



WPRFMC Five-year Research Priorities under the MSRA

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The reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSRA), created new responsibilities and authorities for domestic regional fishery management councils and their advisory bodies. Following is the relevant MSRA text regarding the development and implementation of five-year regional research priorities by Councils.

MSRA TEXT ON FIVE-YEAR RESEARCH PRIORITIES

Section 302 (h) Each Council shall develop, in conjunction with the scientific and statistical committee, multi-year research priorities for fisheries, fishery interactions, habitats, and other areas of research that are necessary for management purposes that shall –

- (A) establish priorities for 5-year periods;
- (B) be updated as necessary; and
- (C) be submitted to the Secretary and the regional science centers of the National Marine Fisheries Service for their consideration in developing research priorities and budgets for the region of the Council.

Based on recommendations from the SSC, at its 140th meeting (March, 2008) the WPRFMC recommended the following research priorities and directed Council staff to expand upon them in a draft document for final review before transmittal to the Pacific Islands Fisheries Science Center and the Secretary of Commerce for their consideration in establishing research priorities and budgets for the region. The final document was transmitted to NMFS on September 21, 2009. Tables 1-4 provide priorities and additional information regarding each of the Council's previously identified research priorities (shown in italics) within each of four broad categories, as revised by the SSC at its 99th meeting. Each priority was reviewed by Council staff based on what had been accomplished since 2009 and literature search of the Pacific Island Fisheries Science Center's publication list. A section was added to indicate the status of each priority. This document will be reviewed by PIFSC and PIRO prior to the 108th SSC and 152nd Council Meeting.

Rank	Table 1. Research Needs – Stocks
1	<p><i>Stock assessments and MSY estimates for major species/stocks in risk order ranking:</i> Risk order ranking refers to the risk (including both the likelihood and the consequences) of overfishing a species/stock. Stock assessments and MSY estimates are needed for federally managed stocks in order to comply with MSRA ACL requirements, and these assessments should be conducted based on a risk ranking of the stocks most likely to be subject to overfishing through to those fish stocks least likely to be subject to overfishing.</p> <p>STATUS: the risk ranked list was shelved due to decision by NMFS that it is not compliant with the requirements of NS1. Most of the stock assessments are conducted only on species or species group that are commercially important (bottomfish and large pelagic). MSY values available for HI akule and opelu, and lobsters.</p> <p>No formal stock assessment was done on any coral reef species. An attempt was made by Hawhee (2007) to establish biological reference points for several species of reef fish from fishery metrics from various fishing methods Moreover, a project is underway where CRED,</p>

	<p>in collaboration with various universities, state agency and Stock Assessment group of PIFSC, will be attempting to generate stock/population metrics such as M, F, B/Bmsy using visual survey data, habitat information and available life history parameters.</p> <p>Improvements to stock assessment via the incorporation of modern tagging/tracking data is being developed by SPC/IATTC (Nicol, Maunder et al), sponsored by PFRP.</p> <p>A global meta-analysis of tuna and billfish stocks is ongoing by Univ of Washington (Branch, Hilborn, Jensen), sponsored by PFRP</p>
1	<p><i>Fishery data via logbooks, observers and port sampling:</i> Many fisheries conducted in federal waters of the WP Region are incompletely monitored through creel surveys and in some cases trip tickets, or sales receipts. Expanded fishery monitoring systems will provide improved data and reduce both scientific and management uncertainty surrounding the establishment and implementation of ACLs and accountability measures. <i>Some ACLs are expected to require real-time monitoring which may be achieved via the daily electronic transmittal of logbook information.</i></p> <p>STATUS: island territories and commonwealth are still doing creel surveys and HI catch reporting. Data collection system remains at status quo. Projects are underway to audit the creel surveys to identify areas for improvements. State of Hawaii now requires reporting at trip level which will aid in the projection of catches for the deep 7 bottomfish species</p>
1	<p><i>Tagging research to provide (semi) fishery independent information:</i> Tagging data is required to understand and define stock boundaries for managed stocks. It will also provide demographic information for estimating life-history parameters for MSY and ACL estimates for managed stocks.</p> <p>STATUS: tagging projects (PIFG, PFRP and PIFSC) are still being conducted on bottomfish in HI and Marianas and on tuna and other pelagic species. Tuna tagging being conducted around Hawaii by HIMB/PFRP (Holland/Itano). Bottomfish electronic tagging being conducted by PFRP/PIRO (Weng/Everson). Monchong tagging being conducted by PFRP/PIFSC (Weng/Seki). Three pelagic tagging studies have been completed. Analyses of pop-up tags attached to bigeye and opah from the Hawaii-based longline fishery have been published (Howell et. al. 2010 and Polovina et al. 2008). Analysis of swordfish movement and dive depth based on tags deployed from the California-based harpoon fishery is completed (Abecassis et. al. In Press).</p>
1	<p><i>Conduct detailed fishery analysis, socio-economic, and socio-cultural studies of yellowfin tuna (YFT) in the Hawaii based fisheries:</i> Given the economic and cultural importance of YFT in Hawaii it is important to conduct a thorough evaluation on the status and determine not only the population dynamics of the species but the dynamics of the fishery and the market as well. Based on several tagging studies, the YFT in the Hawaiian waters are primarily spawned and recruited locally. The ones that successfully recruited in the population tend to remain in Hawaiian waters throughout their lifespan with low level of exchange rate with other regions in the Pacific. Given that these tunas are primarily Hawaii-based, regional management considerations should be given to these species. The following studies would be useful in order to support management of YFT:</p> <p>1) Examine long term trends in yellowfin CPUE by size class for coastal troll and handline gear.</p>

	<p>2) Investigate and estimate the landings and economic value of small yellowfin tuna in poorly documented fisheries and markets.</p> <p>3) Determine the contribution of yellowfin tuna to commercial landings at small size classes, i.e. < 3 lbs, 3 – <10 lbs, 10 - <15 lbs, etc.</p> <p>4) Examine socio-cultural impacts of raising the commercial size limit on yellowfin tuna or the imposition of recreational size and bag limits.</p> <p>5) Conduct a Yield per Recruit analysis of yellowfin harvested by Hawaii-based fisheries.</p> <p>STATUS: New priority added during the 152nd Council Meeting</p>
2	<p><i>Stock structure, especially for bottomfish populations:</i> Genetic and stable isotope data are required to understand and define stock boundaries and the degree of mixing by different stock population segments for managed stocks. These will be essential components for estimating MSYs and ACLs.</p> <p>STATUS: Researchers within PIFSC’s Fisheries Research and Monitoring Division (FRMD) have been working with cooperative bottomfishers and the Pacific Islands Fisheries Group (PIFG) to capture rarely encountered sizes (juveniles and large adults) of Deep-7 bottomfish species. Biosamples are being taken from the fish samples in Hawaii, Guam, American Samoa and CNMI.</p> <p>Research into the stock structure of yellowfin and bigeye tuna in the Hawaii and Pacific region is being conducted by PFRP/Texas A&M (Itano/Rooker), using otolith microchemistry analysis.</p> <p>Larval dispersal of yellowfin tuna, and bottomfish, is being investigated by Univ of Hawaii (Richards), sponsored by PFRP.</p> <p>Residency of tunas in the Hawaiian Archipelagic region, and the effects of FAD networks, is being studied by PFRP (Itano, Holland), sponsored by PFRP.</p>
3	<p><i>Life history and population parameters in risk order ranking:</i> Life history and population parameters, such as natural mortality rates, age and growth rates, and biomass, are needed to provide information on managed stocks in order to provide essential for estimating MSYs and ACLs.</p> <p>STATUS: Biomass information from CRED and catch and length information from WPacFIN and from the new PIFSC Biosampling Program are being used to inform the ACL process. Collaborations have been initiated between PIFSC and SWFSC to use reef fish length frequency information, survey data, and life history information for reef fish stock assessments</p> <p>Age and growth of striped marlin in Hawaii is being investigated by Charles Stuart University/PIFSC (Kopf/Humphries).</p>
4	<p><i>Species interactions and ecosystem functions:</i> Determination of trophic interactions will be necessary for understanding the interrelationships between managed stocks and ecosystem components, for identifying stock complexes, and for estimating MSYs and ACLs.</p> <p>STATUS: Most of the trophic interaction studies had been focused on monk seals, sea birds</p>

	<p>and mid-trophic level pelagic fish (Polovina’s group). No studies have been done of coral reef ecosystems.</p> <p>Trophic pathway research is being conducted by UH researchers (Drazen, Popp, et al), sponsored by PFRP. The project uses multiple chemical tracers to elucidate trophic links.</p> <p>Predation/competition release of mid-level predators (mahi, ono) is being studied by PIFSC (Walsh), sponsored by PFRP.</p>
5	<p><i>Definition of a “stock”, especially for ACLs:</i> Some stocks are managed based on political and administrative boundaries, although they may be biologically contiguous. Identifying and defining appropriate stock boundaries, especially for those stocks with cross-jurisdictional components, will be essential for estimating MSYs and ACLs.</p> <p>STATUS: for coral reef fish ACL purposes, reef fish stocks were defined using taxonomic family conventions. This will have to be refined based on life history and habitat utilization. Council Coral Reef Project in FY2010 is addressing the coral reef fish EFH while the MHI Deep 7 bottomfish is currently being revised through an amendment. Bottomfish EFH revision for American Samoa, Guam and CNMI are currently being addressed.</p>
6	<p><i>Impacts of global climate change, ocean acidification and sea level rises on marine stocks:</i> Understanding large scale oceanographic changes in response to climate change will be essential for evaluating likely impacts to habitat such as coral reefs, seamounts and other features such as current systems, and large-scale changes in stock distribution. These studies will also impact the estimation of MSY and ACLs for federally managed stocks in the WP Region.</p> <p>STATUS: Only few studies done on this topic: Polovina JJ, Abecassis M, Howell EA, Woodworth P. 2009. Increases in the relative abundance of mid-trophic level fishes concurrent with declines in apex predators in the subtropical North Pacific, 1996-2006 Fishery Bulletin 107(4): 523-531. One study was done by Brodziak and Link 2008 on Georges Bank haddock.</p> <p>One paper on the projected expansion of the subtropical gyre over the 21st century is published (Polovina et al. 2011). A second paper on the impact of climate change to the Hawaii-based longline fishery from an Ecosim model driven by a climate model is in prep (Howell et al. in prep). A third paper on impacts of climate change in the North Pacific based on a size-based model driven by a climate model is in prep (Woodworth et al. in prep).</p> <p>Acidification impacts on larval development of tunas is being studied by SPC/IATTC (Nicol, Margulies, Scholey et al), sponsored by PFRP.</p> <p>Development and tuning of the SEAPODYM model is ongoing, enabling predictions of climate change impacts on pelagic fish stocks, conducted by CLS/PIFSC (Lehodey/Domokos), sponsored by PFRP.</p>

Rank	Table 2. Research Needs – Human Communities
1	<i>Transferred effects (including market changes) resulting from domestic regulations, as well as from MPAs within archipelagos:</i> It is essential (and required by law) that resource managers

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	<p>understand and document the full range of likely physical and social impacts before recommending any conservation or management measures directed at fisheries. <i>Domestic regulations and MPAs that constrain fishing can result in transferred effects such as increased pressure on less regulated or less sustainable foreign fisheries.</i> These and other transferred effects of on have been discussed but need further research in order to determine and document their scope.</p> <p>STATUS: the NIOSH study provided an insight on the impact of MPAs to fisherman safety. This is the only study that looked at MPA impacts. A study by Minling Pan on the economic impact of the BET closure was presented during the 107th SSC.</p> <p>The effects of various regulatory scenarios on small boat fisheries in Hawaii were studied by Impact Assessment (Glazier/Petterson).</p> <p>PIFSC Economics Program is undertaking an analysis of market transfer effects associated with proposed HI longline fishery regulations; this analysis is in the draft stage. PIFSC Economics Program presented a study on the economic impact of the BET closure at the 107th SSC. PIFSC Human Dimensions Research Program (HDRP) conducted a study on the socioeconomic effects of the closure and presented it to the 106th SSC and at the subsequent Council meeting. PIFSC HDRP also published a brochure describing the results of the study and is sharing it with fishermen, buyers, and other fishing industry participants and stakeholders.</p>
1	<p><i>Patterns of resource utilization and dependence, including sources, uses and distribution of fish in fishing communities:</i> Analyzing and documenting how fishing communities obtain, utilize and distribute fish will allow science-based consideration of the potential impacts of conservation or management measures prior to their recommendation, approval or implementation. It will also assist in the allocation of ACLs should this become necessary or desirable.</p> <p>STATUS: PIFSC Economics Program completed a demand model for Hawaii bottomfish; the publication is available on the PIFSC website. PIFSC Economics Program has also completed analyses of the demand for local vs. frozen tuna and of consumer preferences for wild-caught vs. farm-raised fish species (PIFSC anticipates a follow-on analysis for the latter in 2012). PIFSC HDRP also is developing FEAT, a tool to link fishing effort to communities at the zip code level to enable analysis of which communities are reliant on which fisheries. A PIFSC HDRP study (2009) that examined traditional fishing practices in American Samoa illustrated the techniques and customary practices in distributing the fish to the community. PIFSC Economics Program also prepared two studies (available on the PIFSC web site and as NOAA Tech Memos) that described patterns of fish sharing and distribution for small boat fishermen in Hawaii fishing communities and separately for bottomfish fishermen. As described on the PIFSC HDRP web site, a study by PIFSC HDRP and coauthored by Ed Glazier assessed patterns of fish distribution in Haleiwa and Waianae: “Distribution and Use of Seafood in the Context of the Community: A Case Study of the Main Hawaiian Islands”. In addition, existing data collections, including many oral histories conducted by HDRP, could be further analyzed to study and document customary exchange activities.</p>
1	<p><i>Improve predictions (forecasts) of the likely responses of fishery participants and the impacts of management alternatives, and measure (monitor) new management regimes for their actual impacts on stocks, fisheries and human communities:</i> Research into the likely (and actual) responses of fishery participants to new fishery regulations will allow science-based consideration of the potential impacts of conservation or management measures prior to their recommendation,</p>

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	<p>approval or implementation. It will also improve our capacity for adaptive management which is predicated upon learning from our past successes and mistakes.</p> <p>STATUS: PIFSC Economics Program and HDRP are performing socioeconomic analyses of the impacts of the BET closure on Hawaii longline fleet participants and stakeholders, a subgroup is associated with the majority of fish landed in Hawaii in terms of both value and volume. The first phase, presented at the 106th and 107th SSC, addressed the social and economic effects of the 2010 closure. PIFSC continues to monitor the fishery and anticipates completing a follow-on study in the event of a 2011 closure. PIFSC Economics Program also completed a spatial model of the tradeoff between sea turtle take reduction and economic returns in the Hawaii longline fishery; the publication is in review and a presentation is available on the PIFSC website. PIFSC HDRP is developing FEAT, a tool to link fishing data with communities at the zip code level to enable evaluation of the community-level effects of changes in fishing regulations. PIFSC Economics Program also is collaborating with UH researchers on an agent-based model for the Hawaii longline fishery, which would model fishers' choices about where to fish choices subject to a set of decision variables. NMFS' Economics Program (nationwide) is also building a tool to model similar location choice questions. PIFSC Economics Program and HDRP also have completed several efforts related to the economic effects of instituting catch shares in Hawaii fisheries, most notably being a workshop in March 2010 that convened over 30 experts to evaluate the appropriateness of catch-share management for HI fisheries. PIFSC is nearing completion of the proceedings from this workshop and also is collecting papers for a special issue of Marine Resource Economics addressing this topic. PIFSC Economics Program also is undertaking, per Council request, an analysis of the economic impacts associated with proposed mandatory release requirements for certain size classes of marlins.</p>
2	<p><i>Fishery cost-earnings data:</i> Fishery managers rely on cost-earnings data to analyze the likely changes in fishery costs and revenues due to result from potential conservation or management measures prior to their recommendation, approval or implementation. The existing lack of information means that measures are often implemented without a clear understanding of their costs or benefits to fishery participants.</p> <p>STATUS: PIFSC Economics Program has completed or is currently working on several cost-earnings studies. Completed analyses include cost-earnings studies of the Hawaii longline fishery; the Northwestern Hawaiian Islands bottomfish fleet; and the Hawaii small boat pelagic fishery. PIFSC has completed or is proceeding imminently on fieldwork for cost-earnings studies of the Hawaii bottomfish fleet, the Marianas small boat fleet, and the Hawaii charter boat fleet; publications are being developed for these projects. PIFSC also conducts two continuous trip-cost data collections for the HI and AS longline fisheries, and is instituting a third as an add-on to the creel survey program in the Marianas. PIFSC also has utilized the Hawaii Input-Output model to estimate the regional contribution of commercial fishing and the impacts of the BET quota.</p>
3	<p><i>Direct and indirect impacts of population/military/coastal buildups on marine resources, beach and fishing access, ports and transportation:</i> Anticipated population increases in the Marianas Archipelago and elsewhere are expected to increase pressure on fishery resources, access, ports and transportation systems. Forecasting and monitoring these impacts will allow the timely development (and adjustment) of appropriate science-based conservation and management measures.</p>

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	<p>STATUS: no particular study has been done to look at this issue. There was an EIS done by private consultants that may have some information. [Might check with PIRO since they are involved in a number of EIS issues related to the military build-up. PIFSC has no study particular to this issue.]</p>
4	<p><i>Community structures, connections and resiliency:</i> Analyzing and documenting the structures, connections and resiliency of fishing communities will allow science-based consideration of the potential impacts of conservation or management measures prior to their recommendation, approval or implementation.</p> <p>STATUS: A study on social networks in the longline fishery is ongoing by UH (Leung), sponsored by PFRP. A study of the human dimensions of Hawaii’s ika-shibi fishery was conducted by Impact Assessment (Glazier), sponsored by PFRP. The PIFSC HDRP study (2009) referenced above examines traditional fishing practices in American Samoa illustrated the techniques and customary practices in distributing the fish to the community. PIFSC HDRP is preparing similar reports for Hawaii and CNMI, with drafts available in 11/11 (CNMI) and 3/12 (Hawaii).</p>
4	<p><i>Community perceptions regarding marine ecosystem status, and the reasons for those perceptions:</i> Understanding of community perceptions is necessary to ascertaining expected levels of voluntary compliance with conservation or management measures. Correcting misperceptions will provide an informed community with the necessary science to act in accordance with their values.</p> <p>STATUS: study by Arielle Levine in American Samoa contained community perceptions to regulation. The report is still being drafted. PIFSC HDRP will be conducting a survey of CNMI and Guam residents’ perceptions, knowledge, and behavior regarding the Marianas Trench Marine National Monument in Fall 2011 as soon as approval is obtained from OMB. The survey also addresses perceptions of conditions in both nearshore and ocean habitats.</p>
5	<p><i>Socio-cultural-economic impacts of ACLs on island communities:</i> Research and analysis regarding the likely impacts of ACLs on the well-being of fishery participants and communities is required by law prior to the recommendation, approval or implementation of any ACLs.</p> <p>STATUS: PIRO is currently drafting an EA on the likely impact of ACLs to fishery participants. In addition, PIFSC economic studies of the small boat pelagic and bottomfish fleets in Hawaii (former is published and latter manuscript is under development) address impacts of ACLs on fishery participants</p>
6	<p><i>Understand and balance the cultural needs and long-term aspirations of indigenous populations, with those of the larger and often very diverse island communities:</i> Well functioning communities are basic to all human endeavors, including fisheries and fisheries management. Communities may develop informal social contracts that would supplant law. Understanding this process will assist policy makers in the development of regulations that support the health of the community.</p> <p>STATUS: PIFSC HDRP is currently conducting a study of community-based fishery management institutions in Hawaii, with a focus on the State’s Community Based Subsistence Program. PIFSC HDRP drafted a companion report on the American Samoa Community-Based Fisheries program and will publish it with the Hawaii-based study in 2012. The report by Ed Glazier on the Council’s Ecosystem Workshops is also highly relevant.</p>

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6	<p><i>Indigenous fishing rights, beach access, human safety and MPAs:</i> The conflicts inherent in these and other social issues may provide opportunities for the development of innovation, changes to the institutional structure and improved outcomes for the community. Documenting the issues and negotiations will assist managers in the development of better policies and regulations.</p> <p>STATUS: the NIOSH report on the impact of establishing MPA on fishermen safety at sea feeds well into this priority. PIFSC human dimensions research in each of the jurisdictions should be useful in helping evaluating these issues but no targeted study is planned.</p>
7	<p><i>Impacts of global climate change, ocean acidification and sea level rises on island communities:</i> Understanding the likely and actual impacts of these pressures will allow fishery managers to develop, recommend, approve and implement appropriate regulatory responses in a timely manner. In addition, conveying this information to fishery participants and communities will allow them to appropriately plan their fishing (and non-fishing) investments and activities.</p> <p>STATUS: Arielle Levine has a project in American Samoa that looks into the impact of climate change and sea level rise to the local coastal communities and how they can prepare for change. The study is being continued through her work with PIRO.</p>
7	<p><i>Basic information/community profiles: demographics, ethnicities, unemployment, income sources, employment opportunities etc. including information from household surveys:</i> Constructing community profiles will allow science-based consideration of the potential impacts of conservation or management measures prior to their recommendation, approval or implementation.</p> <p>STATUS: PIFSC HDRP has published community profiles for Guam and American Samoa and is developing profiles for Hawaii and CNMI (to be completed in 2012). Another PIFSC HDRP project, Human Dimensions of the Kona Integrated Ecosystem Assessment, is developing indicators that reflect community conditions for residents of the Big Island’s Kona Coast. HDRP organized a panel discussion on the human dimensions of ecosystems at the recent Kona Coast IEA workshop in Kona. Surveys of participants in the Hawaii longline fishery have been conducted by University of Hawaii (Leung, Arita), sponsored by PFRP.</p>
8	<p><i>Valuation of key species, including blue marlin:</i> Science-based valuation studies will allow explicit consideration and understanding of the trade-offs often encountered when considering conservation or management measures.</p> <p>STATUS: most of the valuation studies are being done on a fishery level and not on a particular species. There is no specific project that tackles this topic to date. PIFSC HDRP and colleagues studied the recreational value of blue marlin and other species (including ahi) and presented the results at the NAAFE conference in Honolulu this spring. The authors submitted an article based on the research to a special issue of Marine Policy. The study is described on the HDRP web site</p>
9	<p><i>Seafood safety and benefits:</i> A side-by-side scientific analysis of both the potential hazards and benefits of consuming various seafood products will provide consumers with complete information on which to base their dietary decisions.</p> <p>STATUS: information and outreach effort has been conducted on the mercury and selenium issue for swordfish. PIFSC is not involved in seafood safety research which is managed at a</p>

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	national level.
10	<p><i>Potential impacts on marine ecosystems from economic downturns and increased fishing, especially cannery closures:</i> Economic downturns have been observed to increase fishing pressure as displaced workers seek to feed their families. Understanding the likely extent of such increases will allow fishery managers to develop, recommend, approve and implement appropriate regulatory responses in a timely manner.</p> <p>STATUS: no specific study has been done on this topic. However, the closure of the canneries had resulted in deportation of majority of the cannery workers back to their home country thereby the impact would most likely be low. Creel survey data showed no significant increase in fishery participants. PIFSC believes that studying the basic economics of, and social context of, canneries in American Samoa (and indeed, the entire role of the canning industry in the South Pacific) but in the absence of funding directed toward the purse seine fishery, we have no capacity for conducting this sort of study.</p>
10	<p><i>Potential for fishery development projects for indigenous communities:</i> Traditional fishery management is about managing natural resources for the people - for food and sustainability - indigenous communities are under-represented in commercial fisheries and fishery management even though traditional knowledge is becoming viewed as a complex, rational approach to adaptive management of natural resource conservation and utilization.</p> <p>STATUS: fishery development projects had been initiated in American Samoa to support the fishing activities of indigenous communities in the Manua islands particularly a fuel storage and ice making facilities. PIFSC human dimensions research in American Samoa should be useful in helping evaluating these issues but no targeted study is planned.</p>
11	<p><i>Traditional fishing methods (including for sea turtles) and related cultural practices, fish names:</i> Recent examination by researchers and anthropologists found that traditional ecological knowledge has often contributed to environmental conservation and protection. Utilization was part of the fishery conservation and management of native cultures and documenting traditional fishing methods will increase our understanding of successful fishery conservation and management methods.</p> <p>STATUS: traditional knowledge studies were done by Levine et al in American Samoa. The Council supported the Ahu Moku system in Hawaii as well as lunar calendars for the different island areas. The Council also convened the Marianas Archipelago Green Turtle Workshop. A descriptive assessment of small-scale and traditional fisheries in the Western Pacific is ongoing by Impact Assessment (Glazier), sponsored by PFRP. PIFSC human dimensions research in each of the jurisdictions should be useful in helping evaluating these issues but no targeted study is planned.</p>
11	<p><i>Role and impact of aquaculture:</i> Aquaculture is playing a larger role in feeding communities now and will continue to do so in the future. At the same time, it can lead to reduced prices for wild fish caught by the same community. Research into the potential role and impact of aquaculture in and on fishing communities needs to be conducted to determine the appropriate scale and types of aquaculture for various communities.</p> <p>STATUS: PIFSC Economics Program has invested considerable time in developing expertise</p>

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	in this area. PIFSC completed a study on consumer willingness-to-pay for farm-raised vs. wild-caught fish in Hawaii and is planning a follow-on study to further explore this issue in 2012. PIFSC also has convened sessions at PICES and other conferences on the economics of aquaculture and has contributed expertise to NOAA’s aquaculture policy development.

Rank	Table 3. Research Needs – Ecosystems
1	<p><i>Trophic interactions and food webs, including impacts of large predator removals. Expand and update ECOSIM and encourage the development of alternative models:</i> Develop and evaluate ecosystem or trophic models for use in ecosystem management; characterize the trophic dynamics of the ecosystem relevant to key fisheries species; and assess temporal dynamics of reef fish structure and examine recovery rates and yields following removal of large fish biomass.</p> <p>STATUS: Trophic interactions were studied by Parrish et al 2008 on monk seals and large predatory fish in the NWHI; Polovina et al 2009 in increase in mid level trophic pelagic with decrease in pelagic apex predators; Baker et al 2007 on predator (monk seal) as affected by variable oceanic productivity; DeMartini et al 1993 on impacts of temporal changes in reef fish prey population on juvenile monk seals; DeMartini et al 2006 on life history and predator densities at the NWHI.</p> <p>EOD/PIFSC is developing three pelagic ecosystem models. An Ecopath/Ecosim model (Howell), Sepodym turtle and swordfish models (Abecassis), and a size-base model (Woodworth).</p>
1	<p><i>False killer whale and pantropical spotted dolphin demographics including annual survival and breeding probabilities:</i> Current abundance estimates of false killer whales and Pantropical spotted dolphins utilize limited demographic data, and are estimated from EEZ-wide surveys. Any demographic data currently used to derive population estimates are not Hawaii-specific or are not species-specific, and thus research is needed to determine Hawaii-specific demographic data, including annual survival and breeding probabilities, to improve abundance estimates.</p> <p>STATUS: priority added in the 152nd Council Meeting.</p>
2	<p><i>Impacts of forcings, humans, and natural biological cycles on nearshore habitat:</i> Improve understanding of the importance of large oceanographic forcings such as ENSO events, typhoons, seismic events, anthropogenic inputs (including pollution), and natural biological cycles or variability on nearshore reef resources and habitats over extended time scales.</p> <p>STATUS: Richards et al 2011 showed densities and biomass of large bodies fish increases along gradient of decrease human population along an island chain; Williams et al 2011 showed differences in reef fish assemblages between populated and remote reefs in multiple archipelagos; Williams et al. 2008 assessed the fishing impacts on Hawaiian coral reef fish assemblages along a regional scale human population gradient; few directed studies had been done on the natural biological cycles</p>
3	<p><i>Functions and tradeoffs of MPAs:</i> Evaluate the effectiveness of MPAs, including no-take reserves and other marine zoning schemes, taking into account:</p>

Rank	Table 3. Research Needs – Ecosystems
	<ul style="list-style-type: none"> - Abundance of ecologically and economically important species. - Spillover of fishery species into adjacent habitats. - Improvements in the condition of the sessile benthic community and abundance of mobile invertebrates. - Cascading effects on non-target species. <p>Develop useful science-based indicators (biophysical and socioeconomic) of management effectiveness. Such indicators must be clearly articulated, measurable and related to conservation or management objectives.</p> <p>STATUS: Friedlander conducted several studies in evaluating the effectiveness of MPA in Hawaii. No studies had been done on the effect of the monument designation on how the MHI, Tutuila, Guam and Saipan will benefit from such large scale closures. Williams et al Biological Conservation 2009 (142:1066-1073) looked at impacts of ornamental fishery closure areas in West Hawaii on abundance and spillover of the prime target species. Taylor BM, McIlwain JL (2010) Beyond abundance and biomass: MPA effects on the demography of a highly exploited reef fish Lethrinus harak. Marine Ecology Progress Series 411:243-258. Spillover studies from bottomfish closed areas being conducted by PFRP/PIRO (Weng/Everson)</p>
4	<p><i>Status and factors of marine ecosystem resiliency:</i> Identify potential environmental and anthropogenic factors that may influence the long term resilience of coral reef ecosystems and assess the resistance and resilience of specific populations, locations, and habitats to episodic events (e.g., coral bleaching), emphasizing areas that may serve as sources of reproductive propagules.</p> <p>STATUS: resilience studies had been done by Kenyon et al 2006 on hermatypic coral at FFS; Schroeder and Parrish 2005 studies predator resilience to fishing pressure; no carrying capacity studies had been conducted on reef fish populations.</p>
5	<p><i>Impacts of societies on ecosystems:</i> The impacts of fishing, land-based sources of pollution and climate change have been identified by NOAA as the three priority threats to coral reef ecosystems of United States. Studies to determine place-based research and management needs to address these three priority threat areas should be conducted.</p> <p>STATUS: Most of the studies had been conducted on impacts of fishing and very few directed studies had been conducted to determine or quantify the impacts of land based pollution and climate change; majority of the climate change related studies were focused on prevalence of coral diseases and coral bleaching.</p>
6	<p><i>Connectivity within and between island/archipelago ecosystems:</i> Investigate the connectivity of fish populations and other ecosystem factors between/within island or archipelago systems to assess whether changes in fisheries and/or fishery management actions in one area have an effect on fish populations/ecosystems in other areas.</p> <p>STATUS: A collaborative study between UH and PIFSC researchers for one of the deep 7 bottomfish species (Rivera et al., 2011) showed limited connectivity between the NWHI and the MHI. This may imply limited fishery gain for the MHI fishery from the monument closure; Council supported circulation studies done in American Samoa to determine island</p>

Rank	Table 3. Research Needs – Ecosystems
	<p>level connectivity; NOS Biogeography Branch has been coordinating with DMWR and PIFSC for archipelagic scale oceanographic modeling to determine archipelagic connectivities; bumphead parrotfish connectivity was examined in PIFSC status review report.</p>
7	<p><i>Impacts of global climate change, ocean acidification and sea level rises on marine ecosystems:</i> Establish long-term monitoring programs in the U.S. Pacific islands to assess the impacts of global warming, ocean acidification and sea level rise on marine ecosystem resources and Pacific Island communities. This program should provide for timely analysis and public dissemination of the results and consider the socio-economic-cultural dimension of Pacific island fisheries as well as the physical, chemical and biological impacts on the marine environment.</p> <p>STATUS: aside from the oligotrophic area expansion study done by Polovina et al, no other studies had been done on the impacts of climate change; more so any public dissemination of impact information</p>
8	<p><i>Condition factor (energy stores) of top predators:</i> Condition factor refers to a mathematical formula for determining the physiological state of a fish, including its reproductive capacity. It is calculated by dividing fish weight by length cubed (W/L^3). The heavier a fish for a given length, the higher its condition factor (K). Research is needed to calculate condition factor of apex predators for stocks in each island area.</p> <p>STATUS: Humphreys et al 1993 looked at using condition indices for identifying new recruits for sea mount armorhead; no other studies were found in the PIFSC publication database</p>
9	<p><i>Tourism/non-use impacts (jet skis etc.):</i> Tourism in the Western Pacific region continues to grow resulting in increased usage of the coastal ocean environment for non-consumptive recreational purposes such as surfing, snorkeling, para-sailing, jet skiing, kite surfing, whale watching and many other activities. Direct competition for ocean space among fishermen and non-consumptive users should be identified and quantified to better understand impacts to fishery resources and the ecosystem.</p> <p>STATUS: this is paramount when moving forward with CMSP; so far there had been no specific mapping studies had been done to address this issue. There are existing maps available compiled through the PacIOOS Program that provides numerous data overlay that may assist CMSP. The FEAT Program developed by PIFSC also provides spatially explicit information more focused on fishery related issues.</p>
9	<p><i>Impacts of alien and invasive species:</i> Invasive and alien species impacts to marine ecosystems have been identified by State and Federal agencies and other non-governmental organizations as one of the major threats to Pacific Island ecosystems. The public and fishing community continue raise this issue as a major problem at public forums and meetings. Limited research on the impacts of introduced species such as taape, roi, gorilla ogo, and mudweed, has been completed to date.</p> <p>STATUS: Brett Schuhmacher had completed his studies on the ecological impact of taape in Hawaii. Jan Dierking has written some papers (and his thesis) on roi impacts – main paper is Dierking etal Fishery Bulletin 2009 “Diet composition and prey selection of the introduced grouper species peacock hind (<i>Cephalopholis argus</i>) in Hawaii”. Jonatha Giddens of UH Hilo is currently doing a masters</p>

Rank	Table 3. Research Needs – Ecosystems
	project looking at roi removal from patch reefs in Puako on abundance of other predators and potential prey species (and life stages).
9	<p><i>Carrying capacity:</i> Determining the carrying capacity of most management unit species in the Western Pacific region is yet to be completed. Carrying capacity is one of the basic parameters needed to produce stock assessments for these species.</p> <p>STATUS: There were attempts to address carrying capacity for the coral reef population but no concrete results as of yet</p>
10	<p><i>Develop and support decision tools for ecosystem management (e.g. CAMEO):</i> Improve understanding of marine ecosystem processes to support ecosystem considerations in fisheries management by developing decision support tools that will better enable ecosystem approaches to ocean and coastal ecosystem management.</p> <p>STATUS: PacIOOS developed a GIS web based information tool to assist any marine spatial planning efforts; PIFSC developed the Fishery Ecosystem Analysis Tool to assist fishery managers in decision making</p>
11	<p><i>Aqua/mariculture impacts:</i> Offshore aquaculture can impact ecosystems by acting as a fish aggregation device (FAD) and causing fish to congregate in areas where they might normally not occur. Other impacts such as pollution (via fish feed or waste), habitat degradation (site selection and placement), entanglement with protected species, effect of escapes on native species and habitat, and species selection (native vs non-native; use of wild species for brood stock) needs to be researched</p> <p>STATUS: no directed studies had been done on this priority; some information may be available in the EIS for the Kona Blue Water Farm</p>

Rank	Table 4. Research Needs – Protected Species
1	<p><i>Evaluate fishery interactions and post-hooking mortality rates:</i> NMFS' existing post-hooking mortality rates are based on outdated and incomplete information that needs to be updated so as to provide science-based assessments of conservation or management measures under consideration.</p> <p>STATUS: The plan for assessing post hooking mortality of turtles was drafted in 1994 (Balazs and Pooley 1994). The best available model information by Chaloupka et al. 2004 needs to be updated. The current post-hooking mortality rate estimates are based on criteria outlined in the 2006 NOAA Technical Memorandum NMFS-OPR-29. Additional relevant studies of longline-caught turtles have since been conducted (eg., Mangel et al 2011, S. Epperly SWFSC, Swimmer PIFSC). A NMFS online workshop on post hooking mortality of sea turtles will be held sometime in Nov-Dec 2011 to consider new results. Additional studies are needed, particularly to improve post-hooking mortality rate estimates in marine mammals.</p>
1	<p><i>Population demographics specific to false killer whales and pantropical spotted dolphins (added as of 10/18/2011):</i> Current abundance estimates of false killer whales and Pantropical spotted dolphins utilize limited demographic data, and are estimated from EEZ-wide surveys. Any</p>

Rank	Table 4. Research Needs – Protected Species
	<p>demographic data currently used to derive population estimates are not Hawaii-specific or are not species-specific, and thus research is needed to determine Hawaii-specific demographic data, including annual survival and breeding probabilities, to improve abundance estimates.</p> <p>STATUS: New priority added during the 152nd Council Meeting</p>
2	<p><i>Population and status assessments and evaluation of risk factors affecting stock recovery:</i> To date NMFS has emphasized fishery regulations to recover protected species however research has shown that in many cases terrestrial or non-fishing impacts to protected species are greater than fishery impacts. Understanding the relative sources of various impacts will allow the development of the most effective (and cost-effective) recovery plans and actions.</p> <p>STATUS: In 2006, Littnan et al. evaluated disease risk factors for monk seals. Snover in 2008 studied the effect of ontogenetic habitat shift and climate variabilities on loggerhead turtle population. Van Houtan et al. 2010 examined the connection between land use, macroalgae and fibropapillomatosis in Hawaiian green turtles. Additional studies are needed to determine the impact of inter-specific competition on monk seals in the NWHI, as well as to assess potential causes of the apparent decline in the Hawaiian insular false killer whales in the past 20 years.</p>
3	<p><i>Genetic structuring of key species to allow a scientific definition of a “discrete population segment”:</i> Most existing recovery plans for sea turtles address each species as one stock (Pacific and Atlantic combined). A science-based legal process is required to separate these species into appropriate discrete population segments in order to allow for tailored approaches to their assessment, conservation and management.</p> <p>STATUS: Dutton et al 1998 identified genetic stocks for turtles interacting in the Pacific longline fishery. Dutton et al. 2000 identified genetic stocks in Pacific leatherbacks. Dutton et al. 2008 showed evidence for a distinct regional population for the Hawaiian green turtles. Additional sampling and analysis are underway at the SWFSC to determine the genetic structure of green turtles in the Pacific. Independent assessment is necessary for ongoing genetic studies of island-associated cetaceans given the trend to define cetacean stocks on fine-scale genetic groups.</p>
4	<p><i>Examine conservation banking and offsets (credits):</i> As recognized by the USFWS, conservation banking and credits can encourage improved monitoring, conservation and management of listed species by allowing the public to offset some of the adverse impacts of their actions on these species. Failing to allow such offsets has been observed to result in the destruction of protected species or the denial of interactions with them. Research into this issue will determine whether positive impacts would be likely to result for listed species under the purview of NMFS.</p> <p>STATUS: Analysis done by Kobayashi in 2009 on the hatchling equivalency to offset the take in the HI long line fishery; write up exists for the SSC. Additional studies are needed to gather demographic data of sea turtles at various life stages and improve population assessments, and thereby improving the degree to which conservation projects offset impacts from fisheries.</p>
5	<p><i>Impacts of global climate change, ocean acidification and sea level rises on protected species:</i></p>

Rank	Table 4. Research Needs – Protected Species
	<p>Research is needed on the potential impacts global change, such as sea level rise; increase in average ocean temperatures; and ocean acidification, may have on the ocean environment such as changes in trophic structure and prey base, alteration in oceanographic patterns, changes in feeding and migratory pathways, among others and linking these to changes in fish resources.</p> <p>STATUS: Baker et al. 2006 looked at the potential effect of sea level rise on terrestrial habitats of protected species in NWHI. Van Houtan 2010 and Van Houtan et al. 2011 looked at climate change impacts on turtle populations. Tiwari et al. 2010 determined that carrying capacity at the Hawaiian green turtle rookery is substantially greater than current rates, and even with predicted sea level rise and resulting reduction of nesting habitat, carrying capacity at nesting areas is likely to remain high.</p>
6	<p><i>Shark population, status and effects on Mariana Archipelago fisheries:</i> Research into shark depredation and bycatch in Mariana Archipelago fisheries with regards to decreasing shark bycatch and reducing shark depredation on target stocks.</p> <p>STATUS: A depredation study was conducted on the Hawaii longline fishery but no study exists in CNMI. This is identified as a priority in the Cooperative Research for CNMI.</p>
6	<p><i>Potential for cultural takes of sea turtles:</i> It is conjectured that the prohibition on cultural takes of sea turtles is needed for recovery of sea turtle populations. Traditional communities see the prohibition on cultural takes as cultural exploitation. It needs to be determined whether limited cultural takes of sea turtles would significantly affect the recovery of sea turtle populations.</p> <p>STATUS: Carrying capacity studies are helpful to determine possible cultural takes. One study by Tiwari et al. 2010 estimated carrying capacity in FFS and determined that the Hawaiian green turtle population may be limited more by foraging grounds than by available nesting habitat. Wabnitz et al. 2010 determined that the foraging ground at Kaloko-Honokōhau National Historical Park are at carrying capacity based on an ecosystem model, and suggested that the reduced growth rates and poor body condition at a number of foraging sites around the MHI may also indicate conditions approaching or at carrying capacity. Chaloupka and Balazs 2007 estimated the harvest potential of the Hawaiian green turtle stock and determined that the population could withstand a limited annual harvest of less than 10 tons of biomass, which was followed by a response by Snover (2008) indicating that the parameters used in the model resulted in inaccurate conclusions. Additional analysis may be needed with refined data and models. Improved assessment of green turtle populations in the Marianas Archipelago and American Samoa are needed to determine the impact of existing illegal take as well as potential limited take on the recovery.</p>
7	<p><i>Interaction reduction and mitigation methods:</i> Further experimental research into reducing interactions between protected species and fishery activities and gears. Reducing incidental take rates of green sea turtles while maintaining target species catch rates in the American Samoa longline fishery is an important short-term priority.</p> <p>STATUS: Circle hook and gear deployment studies has been conducted by the Council and PIFSC in the American Samoa, Cook Islands, and New Caledonia longline fisheries to minimize turtle interaction and post hooking mortality. WPRFMC, in collaboration with PIFSC, funded a study in 2009 to determine the impacts of large circle hooks on target catch in the American Samoa longline fishery. The False Killer Whale Take Reduction Team</p>

Rank	Table 4. Research Needs – Protected Species
	<p>recommended testing of weak hooks reduce FKW mortality and serious injury in Hawaii deep-set longline fishery; the experiment was subsequently conducted and this measure is now included in the proposed Take Reduction Plan. Other correlates of marine mammal bycatch and depredation were also examined by Forney et al. (2011) in an analysis of longline observer data. WPRFMC also funded a study in 2009 to test buoyless gillnets in Baja California Sur, Mexico. A collaborative project between the Sea Turtle Association of Japan, University of Tokyo, ProPeninsula, PIRO, and PIFSC has been testing gear modifications in Japanese pound nets. PIFSC has also tested bycatch mitigation using visual cues to reduce interactions with gillnet fisheries,</p>
8	<p><i>Evaluation/improvement of turtle conservation projects:</i> A scientific evaluation of the effectiveness of terrestrial turtle conservation projects is needed to identify data gaps, successes or failures and priority projects to be continued or established. This would include developing and identifying science-based success criteria for the appropriate populations and would allow identification of the types of projects that provide the best conservation benefits in the most cost effective manner.</p> <p>STATUS: The National Research Council published an assessment in 2010 that recommended studies on demographic parameters of sea turtles to improve population assessments, which are currently heavily dependent on nesting beach counts. WPRFMC is funding a study in 2011 to assess the methods used to determine hatchling production at Yakushima, Japan.</p>