to avoid interaction with Hawaiian monk seals.

Under this alternative, a maximum of 20 weaned pups per year could be translocated to the MHI from NWHI for the five-year permit period. Each group of monk seals would be returned to the NWHI once they reached 2 or 3 years of age. The maximum number of additional seals that would be present in a single year is 60 seals if it is assumed that:

- the maximum allowed number of juvenile monk seals per year (20) are translocated for at least 3 consecutive years;
- all of these are translocated from the NWHI to the MHI and not vice versa; and
- there is no mortality of translocated seals for three years;

While it is important to consider this scenario in order to understand what might happen if all of these seals survived, that would be very unlikely. A more realistic estimate of the maximum number of translocated monk seals in the MHI is derived by applying the survival rates of native-born MHI monk seals to translocated seals. Retaining the first two assumptions in the preceding bullets, this results in a projected maximum number of 51 additional seals. Again, while this analysis acknowledges that an additional 60 seals in these years would be unlikely, it uses this number (60) in order to present the greatest potential impact scenario for the purposes of evaluating potential effects on commercial fish in the MHI under Alternative 4.

Based upon the liberal consumption rates in Sprague et al. (2013) juvenile monk seals eat approximately 5 kg (11 lb) of prey per day. Therefore, the additional 60 juvenile monk seals that could potentially occur temporarily in the MHI under Alternative 4 would consume at most 60 x 5 = 300 kg (662 lb) of prey per day. This represents at most 0.0018% of the estimated standing biomass of reef fish in the nearshore habitats of the MHI. Furthermore, apex predatory fish are estimated to consume at least 220 times as much as would these 60 potential juvenile monk seals. Interactions between the translocated seals and recreational fishing could increase under Alternative 4, although as noted above, data are lacking to quantify the current level of interaction. Likewise, it is not possible to reliably predict how much those interactions might increase due to the potential temporary addition of 60 juvenile seals to the population. It is reasonable to expect that some of those additional seals would interact with fisheries, though the associated cost of those interactions to the fishermen is not known. However, as under Alternative 3, behavioral modification activities under Alternative 4, if successful, could mitigate fishery interactions with both translocated and seals native to the MHI. Given the exceedingly small potential increase in prey consumption, only part of which would potentially overlap with species fished for subsistence, and the potential increase in fishery interactions (though mitigated by behavioral modification), overall Alternative 4 activities are anticipated to have negligible effects on recreational fishing.

Conclusion for Direct and Indirect Effects on Recreational Fishing from Alterative 4 (Enhanced Implementation)

None of the research and enhancement activities permitted under Alternative 4 would directly affect recreational fishing in the MHI. Therefore, direct effects are likely to be negligible. A temporary increase in the MHI monk seal population due to Alternative 4, combined with implementation of a behavioral modification program, is not likely to result in an indirect adverse effect on recreational fishing. Therefore, this effect would likely be negligible.

4.8.3.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON RECREATIONAL FISHING

This section presents the cumulative effects on recreational fishing in the context of past actions and the RFFAs.

Summary of Direct and Indirect Effects on Recreational Fishing

The alternatives are not anticipated to result in any direct effects on recreational fishing, given that the actions proposed (such as vaccinations, de-worming, translocation) will not likely occur in locations popular for fishing. Indirect effects on recreational fishing, such as a change in the number of fish caught for recreation or a reduction in the population of certain recreational fish species, are not expected to result due to Alternative 4 actions. Likewise, potential increases in fishing cost (*i.e.*, fuel and fishing time expended) due to interactions with Hawaiian monk seals are expected to be negligible given the marginal increase in the population of MHI monk seals expected to result from Alternative 4, and implementation of behavioral modification tools..

Direct and indirect effects of monk seal research and enhancement activities on recreational fisheries are evaluated in terms of potential increases or decreases in recreational catch. Table 4.8-7 summarizes the direct and indirect effects of the alternatives on recreational fisheries.

Table 4.8-7 Summary of Direct and Indirect Effects of the Alternatives on Recreational Fishing

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Recreational Fisheries	Negligible	Negligible	Negligible	Negligible

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Recreational Fishing

Past, present and reasonably foreseeable future actions that may affect recreational fisheries catch are summarized in Table 4.8-8.

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Table 4.8-8 Effects of Past, Present and Reasonably Foreseeable Future Actions on Recreational Fishing

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris		• 2011 Japanese Tohoku earthquake and tsunami debris • Debris increases likelihood of ingestion of debris by fish and affects habitat suitability.	-
Climate Change	• Changes to fish habitat • Injury or mortality to fish • Changes in prey due to ecosystem shift • Changes in fish age class recruitment	• Subtropical Pacific ecosystem changes evident although modest relative to changes from increased fishing effort. However, future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011). • Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish populations are affected by these changes and can be both beneficial and adverse.	+/-
Introduction of Invasive species		• Parasites have been shown to be significant stressors in many species. Reif et al. (2006). • Invasive fish species introduced through ballast water may cause changes in fish population dynamics.	-
Predation by apex predatory fish nearshore (30m depth)	• Mortality of fish	• Apex predatory fish consume a minimum of 66,000 kg/day (146,000 lb/day) approximately 50 times more than a Hawaiian monk seal (Sprague et al. 2013).	-/+
Predation by Hawaiian monk seals nearshore (30m depth)	• Mortality of fish	• Estimated predation by 200 monk seals in MHI is approximately 1,300 kg per day (2,900 lb per day) (Sprague et al. 2013)	-/+
Military activities			

Action / Event	Potential Effects	Description/Example	Effect
U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Mortality of fish • Fish habitat destruction • Temporary or permanent area restrictions to fishing during training	• Possible yet unlikely temporary threshold shift (TTS) impact to fish sensory systems due to sonar and explosive detonations. • Potential strike or contamination by torpedo and ship training activities. • Possible entanglement of fish in parachute assemblies, remote. • Detonation and explosive ordinance impacts to fish (*i.e.*, mortality). • Detonation impacts of buoys and RIMPAC and USWEX to fish. • Impacts to fish to include TTS injury and mortality. • Degradation or destruction of feeding habitat by underwater detonations and training activities. • Possible, however unlikely, TTS impact to fish due to sonar and explosive detonations. • Potential strike or mortality by training activities. • Potential closure or fisheries restrictions in areas where training activities occur.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS)			
Commercial			
Unregulated fishing (1913 - 2002)	• Mortality of fish • Reproductive effects on fish	• Unregulated take, reducing long term sustainability of populations for future fisheries. • Long-term catch trends suggest that there has been approximately an 80 percent decline in the nearshore stocks this century. Overfishing is partially due to an increase in population, improved fishing technology, improved gear, and failure to recognize or follow traditional conservation practices. Additionally, the number of commercial permits issued to collect reef fish increased by 39 percent between 1995 and 1998 (NOAA 2013).	-
Sea cucumber harvest (1882)			
Black-lipped oyster harvest (1928-1930)			
Lobster harvest (1970-1999)			

Action / Event	Potential Effects	Description/Example	Effect
Commercial bottomfish fisheries	• Changes in fisheries catch/landings • Overharvest • Fish mortality or injury	• 1948 – 1978: number of trips per year per fishermen increased and has remained about 8 trips per year between 1980 and 2004. Data suggest there are more fishermen catching fewer fish. • Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006).	-
Commercial pelagic fisheries		• 1996-2006: Increased fishing effort with number of hooks set increasing four-fold. Catch rates for apex predators such as blue shark, bigeye and albacore tunas, shortbill spearfish, and striped marlin declined from 3 to 9% per year while catch rates for mahimahi, sickle pomfret, escolar, and snake mackerel, increased by 6 to 18% per year (Polovina 2009). • 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). Decreased catch rates for large fishes has continued through at least 2011 (Polovina 2011). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013).	-/+
Recreational and subsistence fisheries		• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • Limited data on subsistence harvest of fish species in Hawaii make estimating harvest levels difficult. • 2013: daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) • Widely believed that nearshore recreational and subsistence catch is equal to or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander et al. 2004).	
Inter-Island Transmission Cable	• Disturbance to fishing vessels	• Impacts of cable installation are brief and minimal. Laying cable does cause some disturbance of the ocean floor, but within days the area returns to normal. • Impacts to fish may occur while laying the cable, including entanglement and mortality.	-
Special Coral Reef Ecosystem Fishing Permit to Kampachi	• Aggregation of pelagic fish	• Culture and harvest a coral reef ecosystem management unit fish species kampachi (Seriola rivoliana, marketed as Kona Kampachi[supreg]) in a floating pen moored about 5.5 nm off the west coast of the Island of Hawaii in	-

Action / Event	Potential Effects	Description/Example	Effect
Farms, LLC		about 6,000 ft of water. A 132m [supcaret] 3 (approximately 21 feet in diameter) brass-link mesh aquapod (CuPod) tethered to a moored, 28-ft feed vessel would be used for harvesting. • Fishermen would be able to fish around the array. The small size of the array is not expected to have a large adverse impact on catches by other fishermen in the ocean in west Hawaii.	
Wai`anae Wastewater Treatment Plan Modification Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Water quality improvements	• Wastewater treatment plant improvements would generally be expected to reduce contaminants and biological waste streams entering the coastal ecosystem. Thus, minimizing exposure of fish species to contaminants and biological waste would result in improvements in habitat and would likely be beneficial for fish.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices also widely impact coral reef habitat. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013).	-
Other Government Activities			
Hawai'i Environmental Justice Bill: Senate Bill 2145 EO 12898: Environmental Justice	• Protection of minority interests in fisheries	• To the extent that minority populations rely on fisheries (commercial, subsistence or recreational) for income or for food, protection of minorities from projects that may cause disproportionate impacts would result in benefits to these groups.	+

Action / Event	Potential Effects	Description/Example	Effect
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	• Closed fishery	• 2006: regulations prohibited commercial fishing, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). • 2009 remaining permit holders surrendered permits to NMFS in exchange for compensation from Federal Government and fishery was closed. Total NWHI bottomfish catch in 2009 was 29 metric tons.	-
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Habitat protection for fish • Redistribution of fishing activities to other areas	• No new fishing regulations would result from designating potential time-area closures for human activities such as wildlife viewing, swimming, boating, or fishing. Fishing activities may move to other areas where no time-area closures are in effect though overall this is not expected to reduce fish catch. • Fish populations may benefit from spinner dolphin protection measures due to potential time-area closures in bays around the MHI; potential additional protection of habitat; added recruitment could benefit fisheries.	+
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas	• Reduction in marine debris	• Reduction in marine debris could reduce mortality or entanglement of fish. • Marine debris affects fish via ingestion (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). • Potential reduction in debris entanglement in commercial fishery nets.	+
Removal of marine debris from high entanglement zones	• Mortality • Injury		
Hawaiian Monk Seal Critical Habitat Designation	• Habitat protection	• No new fishing regulations would result from designating Hawaiian monk seal critical habitat. • Fish populations may benefit from Monk Seal Habitat designation due to the additional protection of habitat; added recruitment will benefit fisheries.	+

Action / Event	Potential Effects	Description/Example	Effect
Fishery Ecosystem Plan for the Hawai`i Archipelago	• Mortality • Prey availability	• Fishery plan may promote more stable prey resources. • Researchers may enhance habitat for fish when they remove marine debris during field activities. Marine debris affects fish via ingestion of anthropogenic materials (*e.g.*, plastics, pellets, fish hooks, etc.) and entanglement in derelict fishing gear (recreational or commercial fishing nets, lines, etc.). Removal of marine debris by researchers for Hawaiian monk seals would likely result in a beneficial effect on fish.	+ / -
Measures to End Bottomfish Overfishing in the Hawaiian Archipelago	• Indirect mortality • Prey availability	• Fishery plan may promote more stable prey resources.	+
Bottomfish and Seamount Groundfish Fisheries Management Plan (2005)	• Indirect mortality • Prey availability	• Fishery plan promotes more sustainable management of stocks and promotes stable prey resources.	+
Pilot Aquaculture Project (Tuna cultivation)	• Mortality • Disease • Genetic effects • Pollution	• Potential reduction in pressure on wild fish populations. • Escapement could impact native populations through disease and dilution of locally adaptive gene complexes, disrupt natural ecosystems and jeopardize recovery of depleted or endangered species. • Aquaculture facility can carry excessive nutrients, particulates, bacteria, other diseased organisms and polluting chemicals	+/-

Cumulative Effects Conclusion for Recreational Fishing

The direct and indirect effects on recreational fisheries associated with the Hawaiian monk seal research and enhancement alternatives are negligible because proposed activities would not result in changes to recreational fishing catch. Therefore, the contribution of monk seal research and enhancement to an overall cumulative effect from any of the alternatives is considered negligible.

Documented historical overfishing in the NWHI and MHI has adversely affected fish populations around Hawaii as shown in Table 4.8-9. The effects of ongoing subsistence and recreational fishing are not well understood due to lack of licensing requirements and reporting of catch. Notable fisheries management actions in the past include efforts to end bottomfish overfishing in the MHI and the FEPs for the various fisheries which would be expected to have beneficial effects on fish populations.

There is no license required for saltwater recreational fishing in Hawai`i and, therefore, it is difficult to regulate these fisheries. Fisheries regulations, such as plans to end bottomfish overfishing in the Hawai`i Archipelago, could indirectly affect recreational fishing, as commercial bottomfish fishermen will seek alternatives to supplement their incomes. This could result in changes in the populations of other fish species, including those popular for recreational fishing. The management measures considered in the "Draft Supplemental Environmental Impact Statement – Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region – Measures to End Bottomfish Overfishing in the Hawai`i Archipelago" (March 2006), which supplements the May 2005 Final Environmental Impact Statement, target a 15% or greater reduction in bottomfish fishing mortality in the MHI (except for the no action alternative). Alternatives include area closures, seasonal closures, catch limits, and combinations of the three.

In addition to this, the Western Pacific Regional Fishery Management Council is implementing "ecosystem-based" approaches to fishery management in the Hawaiian Archipelago. This is a move from the "species-based' approach. Notable RFFAs in this context are "Fishery Ecosystem Plan for the Hawaiian Archipelago" (September 2009) and "Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region" (December 2005). Examples of implementation measures under these plans include, among others, ecosystem boundaries, area closures, size restrictions, seasonal closures, gear restrictions, etc.

Effects of development, pollution, and human modifications of the coastal environment have all had adverse effects on fish populations and, thus, fisheries due to changes in overall fish habitat conditions. The local and global economic recession in recent years resulted in a reduction of fish exports by commercial fishermen, leading to reduced commercial catch. Consequently, there was

possibly more fish available for recreational purposes. Another effect of the global recession on recreational fishing was decrease in tourism, leading to lesser non-local recreational fishermen in the MHI and possibly consequently more fish available for local recreational fishermen, as well as for subsistence and commercial fishing. However, as the economy is beginning to recover, commercial catch is trending upwards and more tourists are visiting the MHI, which may increase recreational fishing pressure.

There are other ongoing federal government management actions to protect and enhance monk seal populations and other protected species such as spinner dolphins in the nearshore environment around Hawaiʻi. Designation of Hawaiian monk seal habitat is not anticipated to result in changes to fishing regulations. Protection of monk seal habitat may result in benefits to nearshore fish species through improved overall habitat protection. While it is difficult to determine these effects definitively at this time, improvements in habitat could result in better recruitment and increases in fish populations. Whether this would be of benefit to recreational fisheries cannot be determined at this time. Similar benefits could result from spinner dolphin protection measures such as time-area closures. Time-area closures however could result in limiting access to specific areas in bays around Hawaii. However, these potential spinner dolphin measures would not preclude fishermen from fishing in other areas where there were no closures thus the potential adverse effects of closures would likely be minimal.

Actions listed in Table 4.8-8 provide some overall perspective on actions and events that have had or could have effects (direct, indirect or cumulative) on recreational fisheries. While the net effects on recreational fishing from past and future actions are not known, Hawaiian monk seal research and enhancement actions are not likely to result in anything but negligible direct, indirect or cumulative effects on fisheries.

4.8.4 CULTURAL RESOURCES, TRADITIONAL CULTURAL PRACTICES, AND HISTORIC PROPERTIES

CULTURAL RESOURCES AND TRADITIONAL CULTURAL PRACTICES

A range of cultural resources (other than historic properties, which are discussed in the following section) and traditional cultural practices has the potential to be impacted by monk seal recovery actions proposed under this PEIS. The potential impacts can take two forms: 1) impacts resulting directly from the conduct of the recovery actions themselves, and 2) impacts resulting from the activities of seals influenced by the recovery actions, for example, seals that are translocated or seals that are subject to behavior modification techniques.

The cultural resources that may be directly affected by activities associated with Hawaiian monk seal recovery include shoreline resources such as native strand plants that are traditionally gathered for their medicinal properties. These plants

could be accidentally trampled and damaged by NMFS staff and volunteers during observation, translocation, or other monk seal recovery related activities. Inshore resources such as fish, shellfish, and other marine organisms traditionally collected for food are much less likely to be affected, although patches of edible *limu* (seaweed) could be disturbed. Due to the temporary and transient nature of the physical activities proposed in the PEIS, it is unlikely that customary practices such as fishing, gathering, swimming, or surfing will be significantly affected by recovery activities themselves.

This section evaluates direct, indirect, and cumulative effects to cultural resources and practices that may occur as a result of the four proposed alternatives described in Section 2.6. The effects of proposed Alternatives on the cultural practice of subsistence fishing are addressed in Section 4.8.2.

4.8.4.1 DIRECT AND INDIRECT EFFECTS ON CULTURAL RESOURCES OF ALTERNATIVE 1 – STATUS QUO

Alternative 1, the Status Quo, involves the continuation of currently authorized activities past 2014. These include activities, such as monitoring and some sample collection that do not involve the capture and handling of seals, as well as activities that do involve the capture and handling of seals, such as marking, measuring, sample collection, vaccination, de-worming, disentanglement, removal, and translocation. Under this alternative, the translocation of seals only takes place within the MHI or within the NWHI. There is no translocation of seals from the NWHI to the MHI or from the MHI to the NWHI.

Activities conducted under Alternative 1 include aerial, vessel, and land-based surveys, and some handling and transportation of Hawaiian monk seals. Boats and land vehicles will be used to transport researchers and possibly animals. Researchers will traverse beach and dune areas on foot to reach monk seals. Recovery activities will be conducted throughout the project area, in the MHI, NWHI, and on Johnston Atoll. Researchers will seasonally (typically April or May through August) occupy existing campsites in the NWHI (see Section 3.3.1.9).

Direct impacts to cultural resources other than historic properties that could occur under Alternative 1 within the MHI include the disturbance, damage, or destruction of coastal plants that are used in *lāʻau lapaʻau* (traditional medicine). This could occur if researchers drive over or walk through areas where these plants grow. Training of researchers and volunteers to recognize and avoid native strand flora, as presented in Chapter 5, should serve to mitigate these potential impacts. Activities involved in the observation or translocation of monk seals, as conducted under Alternative 1 are unlikely to directly impact marine resources (fish, shellfish and other marine organisms) that are traditionally gathered for food. The only exception is the possibility that boat landings could disturb beds of *limu kohu* (*Asparagopsis sanfordiana*), *limu loloa* (*Gelindium spp.*), and other edible sea weeds that were traditionally gathered

along the shoreline. Again, this potential impact can be mitigated by training researchers and volunteers to recognize and avoid these resources.

One of the roles of the existing stakeholder and community-based programs described in Chapter 5 has been to develop and maintain a network of Hawaiian cultural practitioners and *kūpuna* (elders) to advise NMFS on cultural matters and to conduct cultural protocols during Hawaiian monk seal response and other monk seal management and recovery-related activities. This network of culturally knowledgeable individuals can assist in developing a cultural awareness training program for monk seal researchers and volunteers.

Permits are required for access to conduct Hawaiian monk seal research and enhancement activities within the limits of the Monument. Any activities associated with monk seal recovery actions undertaken within the NWHI must therefore comply with Monument regulations and the terms and conditions of Presidential Proclamation 8031. Monument regulations state that "permittees [must] attend a cultural briefing on the significance of Monument resources to Native Hawaiians" and that there are "prohibitions against the disturbance of any cultural or historic property" (NMFS 2008b). Under the terms of the Monument permit, researchers and volunteers involved in monk seal recovery actions are required to coordinate their activities with Monument staff to ensure that they do not adversely impact any of the Monument's cultural resources.

Public consultation undertaken in conjunction with this PEIS has revealed some concerns regarding the potential or perceived indirect impacts of current Hawaiian monk seal recovery activities on traditional use of marine resources within the MHI. Many subsistence fishers perceived monk seals to be direct competitors for marine resources. Others felt that the presence of a Federally recognized endangered species within shoreline areas where they normally fished would restrict their access to those areas. These concerns have been addressed in detail in Section 4.8.2 (Subsistence Fishing), where the effects of all alternatives on fishing were determined to be negligible. The public outreach and community collaboration programs outlined in Chapter 5 can assist in resolving the concerns of subsistence fishers regarding monk seal recovery actions.

In summary, Alternative 1 is expected to result in negligible to minor adverse impacts on cultural resources and practices. As defined in Table 4.4-7, minor adverse impacts entail "possible contact with cultural resources, but no effect" on cultural resources or cultural practices due to the temporary nature of contact. Any possible effect is expected to be mitigated as discussed above and in Sections 5.4 - 5.6.

4.8.4.2 DIRECT AND INDIRECT EFFECTS ON CULTURAL RESOURCES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Under Alternative 2, presently authorized activities as permitted under the existing permit (10137) will continue until 2014. Once the present permit expires,

most research and enhancement activities would cease. After 2014 there would be no field research to monitor Hawaiian monk seal populations, implement de-worming, or conduct translocation. During the execution of the current permit through 2014, the potential impacts to cultural resources and traditional practices would be the same as for Alternative 1, and the same precautions are recommended. After the current permit expires, activities would be limited to remote observation and some collection of samples from materials left by monk seals. No monk seal translocation or handling would occur. Therefore, after 2014, Alternative 2 would involve less boat and land vehicle traffic, and less shoreline activity. The likelihood that shoreline resources would be directly impacted would be greatly reduced. Cultural awareness training for researchers and volunteers involved in monk seal recovery actions would still be recommended so as to help mitigate potential direct impacts.

In summary, Alternative 2 is expected to result in negligible to at most minor adverse impacts on cultural resources and practices. As defined in Table 4.4-7, minor adverse impacts entail "possible contact with cultural resources, but no effect on" cultural resources or cultural practices due to the temporary nature of contact. Any possible adverse effect is expected to be mitigated as discussed above and in Sections 5.4 – 5.6.

4.8.4.3 DIRECT AND INDIRECT EFFECTS ON CULTURAL RESOURCES OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)

Under Alternative 3 currently authorized activities under Alternative 1 would be continued and additional activities would be conducted. These additional actions would include increased permitted takes of Hawaiian monk seals for vaccination, deworming, and other activities. Alternative 3 would also include a seal behavior modification program intended to mitigate human-monk seal interactions. This program would serve to mitigate interactions between seals and people engaged in cultural practices such as subsistence fishing and other ocean use activities.

Under Alternative 3 the permitted scope and number of translocations would be expanded. This would include the translocation of monk seals within the MHI or within the NWHI, as well as the translocation of a limited numbers of seals from the MHI to the NWHI. As a result, boat and land vehicle activity, as well as shoreline activities, could be greater under Alternative 3 than under Alternatives 1 or 2. For example, approximately twenty-five more weaned pups could be translocated annually within the MHI under Alternative 3 than under Status Quo (Alternative 1). The direct effects of this increased activity on cultural resources could be successfully mitigated through the implementation of the training program recommended under Alternative 1.

As discussed in Section 4.8.2.3, the marginal increase in the Hawaiian monk seal population growth rate in the MHI resulting from Alternative 3's survival

enhancement activities is not likely to result in an indirect adverse effect on subsistence fishing.

In summary, Alternative 3 is expected to result in negligible to at most minor adverse impacts on cultural resources and practices. As defined in Table 4.4-7, minor adverse impacts entail "possible contact with cultural resources, but no effect on" cultural resources or cultural practices due to the temporary nature of contact. Any possible effect is expected to be mitigated as discussed above and in Sections 5.4 – 5.6.

4.8.4.4 DIRECT AND INDIRECT EFFECTS ON CULTURAL RESOURCES OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Alternative 4 would encompass all of the activities permitted under Alternative 3, plus two-stage translocation of Hawaiian monk seal pups from NWHI to MHI, and then back to the NWHI when the seals reach age two or three years. This translocation program would be a phased process with a gradual increase in seal numbers. Any adverse interactions with humans occurring as a result of translocations would influence whether and at what level the program would continue. The increased capture and transport of the seals under Alternative 4 would result in increased boat and land vehicle traffic, as well as pedestrian traffic to and from capture sites. The mitigation measures recommended under Alternatives 1 and 3 and in more detail in Sections 5.4 – 5.6 should ensure that impacts to cultural resources remain negligible to minor.

Concerns were expressed during public meetings held in association with the PEIS that the introduction of increased numbers of monk seals to the MHI from the NWHI under alternative 4 would result in a depletion of fish stock, directly impacting the livelihood of fishers practicing traditional subsistence fishing. This potential is evaluated in detail in Section 4.8.2.4, and the temporary increase in the MHI monk seal population associated with two-stage translocation under Alternative 4 would be likely to have negligible indirect adverse effects on subsistence fishing.

In summary, Alternative 4 is expected to result in negligible to at most minor adverse impacts on cultural resources and practices. As defined in Table 4.4-7, minor adverse impacts entail "possible contact with cultural resources, but no effect on" cultural resources or cultural practices due to the temporary nature of contact. Any possible effect is expected to be mitigated as discussed above and in Sections 5.4 – 5.6.

4.8.4.5 CUMULATIVE EFFECTS ON CULTURAL RESOURCES AND TRADITIONAL CULTURAL PRACTICES

Summary of Direct and Indirect Effects on Cultural Resources

As described above, the effects of research and enhancement activities proposed under Alternatives 1, 2, 3, and 4 could result in negligible to at most minor direct

and indirect effects on cultural resources and traditional cultural practices within the affected environment. Current and proposed research and enhancement activities would occur infrequently in limited areas along the shorelines of both the MHI and the NWHI. Due to the restricted nature of the activities, the direct effects would also be limited. The recommended mitigation measures described above and in Sections 5.4 – 5.6 would serve to minimize these potential effects. Possible indirect effects to cultural resources and traditional cultural practices from Hawaiian monk seal recovery actions would primarily be associated with the possible impacts of increased monk seal presence on traditional subsistence fishing practices in the MHI. These impacts were found to be negligible in Section 4.8.2 for all alternatives, with impacts potentially additionally mitigated by the behavioral modification programs instituted under Alternatives 3 and 4. The mitigation programs are designed to reduce interactions between monk seals and people engaged in traditional cultural practices such as subsistence fishing and other ocean use activities.

Direct and indirect effects of monk seal research and enhancement activities on cultural/traditional practices and cultural and historic properties are evaluated in terms of how cultural practices might be impeded or properties might be altered. Table 4.8-9 summarizes the direct and indirect effects of the alternatives on cultural/traditional practices and cultural and historic properties.

Table 4.8-9 Summary of Direct and Indirect Effects of the Alternatives on Cultural Resources and Traditional Cultural Practices

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Cultural Resources or Traditional Cultural Practices	Negligible to Minor	Negligible to Minor	Negligible to Minor	Negligible to Minor

Past, Present and Future Actions and Events Contributing to Cumulative Effects

Past, present and reasonably foreseeable future actions that may affect cultural/traditional practices and cultural and historic properties are summarized in Table 4.8-10.

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Table 4.8-10 Effects of Past, Present and Reasonably Foreseeable Future Actions on Cultural and Historic Practices and Properties

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris	• Damage to cultural resources or properties • Restricted access to traditional areas for cultural practices •	• 2011 Japanese Tohoku earthquake and tsunami debris • Storm damage to cultural flora and fauna. • Debris increases likelihood of damage to cultural flora and fauna.	-
Climate Change		• Subtropical Pacific ecosystem changes evident. Future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011). • Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish populations are affected by these changes and can be both beneficial and adverse.	+/-
Introduction of Invasive species		• Parasites have been shown to be significant stressors in many species (Reif et al. 2006). • Invasive plants may outcompete native plants used for cultural practices.	-
Predation by apex predatory fish nearshore (30m depth)	• Mortality of fish	• Apex predatory fish consume a minimum of 66,000 kg/day (146,000 lb/day) approximately 50 times more than a Hawaiian monk seal (Sprague et al. 2013). Predatory fish may consume smaller fish sought for cultural practices.	-/+
Military activities			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Acoustic or physical stressors on cultural resources and historic properties	• "Acoustic stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not affect submerged cultural resources. Training and testing would continue only in areas currently utilized for these activities. As a result, effects on cultural resources are not anticipated within the US territorial waters because measures have been previously implemented to protect these resources" (HSST EIS/OEIS 2013). • Physical stressors resulting from use of seafloor devices during training and testing could affect submerged cultural resources however measures are currently implemented to mitigate these effects" (HSST EIS/OEIS 2013). • To the extent that HSST activities could affect culturally important marine flora and fauna used in traditional practices, potential impacts to cultural resources could occur though based on available information the nature and extent of these impacts cannot be defined at this time.	-
Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS)			
Commercial			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Unregulated fishing (1913 - 2002) Sea cucumber harvest (1882) Black-lipped oyster harvest (1928-1930) Lobster harvest (1970-1999)	• Mortality of fish • Reproductive effects on fish	• Unregulated take, reducing long term sustainability of marine fish populations for cultural practices. • Long-term catch trends suggest that there has been approximately an 80 percent decline in the nearshore stocks this century. Overfishing is partially due to an increase in population, improved fishing technology, improved gear, and failure to recognize or follow traditional conservation practices. Additionally, the number of commercial permits issued to collect reef fish increased by 39 percent between 1995 and 1998 (NOAA 2013).	-
Commercial bottomfish fisheries	• Competition for culturally important fish and other marine fauna	• Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006). • Overfishing may affect the availability of culturally important fish.	-
Commercial pelagic fisheries		• 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013). • To the extent that commercial fisheries compete for resources with cultural uses, the availability of fish and other marine fauna for cultural practices may be affected though the nature and extent of this impact cannot be determined best on available data. However, recreational and subsistence fisheries likely harvest more fish than commercial fisheries as described below.	-
Recreational and subsistence fisheries		• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • Limited data on subsistence harvest of fish species in Hawaii make estimating harvest levels difficult. • 2013: daily commercial nearshore catch was estimated to be 1676 kg, the near-shore recreational and subsistence catch was estimated to be 2178 kg (Sprague et al. 2013) • Widely believed that nearshore recreational and subsistence catch is equal to	-

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
		or greater than the nearshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander et al. 2004). • These data suggest that subsistence and recreational fishing may have a greater impact on the availability of resources for cultural practices than commercial fisheries.	
Wai`anae Wastewater Treatment Plan Modification Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Water quality improvements	• Wastewater treatment plant improvements would generally be expected to reduce contaminants and biological waste streams entering the coastal ecosystem. Thus, minimizing exposure of marine fauna to contaminants and biological waste would result in improvements in habitat and would likely be beneficial for species used in cultural practices.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices widely impact coral reef habitat where cultural resources may be found. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013). • To the extent that culturally important resources are located in areas where sediment runoff and pollution are problematic, cultural resources could be adversely affected.	-
Other Government Activities			

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Hawai`i Environmental Justice Bill: Senate Bill 2145 EO 12898: Environmental Justice	• Protection of minority interests for cultural practices	• To the extent that minority populations rely on subsistence fisheries for cultural practices, protection of minorities from projects that may cause disproportionate impacts would result in benefits to these groups.	+
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	• Closed fishery	• 2006: regulations prohibited commercial fishing, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). • 2009 remaining permit holders surrendered permits to NMFS in exchange for compensation from Federal Government and fishery was closed. Total NWHI bottomfish catch in 2009 was 29 metric tons. • Closure of the commercial fishery may have increased the amount of fish species available for cultural use though the extent of this change is difficult to assess using currently available data.	+
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Redistribution of cultural activities to other areas • Protection of culturally significant historic properties	• Cultural practices may move to other areas where no time-area closures are in effect though overall this is not expected to have a long term negative on cultural practices. • Historic properties may benefit from spinner dolphin protection measures due to potential time-area closures in bays around the MHI; potential additional protection of habitat and better recruitment of marine fauna could benefit and therefore provide more resources for cultural use.	+
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas Removal of marine debris from high seas	• Reduction in marine debris	• Reduction in marine debris could minimize potential damage to culturally important flora and fauna. •	+
Hawaiian Monk Seal Critical Habitat Designation	• Habitat protection	• Marine fauna populations may benefit from Monk Seal Habitat designation due to the additional protection of habitat and better recruitment of marine fauna could benefit and therefore provide more resources for cultural use.	+

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Fishery Ecosystem Plan for the Hawai`i Archipelago	• Improved protection of culturally important species	• Fishery plan may promote more stable prey resources important for cultural practices.	+ / -
Measures to End Bottomfish Overfishing in the Hawaiian Archipelago		• Fishery plan may promote more stable prey resources that are important for cultural practices.	+

Cumulative Effects Conclusion for Cultural Resources

Among the primary past human activities that have affected cultural resources and traditional cultural practices within the affected environment is the extensive coastal development (residential, commercial, and governmental) that has taken place within the MHI since the 1950s. Areas of native coastal vegetation have been disturbed and shoreline access has been restricted. Overfishing from commercial, recreational and even subsistence fishing (PIFSC 2011; Moffitt et al. 2006; Polovina 2011) has also resulted in a depletion of traditional marine subsistence resources. Past military operations have resulted in coastal disturbance on Midway and some of the other NWHI. Significant storm events such as hurricanes and tsunami events have impacted traditional cultural resources both in the MHI and the NWHI due to storm damage or debris. Continued development and overfishing have the potential to further impact these resources.

The contribution of any of the Alternatives to a cumulative impact on cultural resources and traditional cultural practices is considered negligible in light of other stressors described above such as coastal development. In addition, the mitigation measures outlined above and discussed in more detail in Chapter 5 would minimize any long term effects of all Alternatives on cultural resources and traditional cultural practices.

HISTORIC PROPERTIES

As described in Section 3.4.7.3, a variety of historical properties and traditional historic properties are present within the project area for proposed Hawaiian monk seal recovery actions. These sites are most abundant within the MHI, but also occur in the NWHI. The effects to these resources from the recovery actions proposed in this PEIS may be either direct or indirect. Direct effects are those that physically alter the historic property in some way, while indirect effects diminish some significant aspect of the property, but do not physically alter it. The purpose of this section is to identify direct, indirect and cumulative effects to cultural and historical resources that may result from proposed monk seal recovery actions.

Potential direct impacts to historic and cultural resources can result from the physical activities associated with monk seal recovery actions or from the activities of monk seals relocated as part of the recovery effort. Pedestrian and vehicle traffic through remote areas in order to access seal locations and vessel traffic to access seals on remote beaches have the greatest potential to affect historic and cultural resources. Land based pedestrian and vehicle traffic has the potential to directly impact fragile stacked stone structures, subsurface archaeological deposits, and human burials. These sites may be located along the route of travel from the established road to the study or translocation area, on the beach itself, or in adjacent sand dunes. There is much less likelihood that the

activities will affect areas that may be eligible for listing as Traditional Cultural Properties. It is important, however, that NMFS staff and volunteers be aware of such areas and treat them with respect. Vessel anchoring has the potential to directly impact marine wreck sites and other underwater historic properties. Due to the short term nature of monk seal recovery activities there is much less potential for indirect effects on historic properties, such as long-term visual impacts.

During their normal haul out activities, Hawaiian monk seals seldom venture further inland than the high tide line, and therefore translocated seals are unlikely to adversely impact coastal historic and cultural sites. One possible exception is coastal fishponds. A number of traditional *loko iʻa* (fishponds), located along the coastlines of the MHI, have been returned to operation in the last few years. A translocated monk seal that managed to enter such a pond could feed on the fish being raised there, thus disrupt aquaculture operations. The physical activities involved in removing the monk seal from within the pond could possibly result in damage to the structure.

4.8.4.6 DIRECT AND INDIRECT EFFECTS ON HISTORIC PROPERTIES OF ALTERNATIVE 1 – STATUS QUO

Alternative 1, the Status Quo, involves the continuation of currently authorized activities past 2014. These include activities such as monitoring and some sample collection that do not involve the capture and handling of seals, as well as activities that do involve the capture and handling of seals (marking, measuring, sample collection, vaccination, de-worming, disentanglement, carcass removal, translocation). Under this alternative, the translocation of seals only takes place within the MHI or within the NWHI (*i.e.*, no translocation of seals from the NWHI for release in the MHI or from the MHI to the NWHI).

Activities conducted under Alternative 1 may include aerial, vessel, and land-based surveys, as well as some handling and translocation of monk seals. Boats and land vehicles will be used to transport researchers and possibly animals. Researchers will also traverse beach and dune areas on foot to reach monk seal locations. Recovery activities may be conducted throughout the APE, in the MHI, NWHI, and on Johnston Atoll. Researchers will seasonally (typically April or May through August) occupy existing camp sites in the NWHI (see Section 3.3.1.9).

Monk seal recovery actions are likely to take place in both well-traveled beach areas and in more remote locations that have not been subject to much human traffic. The remote areas are fragile and susceptible to disturbance. Archaeological sites located along the path of access to and from monk seal locations have the potential to be affected. Stacked stone structures and surface scatters of cultural material could be impacted by vehicle or pedestrian traffic, as could fragile dune areas that may contain buried cultural deposits or human remains. In order to mitigate potential impacts, researchers and volunteers

undertaking monk seal recovery activities would need to recognize and avoid these sensitive sites and areas. At times researchers will be required to set up temporary campsites near a seal (often a mother and weaning pup) to monitor and protect the seal(s). In these instances, care will need to be taken to avoid establishing campsites on or near historic or cultural sites. While vessel-based activities are less likely to impact historic sites, anchoring could result in damage to marine wreck sites.

There is also the possibility that Hawaiian monk seals may enter fishponds on their own accord and may have to be physically removed from them. The activities associated with the removal of a monk seal from the interior of a fishpond have the potential to result in damage to the fishpond walls and other structural features.

The mitigation measures outlined at the end of this section and further discussed in Chapter 5 have been designed alleviate the potential adverse effects of the activities described above on historic and cultural resources. If these recommended measures are followed, research and enhancement activities authorized under Alternative 1 would not result in any direct impacts to archaeological and cultural sites.

In summary, Alternative 1 is expected to result in negligible to at most minor adverse impacts on historic properties. As defined in Table 4.4-8, minor adverse impacts entail "possible contact with (a) site (or property), but no effect." Any possible effect is expected to be mitigated as discussed above and in Sections 5.4 – 5.6.

4.8.4.7 DIRECT AND INDIRECT EFFECTS ON HISTORIC PROPERTIES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Under Alternative 2, presently authorized activities as permitted under the existing permit (10137) will continue until 2014. Once the present permit expires, most research and enhancement activities would cease. After 2014 there would be no field research to monitor populations, implement de-worming, or conduct translocation. During the execution of the current permit through 2014, the potential impacts to cultural resources and traditional practices would be the same as for Alternative 1, and the same precautions would be taken. After the current permit expires, activities would be limited to remote observation and some collection of samples from materials left by Hawaiian monk seals. No monk seal translocation or handling would occur except potentially under the Marine Mammal Health and Stranding Response Program. Therefore, after 2014, Alternative 2 would involve less boat and land vehicle traffic, and less shoreline activity. The potential for adverse impacts to shoreline cultural and historic resources would be greatly reduced. Mitigation measures associated with monk seal recovery actions (discussed below) would still be recommended for the duration of the permit so as to help mitigate potential direct and indirect impacts.

In summary, Alternative 2 is expected to result in negligible to at most minor adverse impacts on historic properties. As defined in Table 4.4-8, minor adverse impacts entail "possible contact with (a) site (or property), but no effect." Any possible effect is expected to be mitigated as discussed above and in Sections 5.4 – 5.6.

4.8.4.8 *DIRECT AND INDIRECT EFFECTS ON HISTORIC PROPERTIES OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

Under Alternative 3 currently authorized activities under Alternative 1 would be continued and additional activities would be conducted. These additional actions could include increased handling of Hawaiian monk seals for vaccination, de-worming, and other activities. Alternative 3 would also include a seal behavior modification program intended to prevent or reduce human-seal seal interactions, including interactions with people engaged in cultural practices. The scope and number of permitted translocations would also be expanded. This would include the potential for translocation of monk seals within the MHI or within the NWHI, as well as the potential for translocation of monk seals from the MHI to the NWHI. As a result, boat and land vehicle activity, as well as shoreline activities, could be greater under Alternative 3 than under Alternatives 1 or 2. For example, approximately 25 more weaned pups may be translocated annually within the MHI under Alternative 3 than under Status Quo (Alternative 1). Despite the increase in monk seal recovery activities under Alternative 3, the direct effects of these activities could be successfully mitigated through the behavior modification action and implementation of the mitigation measures outlined below.in Chapter 5.

In summary, Alternative 3 is expected to result in negligible to at most minor adverse impacts on historic properties. As defined in Table 4.4-8, minor adverse impacts entail "possible contact with (a) site (or property), but no effect." Any possible effect is expected to be mitigated as discussed in Sections 5.4 – 5.6.

4.8.4.9 *DIRECT AND INDIRECT EFFECTS ON HISTORIC PROPERTIES OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION*

Alternative 4 would encompass all of the activities permitted under Alternative 3, plus two-stage translocation of Hawaiian monk seal pups from NWHI to MHI, and then back to the NWHI when the seals reach age two or three years. This translocation program would be a phased process with a gradual increase in seal numbers. Any adverse interactions with humans occurring as a result of translocations would influence whether and at what level the program would continue. The increased capture and transport of the seals under Alternative 4 would result in increased boat and land vehicle traffic, as well as pedestrian traffic to and from capture sites. As a result of potentially increased translocation activities carried out under Alternative 4, a maximum of sixty additional monk seals could be present temporarily within the MHI. The potential exists that

some of these introduced seals may find their way into coastal fishponds or fish traps. The monk seal behavior modification program included in Alternatives 3 and 4 could help prevent or mitigate the impact of seals on coastal fishponds and fish traps. In addition, the monk seal removal measures outlined below and discussed in detail in Section 5.5.3 should allow these errant seals to be successfully removed without damage to the historic structures. The mitigation measures recommended under Alternatives 1, 2 and 3 (and discussed further in Chapter 5) would not change with Alternative 4. The implementation of these mitigation measures should ensure that impacts to historic and cultural sites remain negligible to minor at most.

In summary, Alternative 1 is expected to result in negligible to at most minor adverse impacts on historic properties. As defined in Table 4.4-8, minor adverse impacts entail "possible contact with (a) site (or property), but no effect." Any possible effect is expected to be mitigated as discussed in Sections 5.4 – 5.6.

4.8.4.10 CUMULATIVE EFFECTS OF THE ALTERNATIVES ON HISTORIC PROPERTIES

The analysis of cumulative effects on historical properties, including traditional cultural properties, considers the potential direct and indirect effects of proposed alternatives within the APE, as well as external (not research or enhancement) past activities that may have resulted in substantial impacts (see Table 4.4-10). In addition, any external future actions that are reasonably foreseeable, referred to as RFFAs, must be considered (see Table 4.4-10 for the list of RFFAs considered in this PEIS).

Summary of Direct and Indirect Effects on Historic Properties

The effects of research and enhancement activities proposed under any of the proposed Alternatives could result in negligible to minor direct and indirect effects on cultural and historic resources within the project area. Research and enhancement activities would be temporary and would occur in a very limited area along and adjacent to the shoreline within the MHI and NWHI where those resources that do occur could be successfully avoided. Mitigation measures presented in Sections 5.4 – 5.6 should mitigate any potential adverse effects.

Table 4.8-11 Summary of Direct and Indirect Effects of the Alternatives on Cultural and Historic Properties

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Cultural and Historic Properties	Negligible to Minor	Negligible to Minor	Negligible to Minor	Negligible to Minor

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Historic Properties

Past, present and reasonably foreseeable future actions that may affect cultural/traditional practices and cultural and historic properties are summarized in Table 4.8-9 presented in Section 4.8.4.5.

Past actions on cultural and historic properties within the Project Area that may have caused impacts included but are not limited to coastal human settlements or development (earth moving activities for residential, commercial, government or transportation projects), military operations or warfare, looting or other deleterious activities, and significant storm events such as a hurricane or tsunami. While awareness and protection of cultural and historic resources throughout Hawai‘i is supported through legislation such as the NHPA and State regulations, potential impacts to these resources could still occur as a result of the same activities and events listed as past actions.

Among the primary past actions that have affected historic properties within the project area is the extensive coastal development (residential, commercial, and governmental) that has taken place within the MHI since the 1950s. Both surface structures and buried cultural deposits have been disturbed or destroyed completely. While awareness of cultural and historic resources throughout Hawai‘i has increased in recent decades, and their protection is supported through legislation such as the NHPA and State regulation, impacts to these resources continue to occur. Significant storm events such as a hurricanes and tsunami have also affected historic properties both in the MHI and the NWHI. Past military operations have resulted in coastal disturbance on Midway and some of the other NWHI. Since the establishment of the Monument, adverse impacts to cultural and historic resources there have been greatly diminished.

Cumulative Effects Conclusion for Historic Properties

Given the temporary and limited nature of the monk seal recovery actions addressed in this PEIS, the likelihood of adverse impacts to cultural and historic

properties is low. The implementation of the mitigation measures presented below will further reduce the potential for adverse effects. The contribution of Alternatives 1, 2, 3, and 4 to cumulative effects on cultural and historic resources is therefore negligible in light of other external activities that may be impacting historic properties throughout Hawaii.

4.8.5 RECREATION AND TOURISM

This section addresses potential direct, indirect and cumulative effects of the alternatives on recreation and tourism in the MHI. In general, there are two potential types of effects on recreation and tourism of any type of action: effects on the recreation and tourism economy that may result from changes in the number of visitors and their expenditures, and effects on the level of enjoyment and value of the experience to the recreators/tourists themselves. These two types of effect are closely related as the level of visitor enjoyment also affects the number of visitors and their expenditures. Based on these types of potential effect, Table 4.4-6 in Section 4.4.3 summarizes the criteria used to evaluate effects of the alternatives on recreation and tourism. As indicated in the table, the number of recreation and tourism trips is the primary criteria used to evaluate effects on recreation and tourism.

The alternatives are not expected to result in direct effects on recreation or tourism because such actions as vaccination or translocation will not likely occur in locations popular for recreation or tourism activities. However, it is possible that there may be indirect effects on recreation or tourism if an Alternative affects the monk seal population in the MHI, and then the monk seal population, in turn, affects the number or value of recreation/tourism trips.

Changes in the monk seal population could affect recreation and tourism activities if the size of the population affects any of the four characteristics of recreation/tourism resources:

1. Quality or quantity of recreation/tourism resources,
2. Level of access to recreation/tourism resources,
3. Public safety associated with use of recreation / tourism resources, and
4. Cost of recreation/tourism resources.

The following discussion analyzes the potential for monk seal populations to affect recreation and tourism through these four pathways.

4.8.5.1 QUALITY/QUANTITY OF RECREATION RESOURCES

Tourism is the #1 industry in Hawaii in terms of value to the state's economy (State of Hawaii Department of Business, Economic Development & Tourism, 2011). Hawaii Tourism Authority surveys indicate that visitors view Native Hawaiian culture and natural beauty as major assets of Hawaii as a destination. Wildlife-related recreation, including whale watching, is popular in Hawai'i. Many people enjoy viewing wildlife, particularly marine mammals such as

whales and monk seals, in their native habitat. A Sierra Club survey of visitors to Maui found that excursions into nature were the most memorable part of most people's trips to Hawaii (53.4%) (Sierra Club Maui Group, 1998). Economically, wildlife viewing opportunities are worth hundreds of millions of dollars to Hawaii's $10 billion a year tourism industry. And tourists are willing to pay more to protect Hawaii's environment: 81% expressed willingness to contribute $1 per day in addition to their room rate to preserve natural areas, coastline and Hawaiian cultural sites. Over 90% of visitors to Hawaii indicated that the preservation of natural areas would be an important factor in their decision to return to the islands (Sierra Club Maui Group, 1998; Dayer *et al.* 2006). Native threatened and endangered species are also important to Hawaii's residents. Based on a 2004 "Wildlife Values in the West" survey, a large majority of Hawaii's residents (71.4%) strongly agree that it is important to take steps to prevent the extinction of endangered species (Dayer *et al.* 2006). To the extent that the monk seal population in the MHI increases due to an alternative, the alternative may indirectly enhance the recreation/tourism experience through increased wildlife viewing opportunities and benefit the recreation/tourism economy.

Increases in the monk seal population could potentially affect recreational fishing, but all such effects under all alternatives are expected to be negligible (See Section 4.8.3). It is possible that such changes in fish abundance associated with change in the monk seal population due to the alternatives may also affect other aquatic recreation activities, such as snorkeling. However, as noted in Section 4.8.3, effects on the abundance of fish species due to any of the alternatives are expected to be negligible.

Therefore, it is expected that any measurable effects on the quality/quantity of recreation resources in the MHI due to the alternatives would be related to changes in wildlife viewing opportunities, specifically, monk seal viewing opportunities that would be enhanced with increased populations of monk seal.

4.8.5.2 *ACCESS TO RECREATION / TOURISM RESOURCES*

Many recreation and tourism activities in Hawai`i are beach and water-related. Recreation and tourism can be affected if an alternative affects access to recreational resources, such as shoreline or waters for boating. NMFS does not use beach closures as a part of their seal management strategy at present, and no such management is part of any of the alternatives. At times, NMFS does establish temporary protective zones on beaches for seals, particularly areas where monk seals are pupping. These protective zones are not closures and do not prohibit access, but simply discourage people from

At times, NMFS does establish temporary protective zones on beaches for seals. These protective zones are not closures and do not prohibit access, but simply discourage people from approaching the monk seals too closely.

approaching the monk seals too closely. If an alternative were to increase the monk seal population such that more monk seals are pupping on public beaches and more protective zones are established, access to some areas of some beaches would be discouraged. It is expected that the benefit of viewing the monk seals would outweigh any adverse effects of reduced access, resulting in a net positive for tourists and recreationists. Pupping in such areas would provide high quality wildlife viewing opportunities for beach recreationists. Many tourists and recreationists actively seek and value marine wildlife viewing opportunities, as indicated by the popularity of such activities as whale watching tours, snorkeling, and scuba diving. Furthermore, reduced access from the establishment of protective zones is not mandatory, but is rather a recommendation. So no enforced access reduction is expected to occur.

4.8.5.3 PUBLIC SAFETY

It is also possible that increased monk seal populations due to an alternative could result in increased human-seal interactions, with potential implications for public safety. However, as discussed in more detail in Section 3.4.9 Public Safety, there are few reported incidents of adverse human-seal interactions. Alternatives 3 and 4 include provisions for behavior modification to develop new strategies for resolving conflicts with habituated seals that might pose a risk to public safety. Given the short-term and marginal increase in the population of monk seal in the MHI under the alternatives and the fact, under Alternative 4 (the only alternative allowing two-stage translocation of young seals from the NWHI to the MHI) no translocated seals will pup in the MHI (they will be moved back to NWHI prior to reaching breeding age), the public safety implications, and attendant effects on recreation and tourism resources due to the proposed alternatives, are expected to be negligible. In fact, behavioral modification activities proposed under Alternatives 3 and 4 are intended, in part, to mitigate seals behaving in a way that involves public safety concerns.

Despite evidence of shark predation on Hawaiian monk seal there is no evidence that more monk seals in the MHI will lead to more shark attacks on humans. For example, while the monk seal population has increased in the MHI over the past 10 years, incidents of shark attacks on people have shown no corresponding increase (see Table 3.3-6).

4.8.5.4 COST OF RECREATION RESOURCES

Changes in cost can also affect recreation and tourism. However, it is not expected that there would be any direct or indirect effects on the cost of business for recreation or tourism service providers that would translate into changes in prices, or any effects on costs of admission to parks and other recreational areas. Therefore, it is not expected that changes in the monk seal population due to any of the alternatives would affect the cost to tourists or recreationists of enjoying recreational resources in Hawai'i.

4.8.5.5 *DIRECT AND INDIRECT EFFECTS ON RECREATION RESOURCES OF ALTERNATIVE 1 – STATUS QUO*

Under Alternative 1, the Hawaiian monk seal population in the MHI is anticipated to increase due to the apparent favorable conditions for continued growth as evidenced by the demographics of the Hawaiian monk seal population (Baker *et al.* 2011*a*) independent of any actions taken by NMFS. While this growth that is occurring naturally already may be enhanced by Alternative 1 activities such as de-hooking, disentanglement, and weaned pup translocation measures, the contribution of Alternative 1 activities to any increase in the monk seal population would be marginal. As discussed above, increases in the MHI monk seal population may affect recreation and tourism if any of the following characteristics of recreation/tourism resources are affected: quality/quantity of resources, level of access, public safety, and cost. Alternative 1 is not expected to have any direct effects on these characteristics.

Indirect effects of Alternative 1 related to increases in the monk seal population are expected to be primarily limited to effects on the quantity of recreation resources, specifically the quantity of monk seal viewing opportunities. As many people enjoy viewing wildlife, increases to the monk seal population would likely enhance wildlife viewing recreation, and consequently, enhance the visitor experience.

Increases in the monk seal population associated with Alternative 1 may limit small portions of some public beaches if more protective zones are established to discourage people from approaching monk seals too closely. However, the benefits associated with increased wildlife presence on such beaches are expected to outweigh any adverse effects due to changes in access. Some weaned pup translocations within the MHI are intended to move pups away from areas where they may be interacting with people and pose a public safety risk. By translocating seals that may be socializing with humans, public safety as well as safety for the seals, would likely be improved. Finally, any small increases in the monk seal population due to alternative 1 would have negligible effects on public safety and cost of recreation experiences.

Conclusion for Direct and Indirect Effects on Recreation Resources from Alternative 1 (Status Quo)

There are negligible direct effects of Alternative 1 anticipated for recreation and tourism activities in Hawai'i. Marginal increases in the MHI monk seal population due to Alternative 1 may have an indirect effect on recreation and tourism activities, but is likely to be negligible due to the small population increase predicted. In summary, direct and indirect effects on recreation and tourism due to changes in the monk seal population under Alternative 1 are expected to be negligible but may result in positive effects on wildlife viewing opportunities.

4.8.5.6 *DIRECT AND INDIRECT EFFECTS ON RECREATIONAL RESOURCES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS OR AUTHORIZATIONS)*

Alternative 2 (No Action) entails the continuation of existing research as permitted under the existing permit (No. 10137) until 2014. Once expired, these research and enhancement activities would cease. Unlike the activities under some other alternatives, there would be no field research to monitor populations, implement de-worming, or translocation.

As discussed above, changes in the MHI monk seal population may affect recreation and tourism if any of the following characteristics of recreation/tourism resources are affected: quality/quantity of resources, level of access, public safety, and cost. Alternative 2 is not expected to have any direct effects on these characteristics.

Indirect effects of Alternative 2 related to changes in the monk seal population would likely be primarily limited to effects on the quantity of recreation resources, specifically the quantity of monk seal viewing opportunities. As many people enjoy viewing wildlife, a smaller increase in the monk seal population compared to Alternative 1 will result in smaller positive effects on wildlife viewing recreation, and consequently, the visitor experience.

Changes in the monk seal population under Alternative 2 would be negligible as no research or enhancement would occur after 2014. Activities that could occur prior to that date are not anticipated to result in notable changes to beach access if protective zones were established to discourage people from approaching monk seals too closely. However, as the benefits associated with increased wildlife presence on such beaches are expected to outweigh any adverse effects due to changes in access, Alternative 2 is expected to provide fewer benefits to recreation/tourism than Alternative 1. Some weaned pup translocations within the MHI are intended to move pups away from areas where they may be interacting with people and pose a public safety risk. By translocating seals that may be socializing with humans, public safety as well as safety for the seals, would likely be improved. Under Alternative 2 effects on public safety and cost of recreation experiences are expected to be negligible.

Conclusion for Direct and Indirect Effects on Recreational Resources from Alterative 2 (No Action)

There are negligible to no direct effects of Alternative 2 anticipated for recreation and tourism activities in Hawai`i. Compared to Alternative 1, MHI monk seal population may increase slightly less, resulting in less indirect effect on recreation and tourism activities. In summary, Alternative 2 is expected to provide fewer benefits to recreation/tourism than Alternative 1 due to fewer wildlife viewing opportunities from a smaller monk seal population.

4.8.5.7 *DIRECT AND INDIRECT EFFECTS ON RECREATIONAL RESOURCES OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

Alternative 3 entails the expansion of research and enhancement activities currently permitted, most of which are focused on improving the population status in the NWHI. The Alternative 3 expanded activities most relevant to the MHI are a vaccination program and behavioral modification activities.

Under Alternative 3, changes in the MHI monk seal population could affect recreation and tourism if any of the following characteristics of recreation/tourism resources were affected: quality/quantity of resources, level of access, public safety, and cost. Alternative 3 is not expected to have any direct effects on these characteristics.

Indirect effects of Alternative 3 related to increases in the monk seal population are expected to be primarily limited to effects on the quantity of recreation resources, specifically the quantity of monk seal viewing opportunities. As many people enjoy viewing wildlife, a larger increase in the monk seal population compared to Alternative 1 will result in larger positive effects on wildlife viewing recreation, and consequently, the visitor experience.

Increases in the monk seal population under Alternative 3 could reduce access to some additional public beaches, compared to Alternative 1, if more protective zones were established to discourage people from approaching monk seals too closely. However, as the benefits associated with increased wildlife presence on such beaches are expected to outweigh any adverse effects due to changes in access, Alternative 3 is expected to provide greater benefits to recreation/tourism than Alternative 1. Changes in the monk seal population due to Alternative 3 would have negligible effects on the cost of recreation experiences. Behavioral modification proposed under Alternative 3 is intended to reduce public safety concerns by reducing human-seal interactions. This would likely result in a moderate beneficial effect on public safety.

Conclusion for Direct and Indirect Effects on Recreational Resources from Alternative 3 (Preferred Alternative)

There are negligible to no direct effects of Alternative 3 anticipated for recreation and tourism activities in Hawai`i. Compared to Alternative 1, the MHI monk seal population may increase slightly more, resulting in greater indirect effect on recreation and tourism activities. However, public safety would likely benefit from reduced human-seal interactions from the combination of behavioral modification and translocating seals that may become socialized. Alternative 3 is expected to provide more benefits to recreation and tourism than Alternative 1 due to the potential for more wildlife viewing opportunities of monk seals as well as improve public safety by reducing human-seal interactions. Therefore, the effect of Alternative 3 on tourism and recreation is likely to be moderate and beneficial.

4.8.5.8 *DIRECT AND INDIRECT EFFECTS ON RECREATIONAL RESOURCES OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION*

Alternative 4 entails expanded research and enhancement activities, most of which, as under Alternative 3, are focused on improving the population status in the NWHI. The Alternative 4 expanded activities most relevant to the MHI are potential two-stage translocation involving temporarily moving weaned seals from the NWHI to the MHI, a vaccination program, and behavioral modification activities. The benefit of Alternative 4 is expected to primarily manifest as a reduction in the rate of decline in the NWHI as opposed to making significant contributions to the increase in MHI population growth naturally occurring (*i.e.,* without NMFS intervention). The proportion of seals temporarily translocated to the MHI under Alternative 4 would comprise a small portion of the total MHI monk seal population. Further, should the option to translocate seals from the NWHI to the MHI (allowed only under this alternative) be exercised, there would only be a temporary increase in the population of monk seals due to that action because seals would be returned to the NWHI once they reach age 2 or 3 yr.

As discussed above, changes in the MHI monk seal population may affect recreation and tourism if any of the following characteristics of recreation/tourism resources are affected: quality or quantity of resources, level of access, public safety, and cost. Alternative 4 is not expected to have any direct effects on these characteristics.

Indirect effects of Alternative 4 related to increases in the monk seal population are expected to be primarily limited to effects on the quantity of recreation resources, specifically the quantity of monk seal viewing opportunities. As many people enjoy viewing wildlife, a larger increase in the monk seal population compared to Alternative 1 will result in larger positive effects on wildlife viewing recreation, and consequently, the visitor experience.

Similar to Alternative 3, increases in the monk seal population under Alternative 4 could reduce access to some additional public beaches, compared to Alternative 1, if more protective zones were established to discourage people from approaching monk seal too closely. However, as the benefits associated with increased wildlife presence on such beaches are expected to outweigh any adverse effects due to changes in access, Alternative 4 could provide slightly greater benefits to recreation/tourism than Alternative 1. Changes in the monk seal population due to Alternative 4 would have negligible effects on public safety and cost of recreation experiences. Public safety would likely benefit from reduced human-seal interactions from the combination of behavioral modification and translocating seals that may become socialized. For this reason, the overall effect of Alternative 4 on public safety would likely be moderate and beneficial.

Conclusion for Direct and Indirect Effects on Recreational Resources from Alterative 4 (Enhanced Implementation)

Under Alternative 4, behavioral modification would likely reduce the number of human-seal interactions, thereby improving public safety and safety for seals. Assuming there would be better seal survival, more wildlife viewing opportunities from a larger monk seal population could occur. The overall effect of Alternative 4 on public safety would likely be moderate and beneficial.

4.8.5.9 CUMULATIVE EFFECTS OF ALTERNATIVES ON RECREATION AND TOURISM

Summary of Direct and Indirect Effects on Recreational Resources

As summarized in Table 4.8-12, the alternatives are not expected to result in any direct effects on recreation or tourism as such actions as vaccination or translocation will not likely occur in locations popular for recreation or tourism activities. However, it is possible that there may be indirect effects on recreation or tourism if an alternative affects the monk seal population in the MHI, and then the monk seal population, in turn, affects the number or value of recreation/tourism trips. In particular, indirect effects include changes in recreation opportunities related to monk seal wildlife viewing. Many people enjoy viewing wildlife, particularly marine mammals such as whales and the monk seal, in their native habitat. To the extent that the monk seal population in the MHI increases due to an Alternative, the Alternative may indirectly enhance the recreation/tourism experience through increased wildlife viewing opportunities and benefit the recreation/tourism economy.

Table 4.8-12 Summary of Direct and Indirect Effects of the Alternatives on Recreation or Tourism

	Alternative 1 **Status Quo**	**Alternative 2** **No Action; No Permit After 2014**	**Alternative 3** **Limited Translocation (Preferred Alternative)**	**Alternative 4** **Enhanced Implementation**
Changes in Recreation or Tourism	Negligible	Negligible	Moderate Beneficial	Moderate Beneficial

Past, Present and Future Actions and Events Contributing to Cumulative Effects on Recreation and Tourism

Past, present and reasonably foreseeable future actions that may affect recreation and tourism are summarized in Table 4.8-13.

Table 4.8-13 Past, Present and Reasonably Foreseeable Future Actions on Recreation and Tourism

Action / Event	Potential Effects	Description/Example	Effect
Natural Events			
Tsunami, Volcano, Earthquake, Hurricane Japanese Tohoku earthquake and tsunami debris	• Damage to recreation and tourism resources • Restricted access to recreation and tourism resources	• 2011 Japanese Tohoku earthquake and tsunami debris • Storm damage to recreation and tourism resources. • Debris increases likelihood of damage or restricted access to recreational or tourism areas.	-
Climate Change		• Subtropical Pacific ecosystem changes evident. Future climate change projected to shift ecosystem towards smaller fish even if fishing remains constant (Polovina 2011). • Long-term dynamics are driven in large part by climate (ocean variability) (Baker et al. 2012). Variability in fish populations are affected by these changes and can be both beneficial and adverse.	+/-
Military activities			
U.S. Navy Training - Hawai'i Range Complex (Hawaii Southern California Training and Testing Activities [HSST])	• Visibility of Naval Ships off the coast • Interference with recreation (*i.e.*, surfing or wildlife viewing)	• "Navy vessels present on the waters of the HRC represent a small fraction of the overall commercial and recreational boat traffic and, correspondingly, account for only a small fraction of the potentially restrictive circumstances present in the open-ocean area around Hawaii" (HSST EIS/OEIS 2013). • Tourism and recreational activities would be closer to shore than Naval activities thus interference of Navy training or other activities is not expected (HHST EIS OEIS 2013).	-
Commercial			

Action / Event	Potential Effects	Description/Example	Effect
Unregulated fishing (1913 - 2002) Sea cucumber harvest (1882) Black-lipped oyster harvest (1928-1930) Lobster harvest (1970-1999)	• Decreased population of marine species important for tourism (*i.e.*, wildlife viewing, etc.)	• Unregulated take, reducing long term sustainability of marine fish and other marine fauna populations important for sustaining tourism or recreation (*i.e.*, wildlife viewing, snorkeling tours, etc.).	-
Commercial bottomfish fisheries	• Decreased population of fish important for wildlife viewing or other recreation	• Aggregated bottomfish stock is below maximum sustainable yield (a fisheries management metric) suggesting that overfishing is resulting in declines in fish populations. Overfishing is most severe in MHI (PIFSC 2011; Moffitt et al. 2006). • Overfishing may affect the availability of fish for wildlife viewing.	-
Commercial pelagic fisheries		• 1950 – 1990s: fishing impacts on marine ecosystems (Pauly 2005). • 2010: pelagic fishery landings 26.6 million pounds (WPacFin 2011). • 2014: 6% increased quota recommended for bottomfish due to improved reporting and reduction in management uncertainty about stocks (WPFMC 2013). • Overfishing may affect the availability of fish for wildlife viewing..	-
Recreational and subsistence fisheries		• No license requirements in Hawaii making it difficult to manage overfishing (Moffitt et al. 2006). • Though data are lacking, recreational overfishing very likely contributing to decreases in fish species and therefore declines commercial fisheries landings (PIFSC 2011). • While recreational fishing is an important component of tourism and recreation overall, the impacts of recreational fishing on other tourism could be adverse if fish populations become overfished.	-
Wai`anae Wastewater Treatment Plan Modification Lā`ie Wastewater Collection System Expansion Phase II – Lā`ie	• Water quality improvements	• Wastewater treatment plant improvements would generally be expected to reduce contaminants and biological waste streams entering the coastal ecosystem. This would be beneficial for tourism and recreation due to improved water quality as well as indirect beneficial effects on marine flora and fauna sustainability.	+
Agriculture	• Nutrient pollution • Sedimentation	• Sediment runoff and pollution and nutrients from agricultural practices widely impact coral reef habitat where cultural resources may be found. • Sources of sediment on Hawaiian reefs include: improperly managed construction sites; cleared agricultural lands; heavy grazed lands; and eroding stream banks. Nutrients from fertilizers and pollutants such as	-

Action / Event	Potential Effects	Description/Example	Effect
		bacteria from livestock, herbicides, and insecticides enter marine waters in runoff and seepage. Nutrient pollution and sediments from coastal development and farming can block sunlight, smother corals, and impede larval settlement (NOAA 2013). • Increased sedimentation and pollution would result in more contaminants and biological waste streams entering the coastal ecosystem. This would have a negative effect on tourism and recreation due to poor water quality as well as indirect adverse effects on marine flora and fauna sustainability.	
Other Government Activities			
Closure of Bottomfish Fishery in the Hawaiian Archipelago (2006)	• Closed fishery	• 2006: regulations prohibited commercial fishing, except for the bottomfish fishery (and associated pelagic species catch), which had potential to continue until 2011 (U.S. Department of Commerce and Department of the Interior, 2006). • 2009 remaining permit holders surrendered permits to NMFS in exchange for compensation from Federal Government and fishery was closed. Total NWHI bottomfish catch in 2009 was 29 metric tons. • Closure of the commercial fishery may have increased the diversity and populations of fish species important for tourism and recreation (*i.e.*, snorkeling tours, wildlife viewing, etc.).	+
Hawaiian Spinner Dolphin Human Interaction Protection Measures	• Redistribution of tourism and recreation activities to other areas • Protection of natural habitats valued by tourists and recreationists	• Recreation or tourism may move to other areas where no time-area closures are in effect though overall this is not expected to have a long term negative impacts on overall tourism or recreation. • Natural habitats and species (*i.e.*, spinner dolphins) would benefit from protection measures due to potential time-area closures in bays around the MHI. The additional protection of habitat and better recruitment of marine fauna is likely valued by many tourists and recreationists.	+
State of Hawai`i DLNR. Clearing of rivers, streams, beach areas Removal of marine debris from high seas	• Reduction in marine debris	• Reduction in marine debris could result in safer, cleaner recreation and tourism areas.	+
Hawaiian Monk Seal Critical Habitat	• Habitat protection	• Restrictions on beach activities would likely have negligible effects on beach access or areas important for recreation. • Marine fauna populations may benefit from Monk Seal Habitat designation	+

Action / Event	Potential Effects	Description/Example	Effect
Designation		due to the additional protection thus benefitting valued resources important for recreation and tourism.	
Measures to End Bottomfish Overfishing in the Hawaiian Archipelago	• Improved protection of important species for recreation and tourism	• Fishery plan may promote more stable prey resources that are important for tourism and recreation.	+

The primary past effect on recreation and tourism in the MHI is the national and global economic decline in recent years that resulted in reduced tourism to the MHI. According to the Hawai`i Tourism Authority, in 2006 and 2007, there were a total of 69.1 million visitor days in Hawai`i. Visitor days decreased to 63.1 million in 2008 and then decreased further to 60.3 million in 2009. Tourism visits in 2010 started recovering (as discussed in Affected Environment section), with an increase of nearly 9 percent over 2009 visitor days.

Global health concerns can also limit air travel and affect the number of visitors to the MHI. For example, the 2009 H1N1 flu virus affected the number of visitors to Hawai`i, particularly from China, Taiwan, Singapore, and Japan (HTA, 2009).

While global economic and health concerns have affected the number of total visitors, visitor surveys show that the level of satisfaction and the likelihood of repeat visits by Hawai`i tourists has actually increased from 2005 to 2009, indicating that visitor perception of the overall quality of recreation and tourism resources in Hawai`i is becoming more positive (HTA 2009).

Reasonably foreseeable future wildlife management that may affect recreation and tourism on beaches and near shore areas include potential restrictions on human interaction with spinner dolphins in Hawai`i. NOAA is currently preparing an EIS (Spinner Dolphin Human Interaction EIS) regarding conservation measures to protect wild spinner dolphins. Among other potential effects, these management actions may limit opportunities for 'swim with wild dolphin' tours or boating tours that closely approach the spinner dolphins. Other future conservation efforts by NMFS and the State of Hawai`i may also affect recreation and tourism on the MHI, with potential positive effects (*i.e.*, enhanced wildlife populations and therefore increased chances of wildlife viewing) and potential adverse effects (*i.e.*, decreased proximity of access) on wildlife-viewing opportunities.

Cumulative Effects Conclusion for Recreation and Tourism

The alternatives would take place against a backdrop of recovering recreation and tourism levels. However, as discussed above, the direct and indirect effects of the alternatives on recreation and tourism are expected to be negligible. As the direct and indirect effects are anticipated to be so small, none of the alternatives is expected to contribute to overall cumulative effects on recreation and tourism.

4.8.6 ENVIRONMENTAL JUSTICE

CEQ, which has oversight of Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued guidance in 1997 for implementing the EO. Since then, some federal agencies such as the Department of Energy's (DOE) Office of NEPA Policy and Compliance, have provided additional detailed guidance for implementation through NEPA. In addition to NMFS' guidance for environmental justice

implementation through NEPA, CEQ and DOE guidance was also followed in this analysis.

The legal foundations for environmental justice in Hawai‘i were also considered in this analysis, including but not limited to the Hawai‘i Constitution, Hawai‘i Revised Statutes, and the Hawai‘i Environmental Justice Bill – Act 294 as presented in Kahihikolo (2008).

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (EPA 2011). Fair treatment is further explained to mean that no population group of any makeup should "bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies" (EPA 2011).

For each alternative, this analysis considered if disproportionately high and adverse human health or environmental (inclusive of the social and economic environment) effects would occur to minority and low-income populations that would appreciably exceed effects to the general population or other comparison group. Specifically, this analysis considered if there were different or unique exposure pathways, exposure rates, special sensitivities, or different uses of natural resources (Office of NEPA Policy and Compliance 2004; CEQ 1997).

As noted in Section 3.4.10 in Table 3.4-12 Study Area Race and Ethnicity 2010, a high percentage of minority populations exist in the state of Hawai‘i in all counties and islands, ranging from 64.2% on the island of Maui (Maui County) to 86.0% on Lāna‘i (Maui County). Statewide, the average presence of minority populations is 75.3%. With the entire state of Hawai‘i comprising the Project Area, all communities are assumed to be minority population communities.

Table 3.4-13 Study Area Income Below Poverty Level 2010, presents the percentage of Hawaiian residents with low-income living on each of the islands and collectively from a statewide perspective. The threshold for analysis is the state of Hawai‘i poverty level, which is approximately 9.6% of residents earning incomes below the poverty level. The counties and islands with greater percentages of residents living in poverty include Molokai (13.4%) and the Big Island (14.4%). The counties and islands with lesser percentages of residents living in poverty include the City and County of Honolulu (8.8%), Maui and Lāna‘i in Maui County (8.9% and 2.9% respectively), Kaua‘i County (8.8%), Honolulu County (8.8%), and Kalawao County (4.1%).

Using the State's poverty level rate as a threshold, disproportionately high and adverse human health and environmental effects experienced by the communities on the islands of Kaua‘i, Moloka‘i, and the Big Island would trigger environmental justice concerns. However, all communities in the Project Area are assumed to be those of minority makeup; therefore, any disproportionately high

and adverse human health or environmental effects to the populations of Hawaiian communities would raise environmental justice concerns that would need to be addressed and potentially mitigated.

In the context of effects to environmental justice communities for this PEIS, specific concerns would arise from potential effects to subsistence fishers who target a fish species that overlaps with one of the various fish species the monk seal includes in their diet. Any such overlap would have to decrease availability of targeted fish species to fishers, and this decreased availability would have to result from an alternative. As described in Section 4.8.2, effects of the alternatives on subsistence fishing are likely to be negligible.

As described in Section 3.4.4, the State defines subsistence fishing as the customary and traditional Native Hawaiian uses of renewable ocean resources for direct personal or family consumption or sharing. As Native Hawaiians are a minority population covered under environmental justice, this analysis considers that potential effects to subsistence could merit potential environmental justice concerns. Economic effects realized from commercial and recreation fishing could also warrant potential environmental justice concerns. Additionally, environmental justice concerns could arise from effects to cultural resources and historic properties meaningful to Native Hawaiians and potentially other minority groups. Mitigations to address any potential disproportionately high and adverse environmental effects to environmental justice communities would be developed and implemented as appropriate.

With regard to human health, potential effects would result from a significant decrease in subsistence fish if they were the primary sustenance for a family or individual for cultural or economic reasons. No alternatives would result in human health effects from the perspective of diminished resources impacting diet; therefore, environmental justice communities would not experience disproportionately high or adverse human health effects.

Under all alternatives, NMFS would continue to conduct education and outreach efforts (to varying degrees), ensuring that environmental justice communities are included in those efforts so that these populations are aware of best practices around wild Hawaiian monk seals. These efforts are conducted in part to limit highly unlikely potential negative consequences of interaction with the wild animals.

4.8.6.1 DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE OF ALTERNATIVE 1 – STATUS QUO

Under Alternative 1 Status Quo, the current level of research and enhancement activities would be sustained through the next permit cycle. The population of monk seals is expected to naturally increase in the MHI for the timeframe of this PEIS with this level of research and enhancement activities. However, the overall population will decrease. As such, effects to fishery resources (commercial,

subsistence, or recreation) that low-income and minority populations might depend on would likely continue with their current trends, barring any unforeseen disruptive natural occurrences. Additionally, minor effects to cultural resources and historic properties would be expected under this alternative.

Disproportionately high and adverse effects to environmental justice communities would not be likely because negligible to no effects on fishery resources are expected, and only potential minor adverse effects on cultural resources and historic properties are expected. NMFS implements best management practices and other mitigations are also in place to minimize or eliminate potential effects to these resources in an effort to ensure major adverse effects are not suffered by Native Hawaiians, other minority populations, and/or low-income populations.

4.8.6.2 *DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)*

If no action is taken with regard to issuing new permits for research and enhancement for Hawaiian monk seals after 2014, then the number of seals is likely to decrease in the NWHI and increase in the MHI. Although fishing occurs in the MHI where the monk seal population is increasing naturally, on fishing are expected to be negligible. Cultural resources and historic properties effects are expected to be minor under this alternative.

As no fishery, economic, or cultural effects would appreciably exceed effects to the general population, it is unlikely disproportionately high and adverse effects to environmental justice communities would result. For the remainder of the current permit cycle, NMFS would continue to implement best management practices and have other mitigations in place to ensure major adverse effects are not suffered by Native Hawaiians, other minority populations, and/or low-income populations.

4.8.6.3 *DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)*

Alternative 3 Limited Translocation encompasses all activities in Alternative 1 Status Quo; plus increased activities as listed in Section 2.9.

Although the rate of MHI monk seal population growth may increase marginally due to Alternative 3 activities, the potential fisheries effects are expected to be negligible. Consequently, disproportionately high and adverse effects to environmental justice communities would not be likely because negligible effects on fishery resources are expected, and only potential minor adverse effects on cultural resources and historic properties are expected. As in the previous two alternative scenarios, NMFS would continue to implement best management practices and maintain other mitigations to minimize or eliminate potential effects to these resources in an effort to ensure major adverse effects are not

suffered by Native Hawaiians, other minority populations, and/or low-income populations.

4.8.6.4 DIRECT AND INDIRECT EFFECTS ON ENVIRONMENTAL JUSTICE OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Alternative 4 Enhanced Implementation differs from Alternative 3 with regard to the way translocations would be conducted. Under this alternative, weaned Hawaiian monk seals could be moved from the NWHI to the MHI, and then taken back to the NWHI when they reach the age of 2 to 3 years. Details of this alternative are included in Section 2.10 Alternative 4 Enhanced Implementation.

Effects under Alternative 4 are expected to be negligible. Disproportionately high and adverse effects to environmental justice communities would not be likely, as negligible effects on fishery resources are expected, and only potential minor adverse effects on cultural resources and historic properties are expected. As in the previous two alternative scenarios, NMFS would continue to implement best management practices and maintain other mitigations to minimize or eliminate potential effects to these resources in an effort to ensure major adverse effects are not suffered by Native Hawaiians, other minority populations, and/or low-income populations.

4.8.6.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON ENVIRONMENTAL JUSTICE

As discussed, anticipated environmental effects that could potentially raise environmental justice concerns would be negligible and not likely to be disproportionately borne by Native Hawaiians, other minority populations, and/or low-income populations. Nor would any of these effects appreciably exceed effects to the general population. Further, human health effects are not expected.

Also, under all alternatives, NMFS would continue to conduct education and outreach efforts, ensuring that environmental justice communities are included in those efforts so that these populations are aware of best practices around wild Hawaiian monk seals. To further minimize any potential for disproportionately high and adverse effects to environmental justice communities, NMFS would continue to implement best management practices and maintain other mitigations to minimize and/or eliminate potential effects to socioeconomic resources.

All alternatives would result in negligible effects to fisheries, economics, and cultural resources. As a result, the alternatives are not likely to contribute cumulative effects that would raise environmental justice concerns.

4.8.7 MILITARY ACTIVITIES

Military operations and exercises occur along the shoreline and in the offshore areas within the Project Area described in Section 1.3 Description of the Project

Area. The Army installations (DMR and MMR) together have approximately three miles of shoreline. The shoreline area adjacent to the U.S. Coast Guard (USCG) installation has been removed from base operations.

As described in Section 3.4.12.3, NMFS currently has an MOU with the USCG to assist with translocation activities that are part of the Marine Mammal Health and Stranding Response Program (MMHSRP) (Permit 932-1905). Thus, the translocation described in this assessment would not necessarily involve the USCG. The USCG area operates in an area of approximately 14.2 million square miles in and around the Hawaiian Archipelago (USCG and NOAA, 2010; see Section 3.4.12.3 Coast Guard).

The U.S. Marine Corps (USMC) operates in approximately 12.5 miles of shoreline and nearly four square miles of area directly offshore of the Marine Corps Base Hawai`i (MCBH).

Both the Air Force and the Navy operate in approximately 40 miles of shoreline (Pearl Harbor and PMRF) and approximately 1,200 square miles of ocean in and around the Hawaiian Archipelago.

This section discusses the potential direct and indirect effects for military installations in Hawai`i. There would be no direct effects associated with any of the alternatives. Indirect effects for the Navy, USMC and the Air Force are based upon whether or not the proposed alternatives would be likely to result in changes to military operations, exercises or military response efforts throughout the Project Area. As described in Chapter 3, the Hawaiian monk seal are located where the majority of military activities occur in Hawai'i.

4.8.7.1 DIRECT AND INDIRECT EFFECTS ON MILITARY ACTIONS OF ALTERNATIVE 1 – STATUS QUO

Under Alternative 1 Status Quo, the current NMFS Research and Enhancement Permit (10137) would continue until expiring in 2014. Following this date, subsequent permits will be issued to continue the research and enhancement activities that are currently permitted. For a complete description of permitted research under Alternative 1, please refer to Section 2.7.

Under Alternative 1, the Hawaiian monk seal population in the MHI is anticipated to increase due to the apparent favorable conditions for continued growth as evidenced by the demographics of the Hawaiian monk seal population (Baker et al 2011*a*) independent of actions take by NMFS. While this growth may be enhanced by Alternative 1 activities such as de-hooking, disentanglement, and weaned pup translocation measures, the contribution of Alternative 1 activities to any increase in the monk seal population would be marginal. As described above, NMFS may cordon off small sections of beaches where monk seals haul out but this would be temporary until the seal moved or swam away.

Under Alternative 1, at most 85 Hawaiian monk seals can be translocated by boat, vehicle, or aircraft per year (Table 2.10-1). While the *Coast Guard* does assist NMFS with the translocation of Hawaiian monk seals, approximately three to five annually, these translocation activities are authorized under NMFS permit 932-1905 and not under Permit 10137. NMFS may involve USCG in future translocations if the activity fits within existing operations and does not require significant effort. Thus the majority of these 85 possible translocations would not involve *Coast Guard* assistance (NMFS personal communication 2011). Any small areas to be cordoned off around seals would not likely affect USCG activities and would therefore be negligible.

As previously described, the MHI Hawaiian monk seals population is naturally increasing independent of any research or enhancement taken by NMFS. The implementation of Alternative 1 may have a negligible indirect effect on MHI Hawaiian monk seal population beyond that of natural MHI population growth due to de-hooking, disentanglement and weaned pup translocation. However, it is anticipated that this small population effect will have negligible indirect effects upon military training and operations within the MHI.

Conclusion for Direct and Indirect Effects on Military Activities from Alterative 1 (Status Quo)

None of the research methods permitted under Alternative 1 would directly affect military activities or operations in Hawai`i. Furthermore, it is unlikely that Hawaiian monk seal population changes within the MHI resulting from enhancement activities would indirectly affect military training activities or operations. Therefore, direct and indirect effects are likely to be negligible.

4.8.7.2 DIRECT AND INDIRECT EFFECTS ON MILITARY ACTIVITIES OF ALTERNATIVE 2 – NO ACTION (NO NEW PERMITS AFTER 2014)

Under the No Action Alternative, existing research as permitted under the current permit (10137) would continue until 2014. Once this permit expires, no research or enhancement activities on monk seals would occur. Unlike the activities under other alternatives, there would be no field research to monitor populations, implement de-worming, or translocation once the permit expires in 2014.

As discussed above, demographic data for monk seals suggests that the Hawaiian monk seal population in the MHI is anticipated to continue to increase regardless of NMFS actions. Under Alternative 2, given that most monk seal research and enhancement activities would cease after 2014, potential effects on military activities under Alternative 2 would not likely occur and are therefore considered negligible.

It is unlikely that Alternative 2 would result in any direct or indirect affect on the military in Hawai`i. Under Alternative 2, regardless of any NMFS action, the MHI Hawaiian monk seal population is anticipated to grow, however under this

Alternative this increase is expected to be lower than all other Alternatives. Indirect effects of Alternative 2 might include fewer occasions of cordoning off areas near military installation shorelines and fewer instances of Navy training exercise conflicts. However, the potential effects of Alternative 2 would likely be negligible for all branches of the military.

Conclusion for Direct and Indirect Effects on Military Activities from Alternative 2 (No Action)

It is anticipated that there would be no direct affects to military activities or operations in Hawai`i resulting from Alternative 2. Given that most research and enhancement would cease once the permit expires in 2014, military activities are not likely to be affected and therefore, potential effects would be considered negligible.

4.8.7.3 DIRECT AND INDIRECT EFFECTS ON MILITARY ACTIVITIES OF ALTERNATIVE 3 – LIMITED TRANSLOCATION (PREFERRED ALTERNATIVE)

Under Alternative 3, the research and enhancement activities currently permitted would be expanded (see Section 2.9 for details).

Alternative 3 entails the expansion of research and enhancement activities currently permitted, most of which are focused on slowing Hawaiian monk seal population decline within the NWHI. The expanded activities under Alternative 3 would include translocation, vaccination, behavioral modification, and deworming none of which, themselves would likely affect military activities. Emergency response to a disease outbreak is already mandated under provisions of the MMPA's Marine Mammal Health and Stranding Response Program (MMHSRP)(Title IV, 16 U.S.C. 1421) and the permit held by the MMHSRP.

The implementation of Alternative 3 could result in translocations of seals (see Appendix H, Take Tables) by boat, vehicle, or aircraft. While the Coast Guard does assist NMFS with the translocation of approximately three to five Hawaiian monk seals annually, these translocation activities are authorized under NMFS permit 932-1905 and not under Permit 10137. Therefore, these possible translocations would not involve Coast Guard assistance (NMFS 2011).

The geographic extent of haul out occurrences within the MHI is not likely to expand as a result of NMFS actions, rather independent of such actions as the natural population growth in the MHI may continue to alter their distribution (Baker *et al.* 2011). While it is noted that the frequency of these events could increase it is not likely to be attributable to NMFS actions under Alternative 3 and the effect of increased haulouts on military operations is anticipated to be negligible for each military branch.

The marginal population increase in monk seal populations in the MHI due to research and enhancement activities are not likely to result in any change in the

number of conflicts with Navy training activities. It is anticipated that the number of Navy training exercises affected by monk seal is to be negligible.

Conclusion for Direct and Indirect Effects on Military Activities from Alternative 3 (Preferred Alternative)

None of the research methods permitted under Alternative 3 would directly affect military activities or operations in Hawai`i. Furthermore, it is unlikely that Hawaiian monk seal population changes within the MHI resulting from enhancement activities will indirectly affect military training activities or operations. Therefore, direct and indirect effects of Alternative 3 are likely to be negligible.

4.8.7.4 DIRECT AND INDIRECT EFFECTS ON MILITARY ACTIVITIES OF ALTERNATIVE 4 – ENHANCED IMPLEMENTATION

Under Alternative 4, the research and enhancement activities would be the same as presented for Alternative 3 with the addition of the potential to translocate weaned seals from areas of low survival in the NWHI to areas of higher survival in the MHI temporarily until age 2 or 3 yr at which point they would be returned to the NWHI.

Alternative 4 entails expanded research and enhancement activities, most of which, as under Alternative 3, are focused on improving the population status in the NWHI. The Alternative 4 expanded activities most relevant to the MHI are potential two-stage translocation involving temporarily moving juvenile seals from the NWHI to the MHI, a vaccination program, and behavioral modification activities. It is anticipated that Alternative 4 will exhibit the greatest benefit to Hawaiian monk seal populations relative to all alternatives. However, that benefit is expected to primarily manifest as a reduction in the rate of decline in the NWHI as opposed to making significant contributions to the already underway MHI population growth.

The implementation of Alternative 4 could result in additional monk seal translocation activities each year for 5 years. While the Coast Guard does assist NMFS with the translocation of Hawaiian monk seals, approximately three to five annually, these translocation activities are authorized under NMFS permit 932-1905 and not under Permit 10137. Therefore, these possible translocations would not involve Coast Guard assistance (NMFS 2011).

Indirect effects of Alternative 4 on military activities could occur if there were marked changes in the population of Hawaiian monk seals within the MHI due to NMFS action. Under this alternative, up to a maximum of 60 translocated (from the NWHI) juvenile Hawaiian monk seals could be present in the MHI in some years. This temporary increase in the Hawaiian monk seal population is anticipated to have negligible effect on military training activities and operations.

Conclusion for Direct and Indirect Effects on Military Activities from Alternative 4 (Enhanced Implementation)

None of the activities permitted under Alternative 4 would directly affect military activities or operations in Hawai'i. Furthermore, it is unlikely that temporary Hawaiian monk seal population increases within the MHI resulting from enhancement activities would indirectly affect military training activities or operations. Therefore, direct and indirect effects would likely be negligible.

4.8.7.5 CUMULATIVE EFFECTS OF ALTERNATIVES ON MILITARY ACTIVITIES

Research and enhancement activities would likely result in negligible direct and indirect effects on military operations under all alternatives. Thus, cumulative impacts of proposed research and enhancement activities under any Alternative would not likely contribute to any cumulative effect on military activities.

4.9 Summary of Effects on All Resources

The following tables (Tables 4.9-1 through 4.9-12) summarize the direct, indirect, and cumulative effects under each alternative for resources where environmental consequences were evaluated. More detailed discussions of direct, indirect, and cumulative effects can be found in Sections 4.7 through 4.8.

Table 4.9-1 Summary of Direct/Indirect and Cumulative Effects – Hawaiian Monk Seals

	Alternative 1: Status Quo	Alternative 2: No Action No Permit After 2014	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
HAWAIIAN MONK SEALS				
DIRECT / INDIRECT EFFECTS				
Mortality	**Minor Adverse** - could result in a reduction of total abundance of 9 seals, representing a 1% decline.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Minor to Moderate Adverse** - small changes in the population, a small number of individuals would be affected, although levels of take are not likely to be realized.	**Minor to Moderate Adverse** – same as Alternative 3.
Reproduction	**Negligible** - precautionary measures undertaken such that no adult female is captured that appears to be pregnant.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible** - same as Alternative 1.	**Negligible** - same as Alternative 1.
Contribution to Conservation Objectives	**Moderate beneficial** - addresses conservation though not at a level that would be expected to result in notable effects on recovery.	**Major adverse** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals. No contribution towards conservation objectives after 2014.	**Major beneficial** - provides a variety of ways to conduct enhancement at any one time. Benefits are more likely to be long-term.	**Major beneficial** - flexibility to adapt to potential future conditions that might make translocations from the NWHI to MHI even more beneficial would allow NMFS to adapt strategies to a greater range of future scenarios for promoting survival.
CUMULATIVE EFFECTS				
Mortality	**Negligible** - Relative to mortalities caused by predation, starvation, entanglement, intentional lethal shootings by humans and potential diseases, contribution of effects of Alternative would be negligible.	**Negligible** – after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible** - same as Alternative 1.	**Negligible** - same as Alternative 1.
Reproduction	**Negligible** - alternatives vary in the amount of research- and enhancement-related disturbance although none of the proposed alternatives are expected to contribute anything but negligible effects on reproduction.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible** - same as Alternative 1.	**Negligible** - same as Alternative 1.

	Alternative 1: Status Quo	Alternative 2: No Action No Permit After 2014	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
Contribution to Conservation Objectives	**Moderate beneficial contribution –** addresses conservation though not at a level that would be expected to result in notable cumulative effects on recovery.	**Major adverse contribution** - no additional research or enhancement would occur on wild seals could result in higher seal mortality.	**Major beneficial contribution** - provides a variety of ways to conduct enhancement at any one time. Benefits are more likely to be long-term.	**Major beneficial contribution –** enhanced translocation promotes greatest flexibility in translocation options along with all actions contained in Alternative 3.

Table 4.9-2 Summary of Direct/Indirect and Cumulative Effects – Sea Turtles

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
SEA TURTLES				
DIRECT / INDIRECT EFFECTS				
Mortality	**Negligible** - Injury or mortality affecting sea turtles rare.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible**- injury or mortality due to collisions with sea turtles extremely rare; no effect on population/species level. Despite slight increase in level of activities, BMPs and other mitigations minimize risks for collisions with turtles.	**Negligible** - same as Alternative 3.
Reproduction	**Negligible**- disturbance is not likely to result in effects on sea turtle reproduction.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible** - while level of disturbance may increase, this is not likely to cause measurable changes in sea turtle reproduction.	**Negligible –** same as Alternative 3.
CUMULATIVE EFFECTS				
Mortality and Reproductive Effects	**Negligible contribution** - compared with other external sources of mortality, BMPs and other mitigation measures minimize risk of mortality and potential effects on reproduction.	**Negligible contribution** - no research or enhancement on wild seals after 2014. Contribution to sea turtle population declines negligible.	**Negligible contribution** - despite slight increase in research and enhancement, compared with other external sources of mortality, BMPs and other mitigation measures minimize risk of mortality and potential effects on reproduction.	**Negligible contribution –** same as Alternative 3.

Table 4.9-3 Summary of Direct/Indirect and Cumulative Effects – Cetaceans

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
CETACEANS				
DIRECT / INDIRECT EFFECTS				
Mortality	**Negligible** - injury or mortality due to collisions with cetaceans from activities such as vessel surveys extremely rare.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible** – same as Alternative 1.	**Negligible** – same as Alternative 1.
Reproduction	**Negligible** - vessel activity infrequent; disturbance would be short-term and not likely to result in reproductive effects.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible** – same as Alternative 1.	**Negligible** – same as Alternative 1.
CUMULATIVE EFFECTS				
Mortality and reproductive effects	**Negligible contribution** - potential effects of all alternatives on mortality or reproduction negligible at the population level relative to other external stressors. BMPs and other mitigation measures in place to minimize risks of collisions and disturbance. Vessel activity infrequent and not likely to result in any long-term effects. Under Alternative 2, no research or enhancement on wild seals after 2014. Contribution to cetacean population declines negligible. Long-term effects on reproduction negligible.			

Table 4.9-4 Summary of Direct/Indirect and Cumulative Effects – Fish

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
FISH				
DIRECT / INDIRECT EFFECTS				
Mortality	**Negligible** - given the wide variety of fish consumed by monk seals, long-term decline in fish populations not likely.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible –** same as Alternative 1.	**Negligible –** same as Alternative 1.
CUMULATIVE EFFECTS				
Mortality	**Negligible contribution** -relative to other external sources of fish mortality, research and enhancement alternatives are not likely to result in any measurable effects on mortality.	**Negligible contribution** - no research or enhancement on wild seals after 2014.	**Negligible contribution** - same as Alternative 1.	**Negligible contribution** - same as Alternative 1.

Table 4.9-5 Summary of Direct/Indirect and Cumulative Effects – Birds

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
BIRDS				
DIRECT / INDIRECT EFFECTS				
Productivity	**Minor adverse** effects expected from human disturbance on beach-nesting seabirds. **Negligible** effects on shorebird productivity. **Minor adverse** effects on Laysan Finch from research and enhancement camp activities.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible to Minor adverse** – same as Alternative 1.	**Negligible to Minor adverse** – same as Alternative 1.
Survival	**Minor adverse** - periodic effects on avian survival due to potential collisions with aircraft and fencing from monk seal holding pens, and camp activities.	**Negligible** - no research or enhancement on wild seals after 2014.	**Minor adverse** – same as Alternative 1.	**Minor adverse** - same as Alternative 1.
Habitat Alteration	**Minor adverse** - strict protocols for entering the NWHI prevent the spread of invasive species. Despite protocols, minor effects on habitat, survival, and productivity due to introduction of invasive species.	**Negligible** - no research or enhancement on wild seals after 2014.	**Minor adverse** - increased translocation of seals from MHI to NWHI may introduce invasive species to the Monument but would be mitigated through strict protocols.	**Minor adverse** – same as Alternative 3.
CUMULATIVE EFFECTS				
	Minor adverse contribution– Relative to other sources of mortality and effects on productivity such as longline fisheries, climate change, invasive species and marine debris, the contribution of research and enhancement activities is considered minor adverse for avian mortality, productivity and habitat. Precautions would be implemented to avoid take of birds and nesting birds on beaches would be avoided.			

Table 4.9-5 Summary of Direct/Indirect and Cumulative Effects – Corals

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
CORALS				
DIRECT / INDIRECT EFFECTS				
Damage to coral and live rock.	**Negligible** effects due to strict protocols to minimize damage.	**Negligible** - no research or enhancement on wild seals after 2014.	**Negligible–** Some increase in activities that could impact corals, but adherence to strict protocols maintained.	**Negligible–** same as Alternative 3.
CUMULATIVE EFFECTS				
Damage to coral and live rock.	**Negligible contribution.** Considering that there would only be negligible direct and indirect effects are anticipated under any of the Alternatives, there would be no contribution of monk seal research and enhancement activities to a cumulative impact on coral species.			

Table 4.9-6 Summary of Direct/Indirect and Cumulative Effects – Invasive Species

	Alternative 1: Status Quo	Alternative 2: No Action No Permit After 2014	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
INVASIVE SPECIES				
DIRECT / INDIRECT EFFECTS				
Spread of Invasive Species	**Minor adverse** - strict protocols described for entering the NWHI under a Monument permit prevent the spread of invasive species.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild.	**Minor adverse** - strict protocols for entering the Monument would help prevent spread of invasive species; however, increased activity may slightly increase chances of doing so.	**Minor adverse** – same as Alternative 3.
CUMULATIVE EFFECTS				
Spread of Invasive Species	**Negligible** – given the high population and level of ecotourism, recreation, fishing, and other human activities in the MHI, research and enhancement activities proposed would be expected to result in negligible effects. Strict protocols for entering the Monument limit spread of invasive species.	**Negligible** – after the permit expires in 2014, no additional research or enhancement would occur on wild seals thus there would be no potential to spread invasive species	**Negligible** – despite increased translocation of seals from MHI to NWHI, spread of invasive species would be negligible and be mitigated through strict monument protocols. High population and level of ecotourism, recreation, fishing, and other human activities in the MHI would be expected to have a greater probability to spread invasive species.	**Negligible** – same as Alternative 3.

Table 4.9-7 Summary of Direct/Indirect and Cumulative Effects – Commercial Fisheries

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
COMMERCIAL FISHERIES				
DIRECT / INDIRECT EFFECTS				
Commercial Landings	**Negligible –** no direct effect on commercial fishing. Marginal Hawaiian monk seal population increase within the MHI not likely to result in indirect effect on commercial fishing. While indirect effects on commercial fishing could stem from costs associated with interactions between fishers and Hawaiian monk seals, these are likely to be negligible.	**Negligible –** after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible –** no direct effect on commercial fishing in MHI. Analysis does not indicate that the effects of the alternative on the number of monk seals would measurably affect the amount of fish available to be harvested commercially, or the number of interactions with commercial fishing. Behavioral modification may reduce seal interactions with fishing operations. Marginal monk seal population increase not likely to result in an indirect adverse effect on commercial fishing.	**Negligible –** same as Alternative 3. Small, temporary monk seal population increase in MHI not likely to result in an indirect adverse effect on commercial fishing.
CUMULATIVE EFFECTS				
Commercial Landings	**Negligible contribution** - Commercial fishing in the MHI could be affected by fisheries management actions in Hawai'i, as well as the local and global economy. Overfishing could result in reduction in fish populations for sustainable harvest. Offshore military activities could have temporary effects on fishing through access restrictions or TTS on fish hearing due to underwater training. The direct and indirect effects associated with the Alternatives are expected to be negligible, thus would not contribute to the overall cumulative effects on subsistence fishing. Direct and indirect effects associated with the alternatives are negligible and would not contribute to overall cumulative effects on commercial fishing.			

Table 4.9-8 Summary of Direct/Indirect and Cumulative Effects – Subsistence Fisheries

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
SUBSISTENCE FISHERIES				
DIRECT / INDIRECT EFFECTS				
Subsistence Catch	**Negligible** - no direct effect on subsistence fishing. Marginal Hawaiian monk seal population increase within the MHI not likely to result in indirect effect on subsistence fishing. While indirect effects on subsistence fishing could stem from costs associated with interactions between fishers and Hawaiian monk seals, these are likely to be negligible.	**Negligible –** after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible –** no direct effect on subsistence fishing in MHI. Analysis does not indicate that the effects of the alternative on the number of monk seals would measurably affect the amount of fish available to be harvested for subsistence, or the number of interactions with subsistence fishing. Behavioral modification may reduce seal interactions with fishing operations. Marginal monk seal population increase not likely to result in an indirect adverse effect on subsistence fishing.	**Negligible –** same as Alternative 3. Small, temporary monk seal population increase in MHI not likely to result in an indirect adverse effect on subsistence fishing.
CUMULATIVE EFFECTS				
Subsistence Catch	**Negligible contribution –** Subsistence fishing in the MHI could be affected by fisheries management actions in Hawai`i, as well as the local and global economy. Overfishing could result in reduction in fish populations for sustainable harvest. Offshore military activities could have temporary effects on fishing through access restrictions or TTS on fish hearing due to underwater training. The direct and indirect effects associated with the Alternatives are expected to be negligible, thus would not contribute to the overall cumulative effects on subsistence fishing.			

Table 4.9-9 Summary of Direct/Indirect and Cumulative Effects – Recreational Fisheries

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
RECREATIONAL FISHERIES				
DIRECT / INDIRECT EFFECTS				
Recreational Catch	**Negligible –** no direct effects on recreational fishing in MHI. No decrease in fishing trips or in number of fish caught for recreation. While indirect effects on recreational fishing could stem from costs associated with interactions between fishers and Hawaiian monk seals, these are likely to be negligible.	**Negligible –** after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible –** no direct effect on recreational fishing in MHI. Analysis does not indicate that the effects of the alternative on the number of monk seals would measurably affect the amount of fish available to be harvested for recreation, or the number of interactions with recreational fishing. Behavioral modification may reduce seal interactions with fishing operations. Marginal monk seal population increase not likely to result in an indirect adverse effect on recreational fishing.	**Negligible –** same as Alternative 3. Small, temporary monk seal population increase in MHI not likely to result in an indirect adverse effect on recreational fishing.
CUMULATIVE EFFECTS				
Recreational Catch	**Negligible contribution –** recreational fishing in the MHI could be affected by fisheries management actions in Hawai'i, as well as the local and global economy. Overfishing could result in reduction in fish populations for sustainable harvest. Offshore military activities could have temporary effects on fishing through access restrictions or TTS on fish hearing due to underwater training. Direct and indirect effects associated with the alternatives are negligible, thus would not contribute to the overall cumulative effects on recreational fishing.			

Table 4.9-10 Summary of Direct/Indirect and Cumulative Effects –Cultural Resources and Traditional Cultural Practices; and Historic and Traditional Cultural Properties

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
CULTURAL RESOURCES AND TRADITIONAL CULTURAL PRACTICES				
DIRECT / INDIRECT EFFECTS				
Traditional Fishing and Gathering Resources and Activities	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential direct and indirect effects to cultural resources. Pedestrian traffic to and from monk seal locations in remote areas could cause minor disturbance to native medicinal plants located along the path of access. Marine resources are not likely to be impacted by vessel based activities. These effects are expected to be mitigated by the implementation of the mitigation measures presented in Chapter 5.	**Minor adverse –** The potential effects listed under Alternative 1 would remain until after the permit expires in 2014. Beyond that point no additional research or enhancement would occur on wild seals.	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential direct and indirect effects to cultural resources. Increased handling and translocation of monk seals under Alternative 3 would slightly increase the potential for effects to cultural resources and traditional customary practices. Pedestrian traffic to and from monk seal locations in remote areas could cause minor disturbance to native medicinal plants located along the path of access. Marine resources are not likely to be impacted by vessel-based activities. The indirect effects of potential marginal increases in the MHI monk seal population growth associated with the alternative could include locally increased interactions between monk seals and traditional fishers. These effects can be mitigated by the seal behavior modification actions included under Alternative 3 and by the implementation of the mitigation measures presented in Chapter 5.	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential direct and indirect effects to cultural resources. The increased handling and translocation of monk seals under Alternative 4 would slightly increase the potential for effects to cultural resources and traditional customary practices. Pedestrian traffic to and from monk seal locations in remote areas could cause minor disturbance of native medicinal plants located along the path of access. Marine resources are not likely to be impacted by vessel-based activities. Temporary translocation of seals from the NWHI is expected to have negligible impact on subsistence fishing (See Section 4.8.2) and on traditionally collected marine resources. The indirect effects of monk seal translocation from the NWHI and within the MHI could include increased interactions between monk seals and traditional fishers. These effects can be mitigated by the seal behavior modification actions included under Alternative 4 and by the

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
				implementation of the mitigation measures presented in Chapter 5.
CUMULATIVE EFFECTS				
Traditional Fishing and Gathering Resources and Activities	**Negligible contribution –** The temporary nature of monk seal research and enhancement activities and their restriction to the shoreline and immediate off-shore zones would limit direct and indirect effects on cultural resources and traditional practices. Some potential exists for minor impacts on shoreline plant resources, and to a lesser extent on marine resources, but these can be mitigated by the implementation of mitigation measures presented in Chapter 5.5. The potential for increased interactions between monk seals and traditional fishers could be mitigated by the seal behavior modification actions and by the implementation of the other mitigation measures. These would serve to make the contribution of any alternative to cumulative effects on cultural resources and traditional practices negligible.			
HISTORIC AND TRADITIONAL CULTURAL PROPERTIES				
DIRECT / INDIRECT EFFECTS				
Archaeological Sites, and other Historic Sites, and Cultural Properties	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential to impact cultural and historic properties. Pedestrian traffic to and from monk seal locations in remote areas could directly affect archaeological sites located along the path of access. Shipwrecks and other offshore sites have the potential to be impacted by vessel based activities. The removal of monk seals from within coastal fish ponds could possibly result in minor structural damage to these sites. These effects can be mitigated by implementation of the mitigation measures presented in Section 5.5.	**Minor adverse –** The potential effects listed under Alternative 1 would remain until after the permit expires in 2014. Beyond that point no additional research or enhancement would occur on wild seals.	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential to impact cultural and historic properties. Increased handling and translocation of monk seals under Alternative 3 would increase the potential for effects to cultural and historic properties. Pedestrian traffic to and from monk seal locations in remote areas could directly affect archaeological sites located along the path of access. Shipwrecks and other offshore sites have the potential to be impacted by vessel-based activities. The removal of monk seals from within coastal fish ponds could possibly result in minor structural damage to these sites. These effects can be mitigated by the seal behavior modification actions included under Alternative 3 and by implementation of the mitigation measures presented in Section 5.5.	**Minor adverse –** The temporary and geographically limited nature of monk seal recovery activities limits the potential to impact cultural and historic properties. As with Alternative 3, the increased handling and translocation of monk seals would increase the potential for effects to cultural and historic properties. Pedestrian traffic to and from monk seal locations in remote areas could directly affect archaeological sites located along the path of access. Shipwrecks and other offshore sites have the potential to be impacted by vessel-based activities. The removal of monk seals from within coastal fish ponds could possibly result in minor structural damage to these sites. These effects can be mitigated by the seal behavior modification actions included in Alternative 4 and by implementation of the mitigation measures presented in Section 5.5.
CUMULATIVE EFFECTS				

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
Archaeological Sites, and other Historic Sites, and Cultural Properties	**Negligible contribution –** The temporary nature of monk seal research and enhancement activities and their restriction to the shoreline and immediate off-shore zones would limit encounters with cultural or historic properties. Some potential exists for direct impacts on archaeological sites, but these can be mitigated by the implementation of mitigation measures presented in Section 5.5. Compared to other sources of disturbance to cultural and historic resources including development, major storm events, previous military actions (*i.e.,* warfare), looting or other deleterious activities, the contribution of any alternative to cumulative effects on cultural and historic resources would be negligible.			

Table 4.9-11 Summary of Direct/Indirect and Cumulative Effects – Recreation and Tourism

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
RECREATION AND TOURISM				
DIRECT / INDIRECT EFFECTS				
Recreation Experience and Cost, and Public Safety	**Negligible** - small portions of some public beaches may be cordoned off but benefits associated with increased wildlife presence. Pup translocations would continue to minimize human-seal interactions.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals. While there is potential for increased seal-human interactions due to lack of behavioral modification, any change in these interactions is still likely to be negligible.	**Moderate beneficial** – same as Alternative 1. Potential for more wildlife viewing opportunities of monk seals. Despite evidence of shark predation on seals, there is no evidence that more monk seals in the MHI will lead to more shark attacks on humans. Public safety would likely benefit from reduced human-seal interactions from the combination of behavioral modification and translocating seals that may become socialized.	**Moderate beneficial** – same as Alternative 3.
CUMULATIVE EFFECTS				
Recreation Experience and Cost, and Public Safety	**Negligible contribution** - alternatives would take place against a backdrop of recovering recreation and tourism levels due to the nation's economic downturn. Direct and indirect effects are anticipated to be so small, none of the alternatives is expected to contribute to overall cumulative effects on recreation and tourism.			

Table 4.9-12 Summary of Direct/Indirect and Cumulative Effects – Environmental Justice

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
ENVIRONMENTAL JUSTICE				
DIRECT / INDIRECT EFFECTS				
Disproportionate Effects on Minority Populations	**Negligible -** disproportionately high and adverse effects to environmental justice communities would not be likely because negligible to no effects are expected to fishery resources or cultural resources and historic properties.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals. While there is potential for increased seal-human interactions due to lack of behavioral modification, any change in these interactions is still likely to be negligible.	**Negligible -** same as Alternative 1.	**Negligible -** same as Alternative 1.
CUMULATIVE EFFECTS				
Disproportionate Effects on Minority Populations	**Negligible contribution** - none of the alternatives would likely contribute to cumulative effects that would raise environmental justice concerns.			

Table 4.9-13 Summary of Direct/Indirect and Cumulative Effects – Military Activities

	Alternative 1: Status Quo	Alternative 2: No Action	Alternative 3: Limited Translocation (Preferred Alternative)	Alternative 4: Enhanced Implementation
MILITARY ACTIVITIES				
DIRECT / INDIRECT EFFECTS				
Military Activities	**Negligible –** no direct effect on military activities. Translocation of seals would likely not involve USCG. Any small areas to be cordoned off around seals would not likely affect military activities or operations.	**Negligible** - after the permit expires in 2014, no additional research or enhancement would occur on wild seals.	**Negligible –** same as Alternative 1.	**Negligible –** same as Alternative 1.
CUMULATIVE EFFECTS				
Military Activities	**Negligible contribution** -RFFAs that may potentially affect military activities and operations may include but are not limited to those actions that could alter the ability of the military to carry out missions, additional administrative requirements, new restrictions or changes to areas where operations may occur, or other potential natural disasters such as tsunamis or hurricanes, etc. Direct and indirect effects associated with alternatives would be negligible, thus would not contribute to the overall cumulative effects on military activities.			

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