Habitat-based models of cetacean density in the central North Pacific - UPDATES

Becker et al. (2012) NOAA Tech Memo NMFS-SWFSC 490

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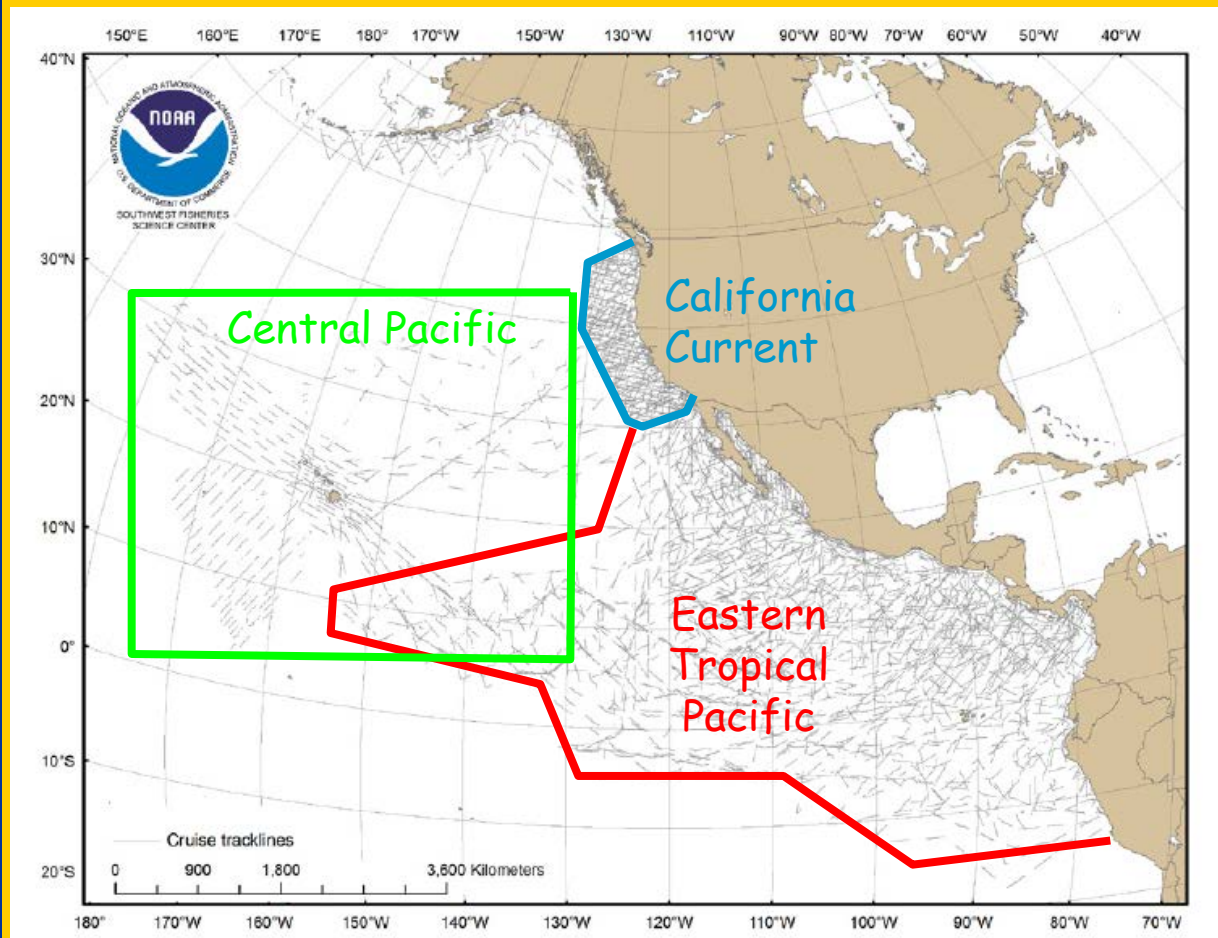


Figure 1. Cruise tracklines surveyed by the Southwest Fisheries Science Center, 1986-2005.

Central Pacific methods and data sources

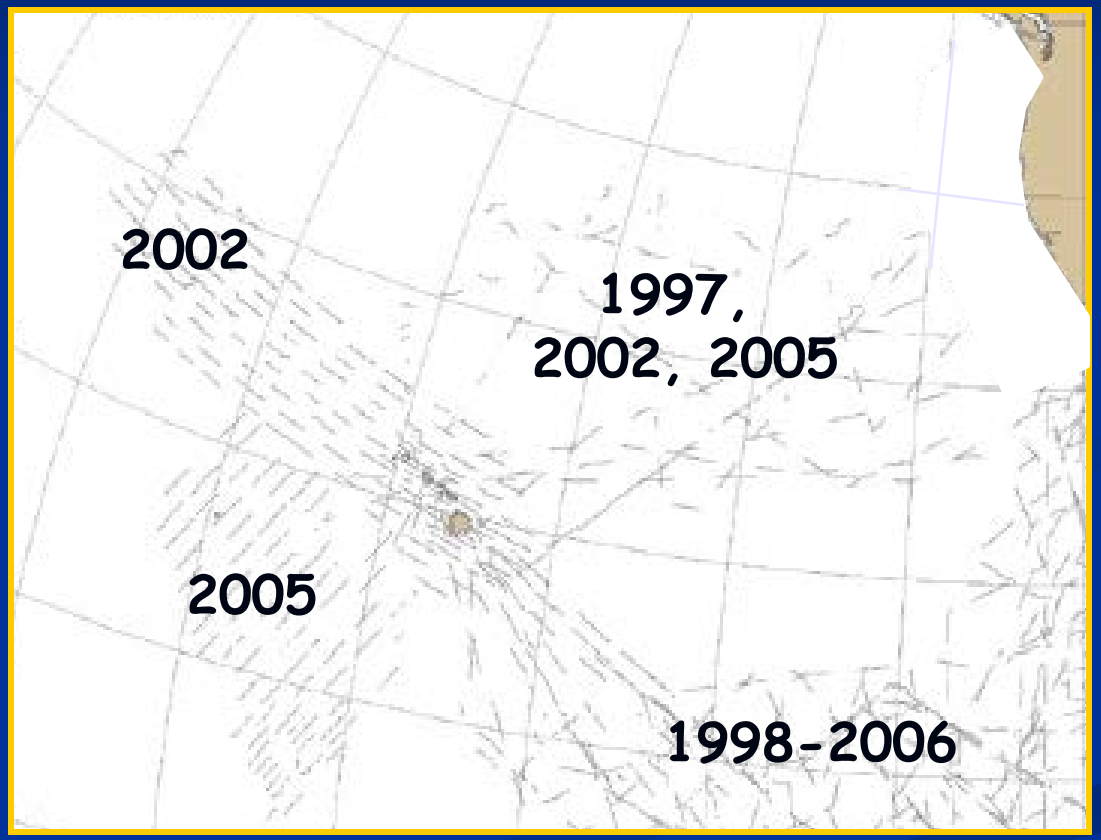
Cetacean data from multiple line-transect surveys in central and eastern North Pacific, 1997-2006.

Habitat Predictors:

- Dynamic, satellite-derived: SST, CHL, SSHrms, Primary Productivity
- Static: Distance to land, *latitude, longitude*

Models developed using 10-km transect segments

Density surfaces created from transect predictions using inverse distance weighting (at large scales)

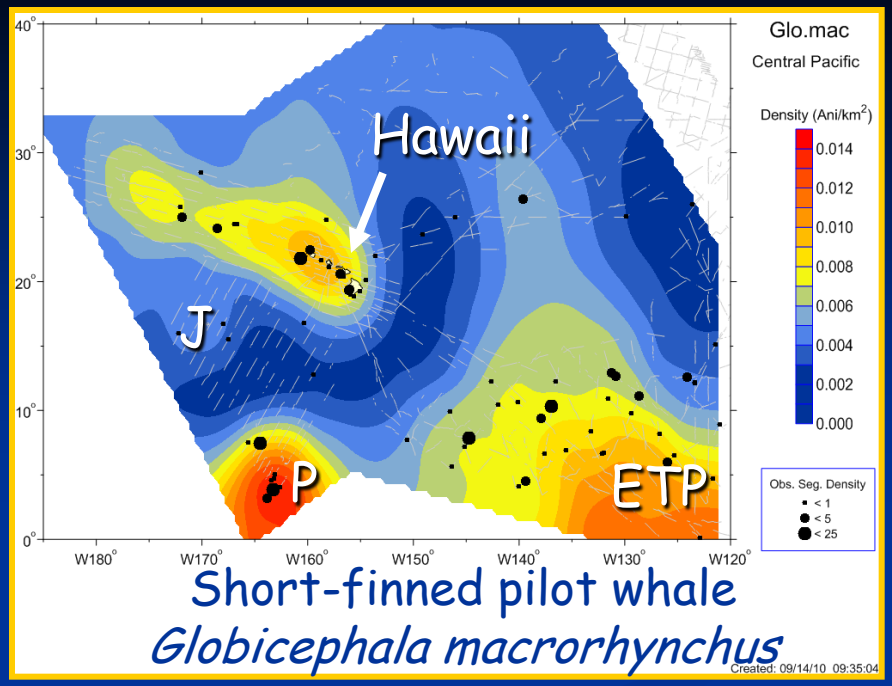


Details in Becker et al. (2012)

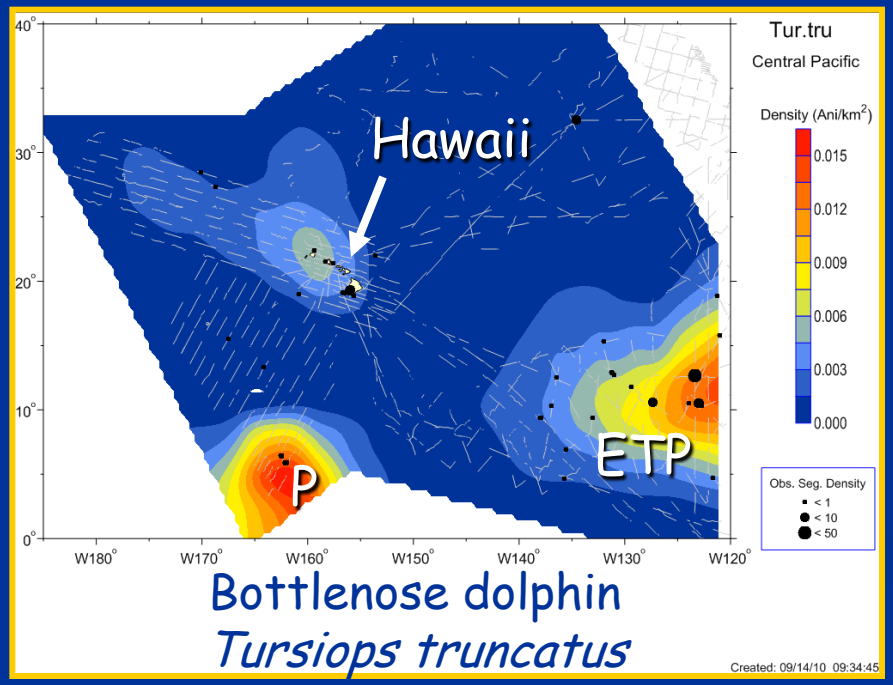
Sample Results

Three island-associated species

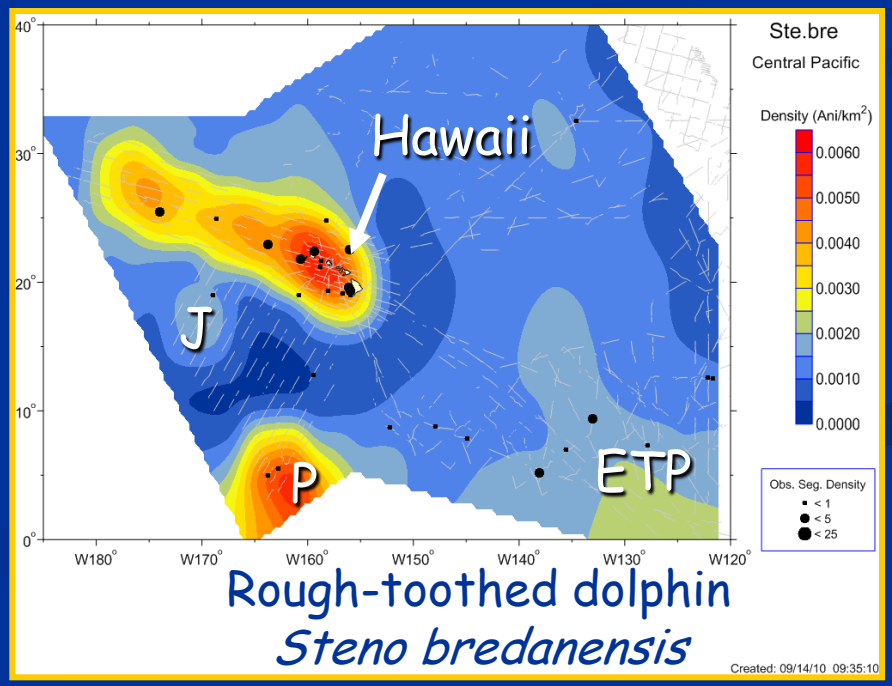
- Densities greater in ETP and around Hawaii, Palmyra Atoll (P), Johnston Atoll (J)
- Consistent with observed patterns near Hawaii/Palmyra



Short-finned pilot whale
Globicephala macrorhynchus

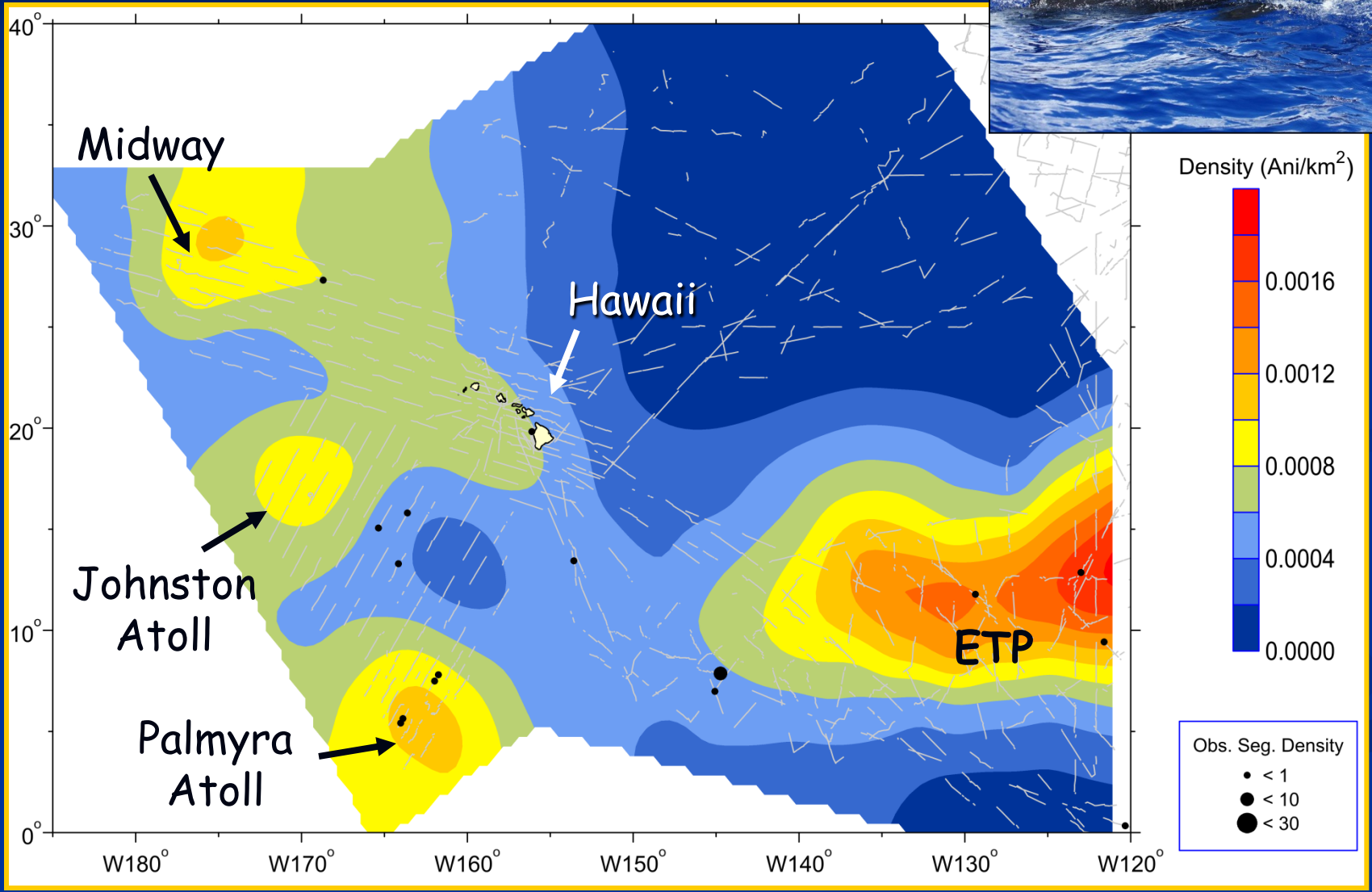


Bottlenose dolphin
Tursiops truncatus



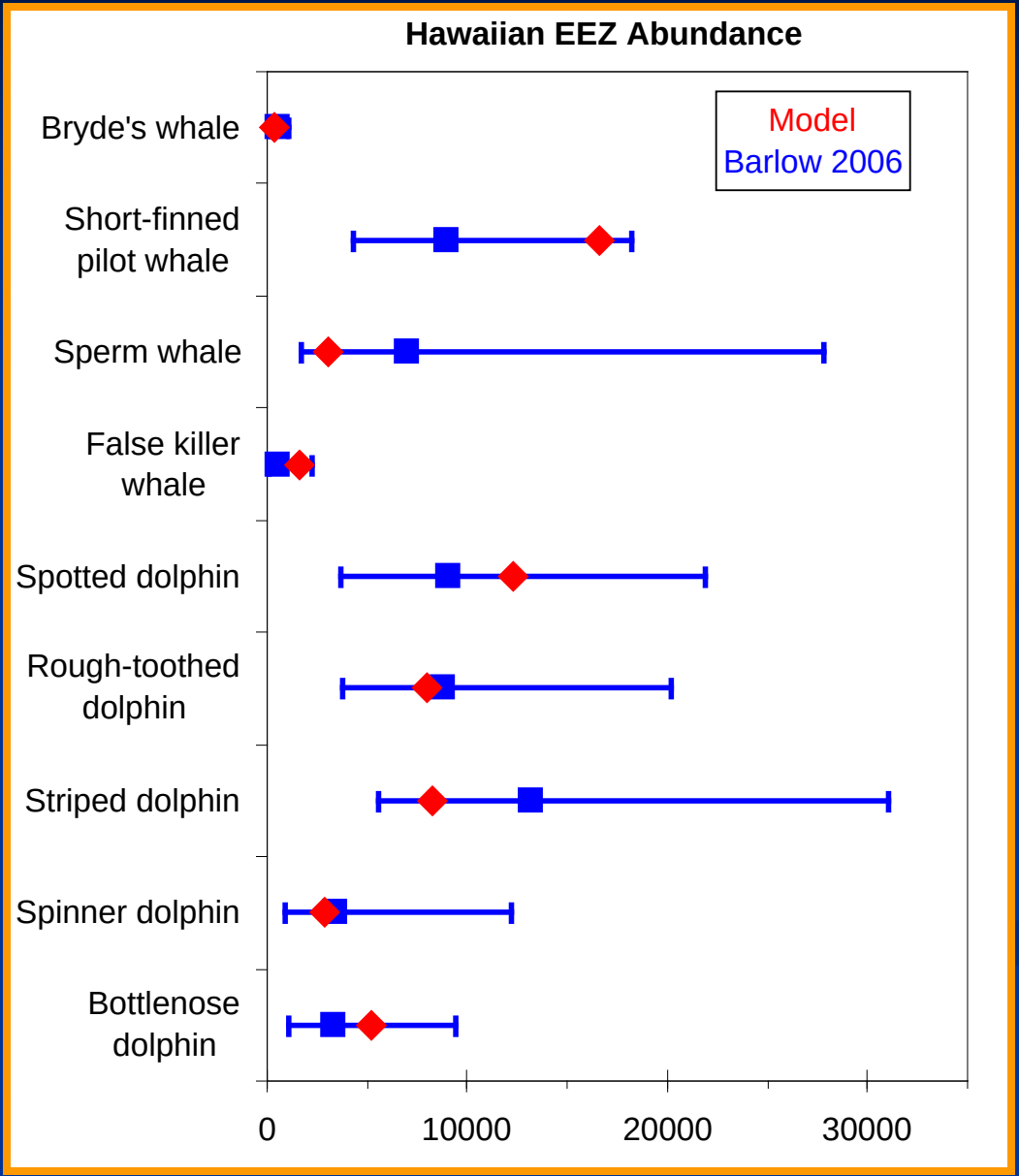
Rough-toothed dolphin
Steno bredanensis

False killer whale
Pseudorca crassidens

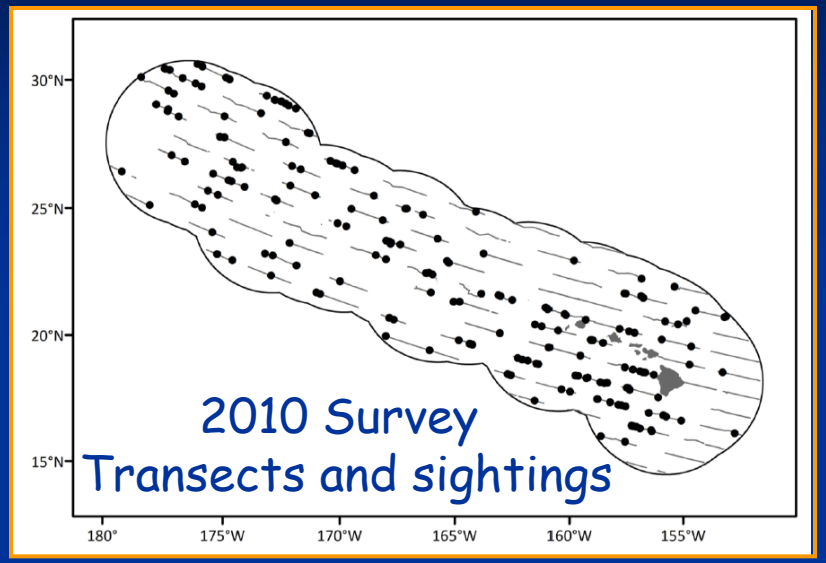


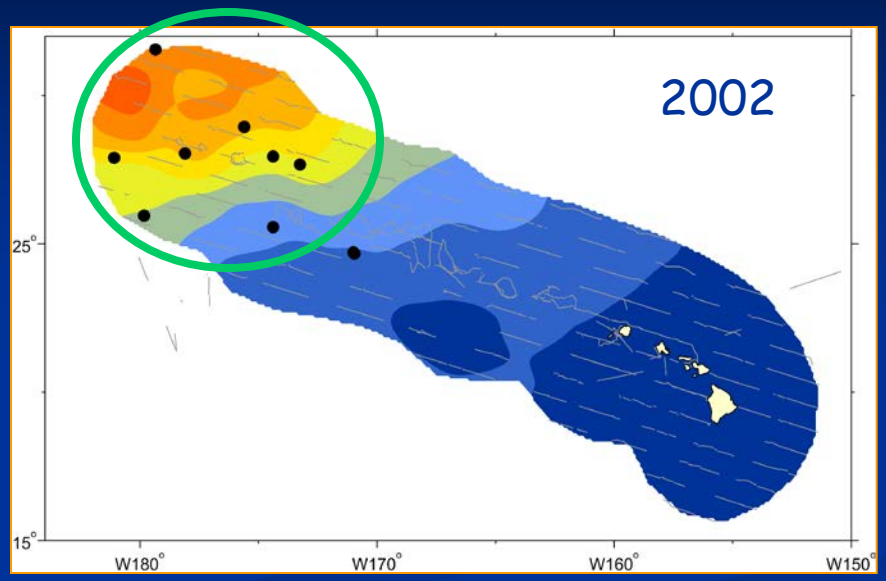
But are the models correct?

- No independent data available for validation
- Compared model abundance to published line-transect estimates from the 2002 Hawaiian EEZ survey
  -Barlow 2006
- All model estimates within 95% confidence limits.
- Encouraging, but need independent validation

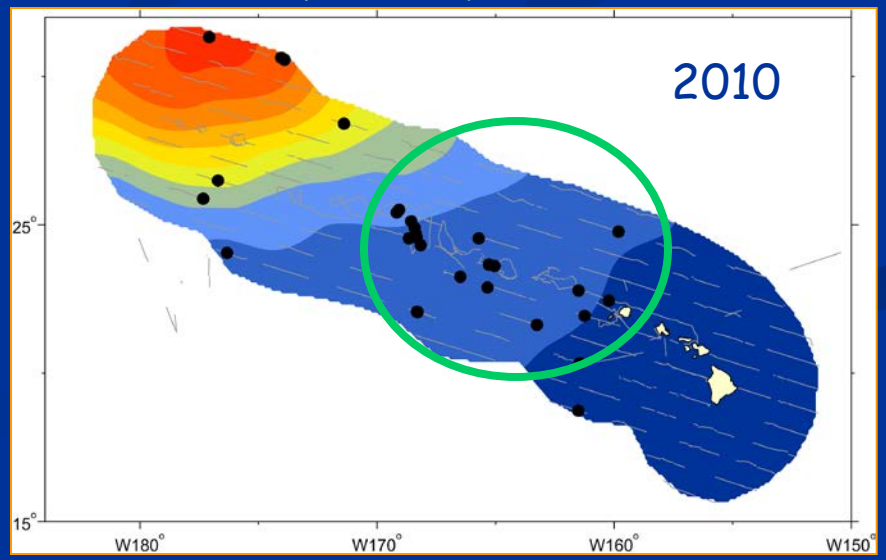


Updates: Model validation using 2010 Hawaiian EEZ survey data





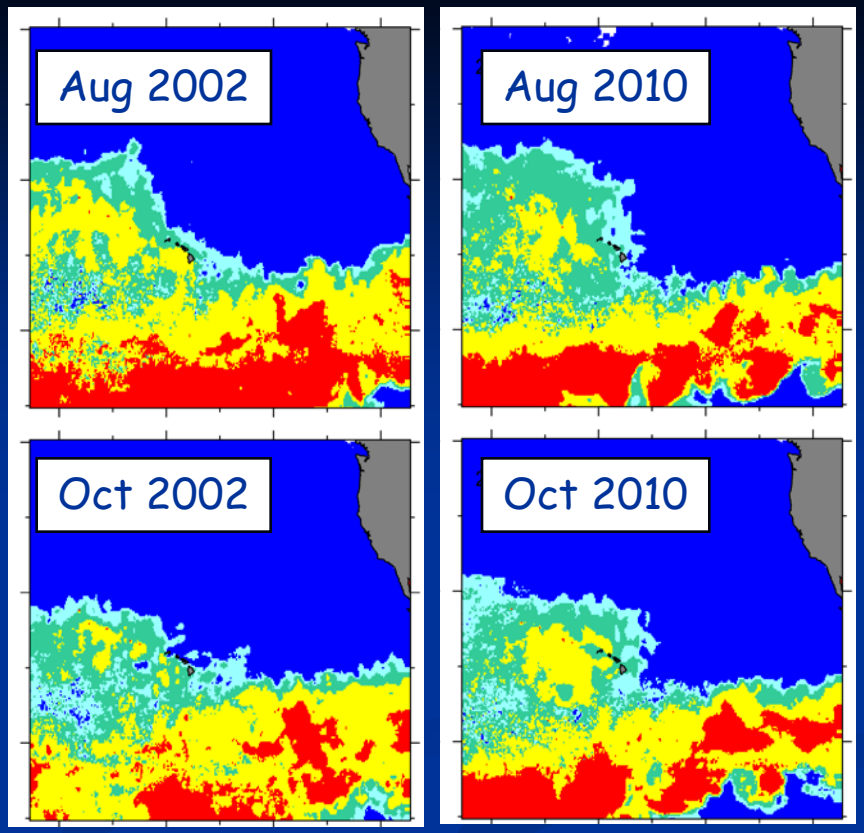
Example: Bryde's whale



- Validate models using 2010 Hawaiian EEZ survey data
  - Bradford et al. 2012, 2013
- Update models based on validation results and with new survey data

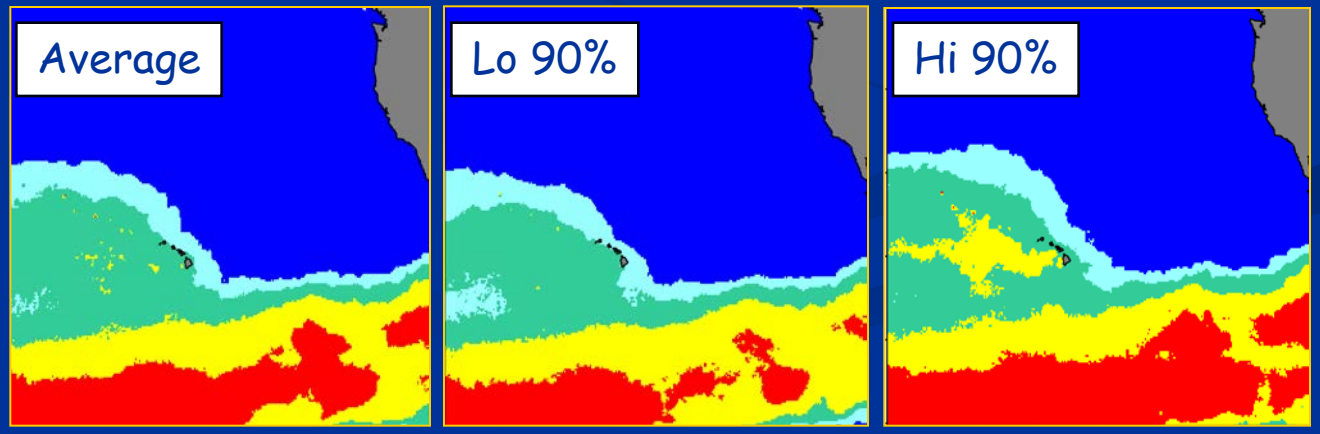
Updates: Build new models with new survey data and improved methods

- Predict directly on 25x25 km pixels throughout study area to avoid interpolation artifacts
- Estimate monthly densities in each year



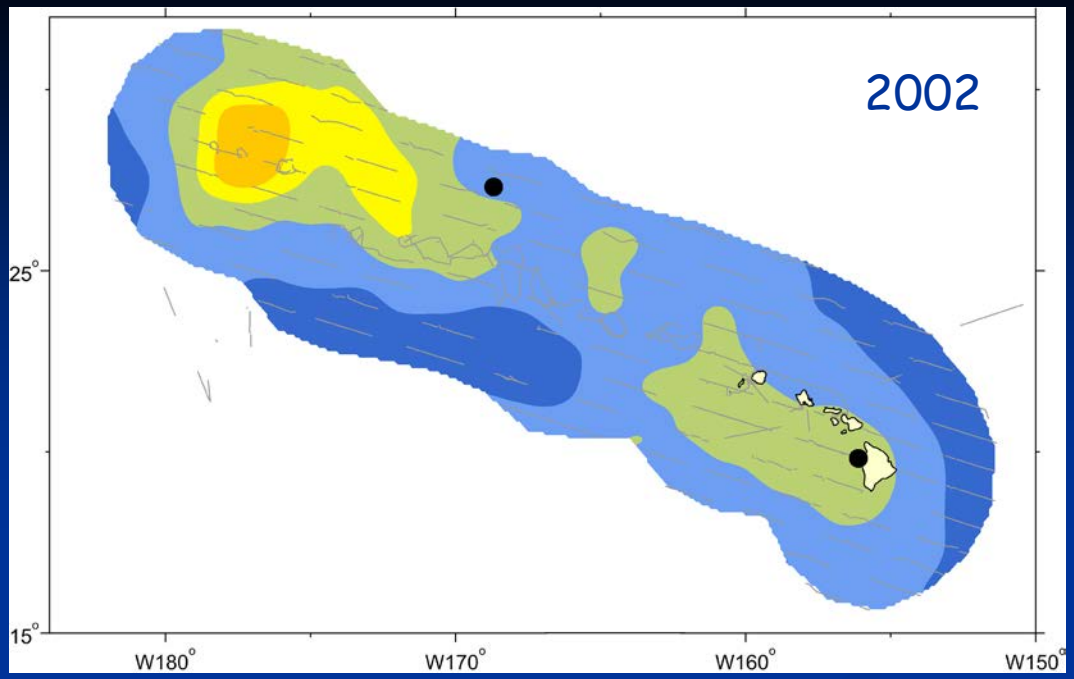
Example: Bryde's whale

- Estimate average density, variance, and confidence intervals

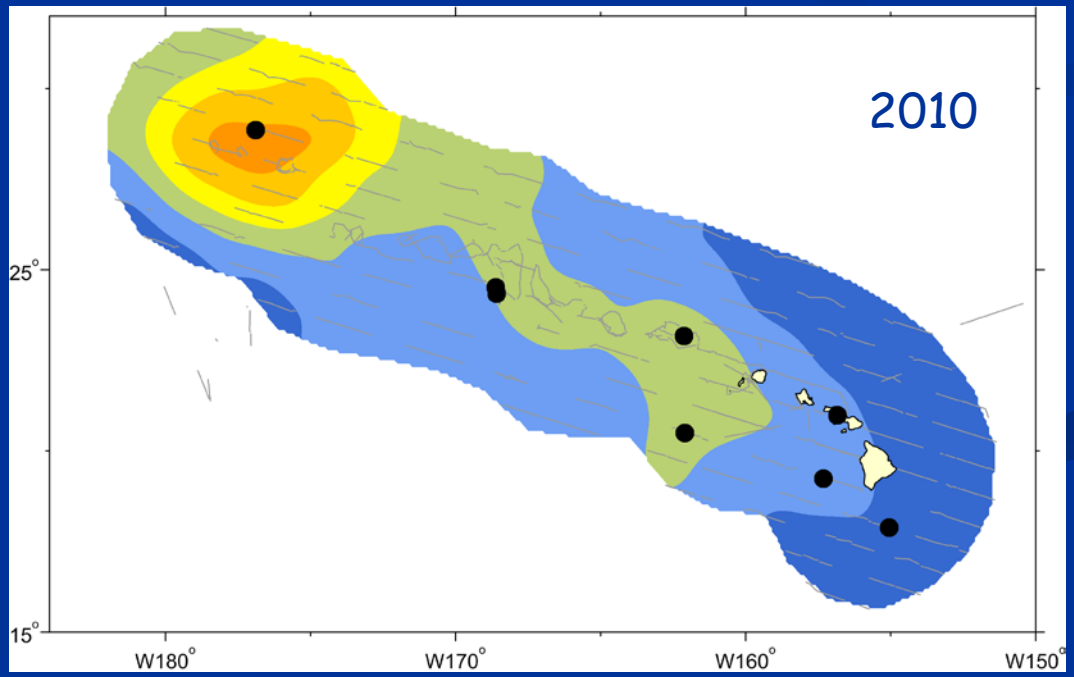


False killer whale model validation (original model in Becker et al. 2012)

Compared to 2002 survey →



Model predictions (based on 2010 habitat conditions) with 2010 sightings →



Next steps

- Complete model validation:
  - Plot predicted densities vs. actual 2010 sightings for all species
  - Compare model-based abundances to 2010 line-transect estimates (Bradford et al. 2012, 2013)
- Update models with new survey data (2010-2012)

For validated (good) models:

- Create GIS layers with density grids (and confidence limits)
- 'Range-wide' estimates of pelagic false killer whale abundance?

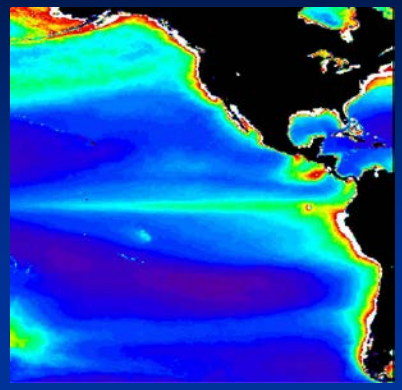
Modeled species

- False killer whale
- Sperm whale
- Short-finned pilot whale
- Rough-toothed dolphin
- Bottlenose dolphin
- Spinner dolphin
- Spotted dolphin
- Striped dolphin

Back Pocket Slides

TECHNICAL APPROACH

Marine Mammal Survey Data

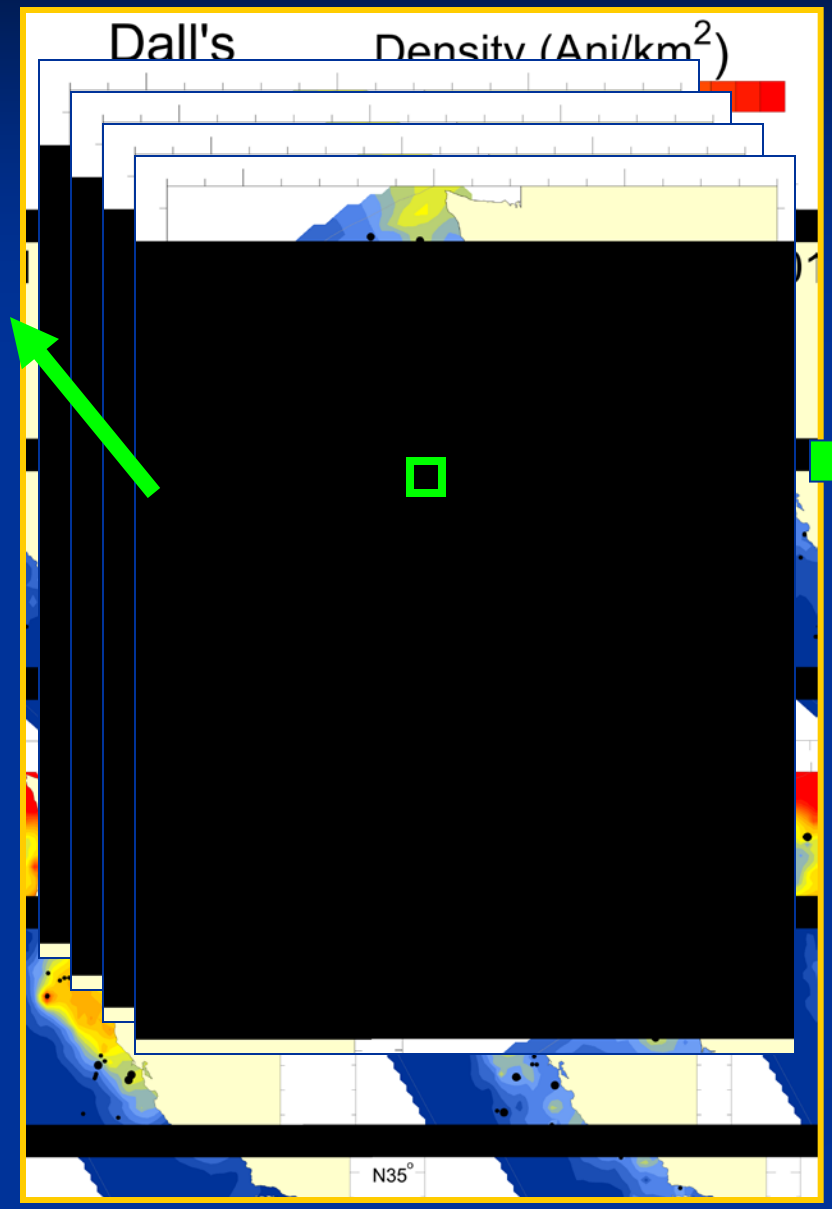
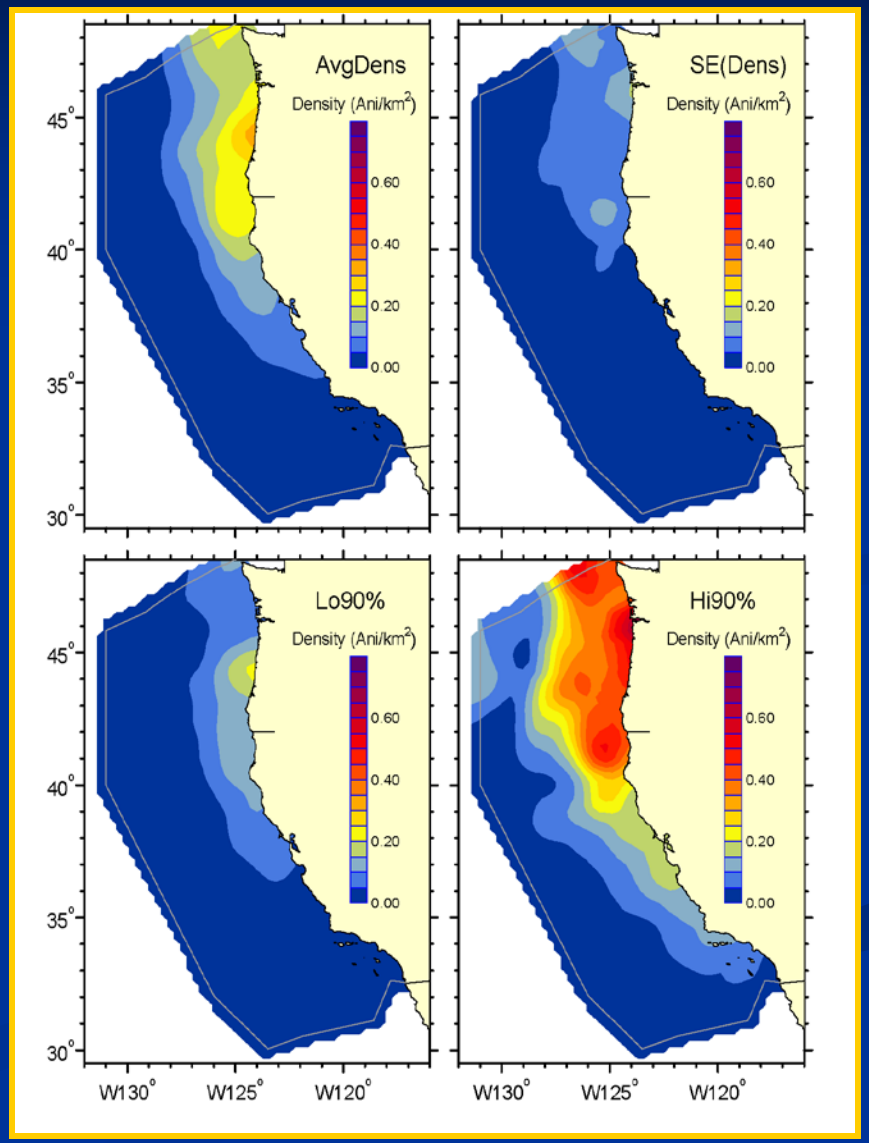


Habitat Data

Statistical models of marine mammal density

$$\text{Density} = \frac{n \cdot s}{L \cdot 2 \cdot w \cdot g(0)}$$

n = # groups
L = length of transect
s = group size
w = effective strip $\frac{1}{2}$-width
g(0) = probability of detection on transect line

Line-transect framework
(Buckland et al. 2003)

Multiple survey years allow spatial and temporal characterization of animal distribution and density