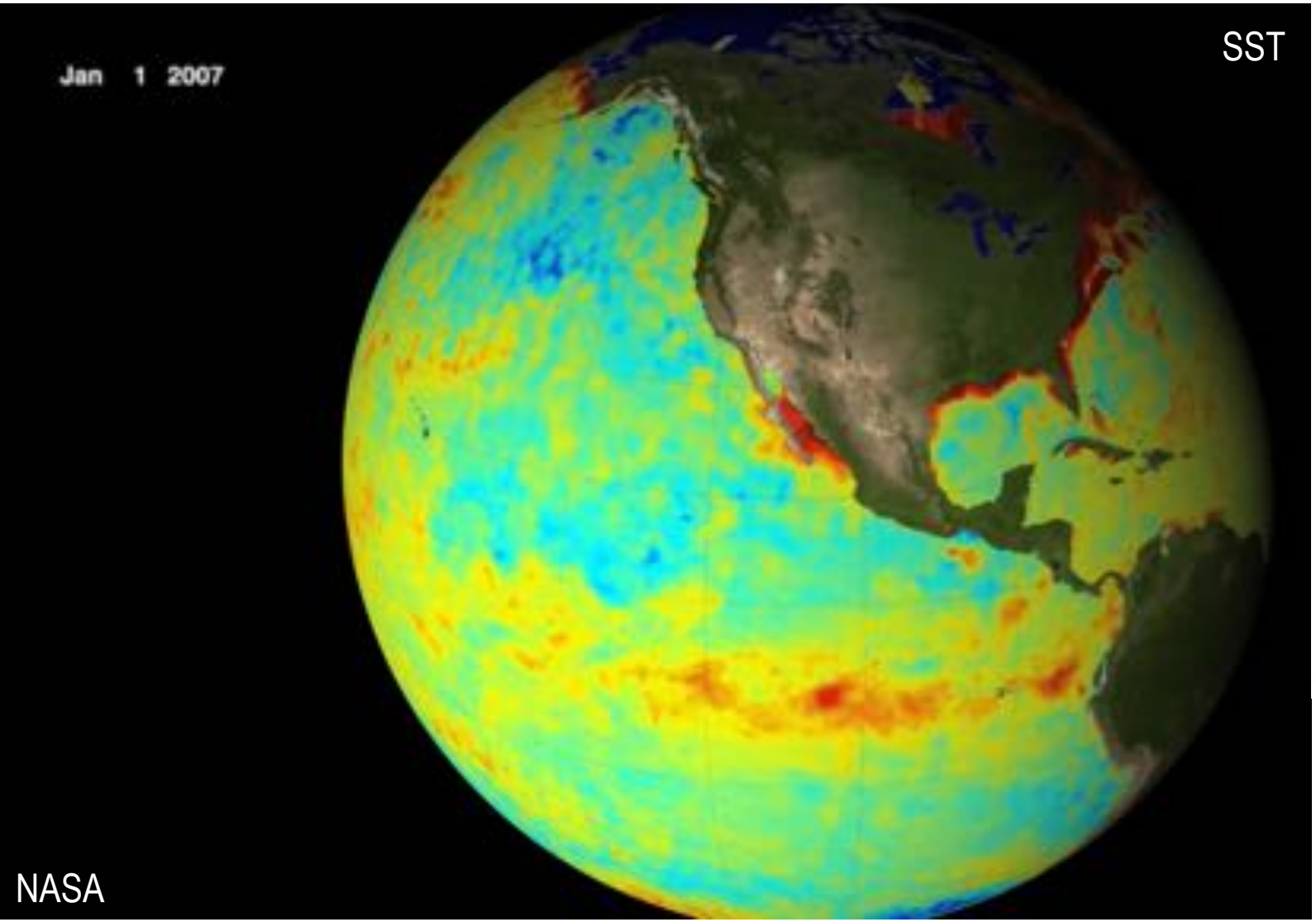
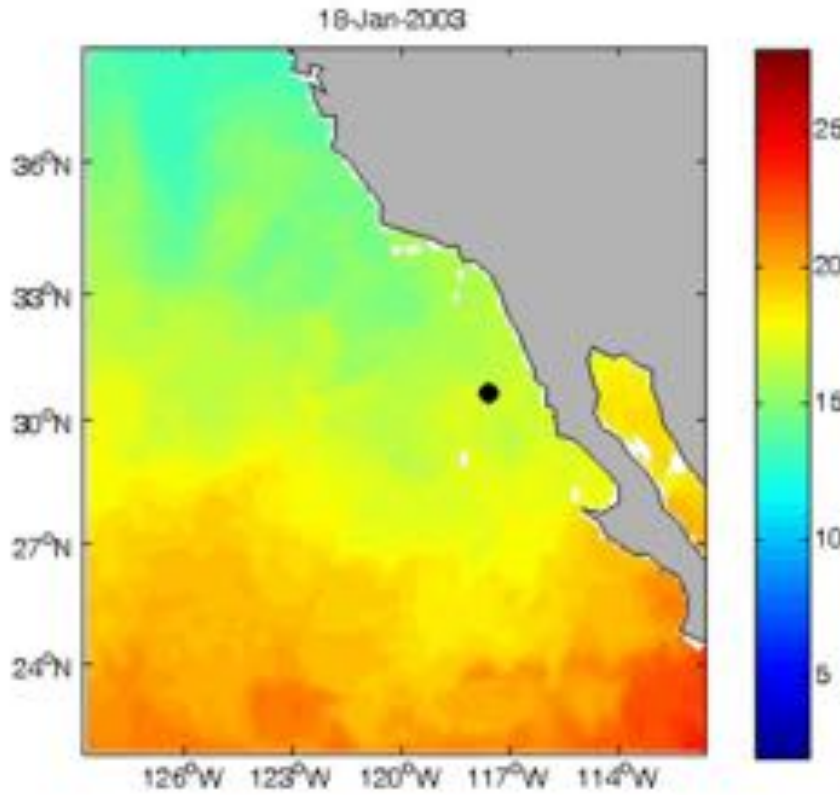
Dynamic Oceans and Dynamic Ecosystems





Southwest Fisheries Science Center,
Environmental Research Division
UCSC – Cooperative Institute for Marine
Ecosystems and Climate
elliott.hazen@noaa.gov

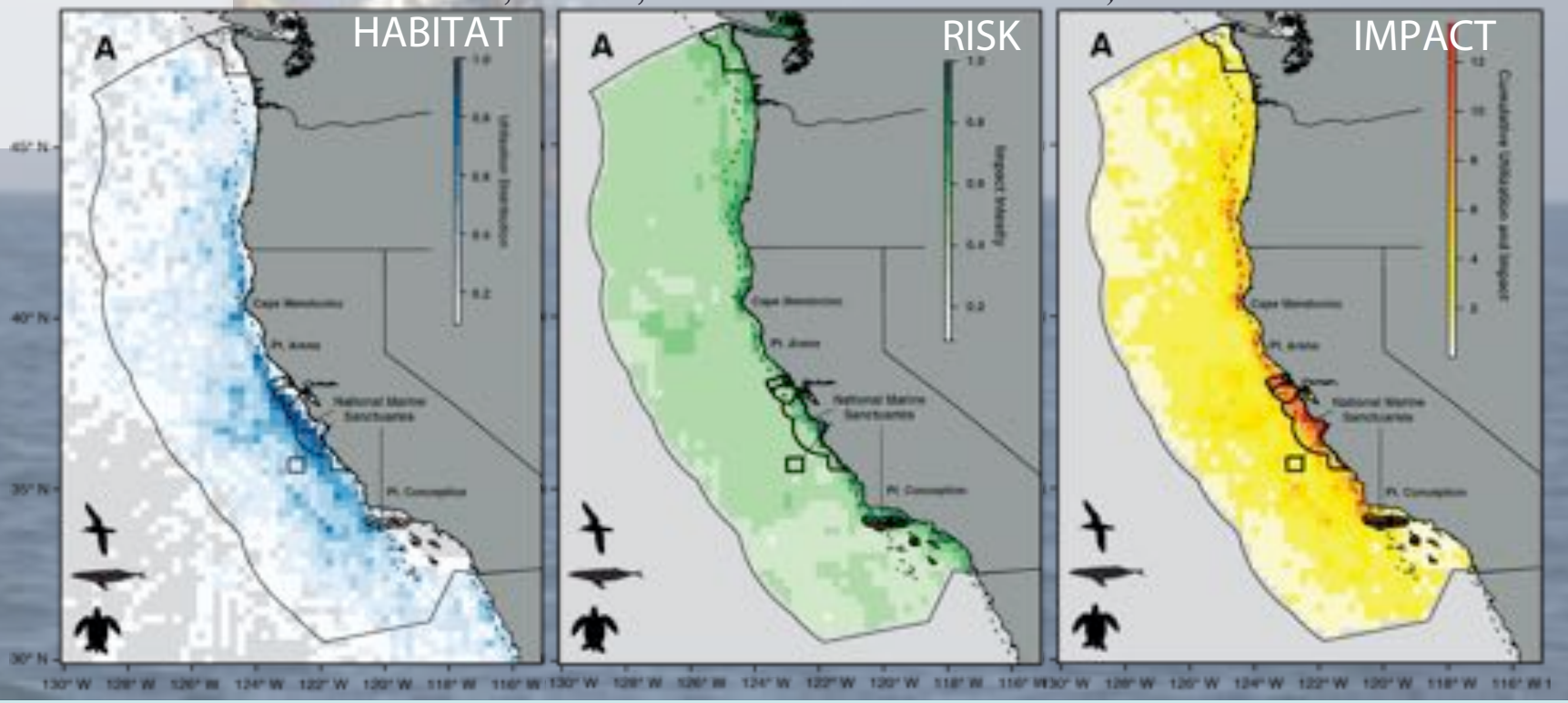
Cumulative Risks in the California Current

Multiple Risks

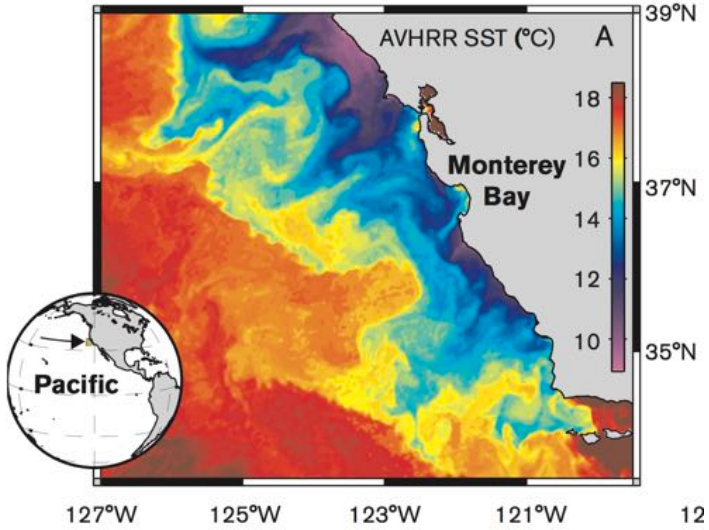
- Ship strikes
- Bycatch / entanglement
- Noise
- Climate change

- Use satellite data to model species and risk in near real time

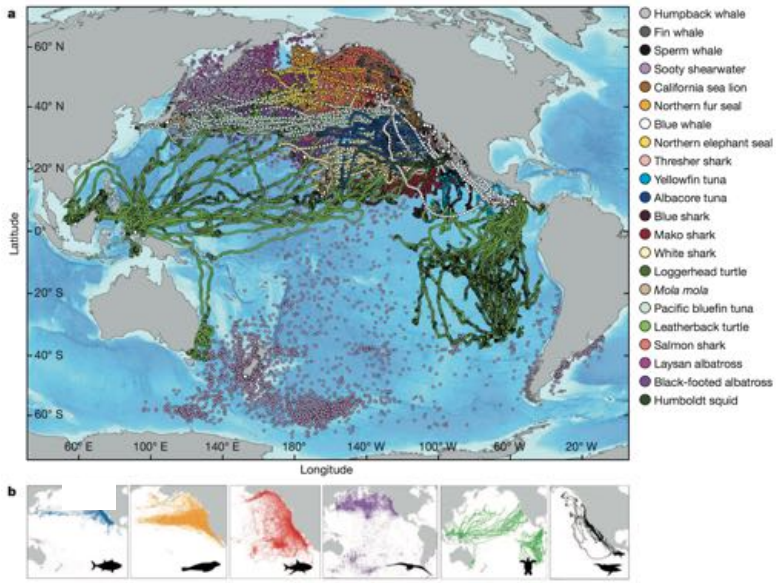
Maxwell, Hazen, et al. 2013 *Nature Comm.; 2013 CCIEA*



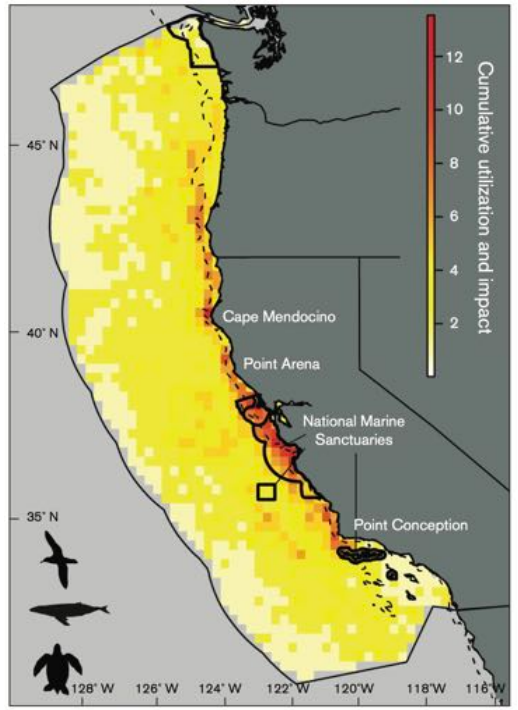
Dynamic Ocean Management



Ryan et al. 2005



Block et al. 2011

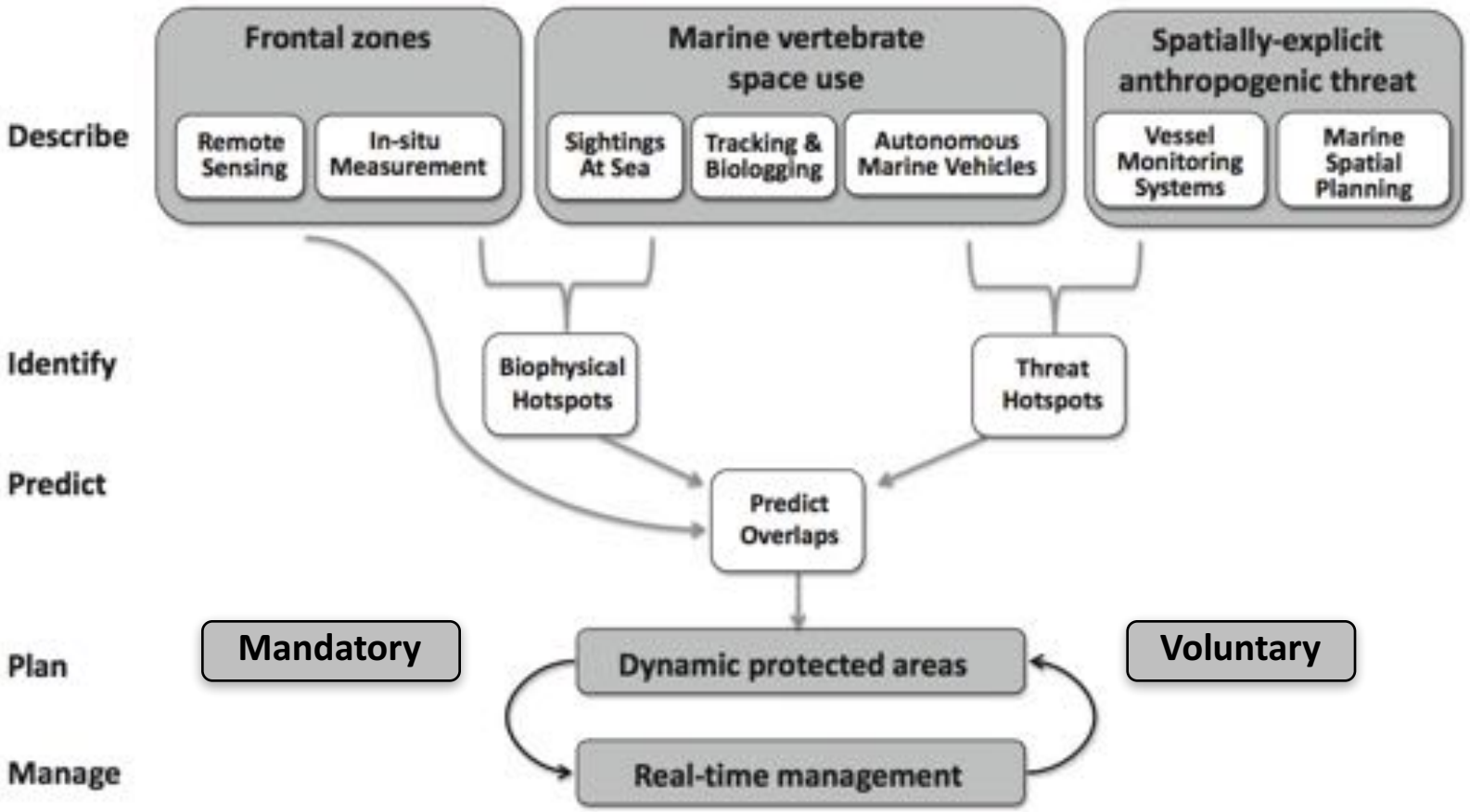


Maxwell et al. 2013

Management that changes in space and time, at scales relevant for animal movement and human use.

Hobday et al. 2014, Lewison et al. 2015, Maxwell et al. 2015

Dynamic Ocean Management



TurtleWatch

⇩

WhaleWatch

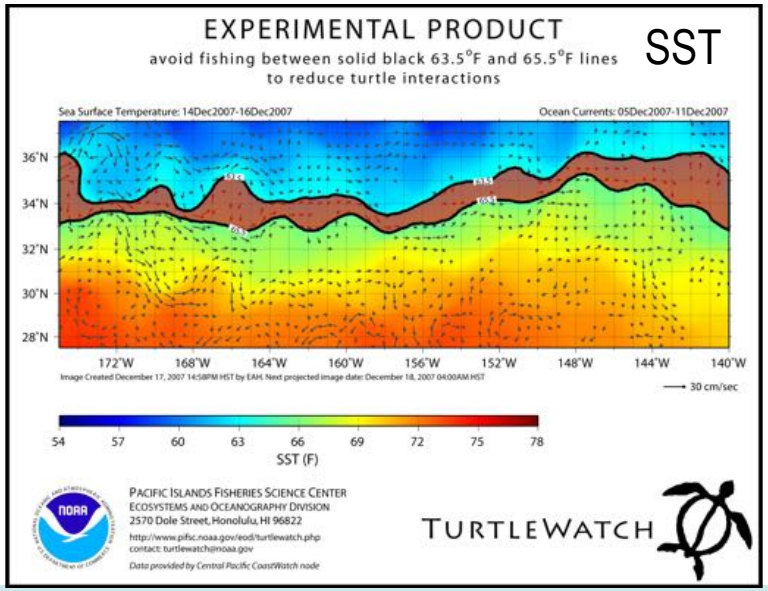
⇩

EcoCast

Scales et al. 2014 J Appl Ecol

TurtleWatch

Voluntary,
yet effective



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ENDANGERED SPECIES RESEARCH
Endang Species Res
Printed December 2008
Published online July 1, 2008
Contribution to the Theme Section 'Fisheries bycatch: problems and solutions'
OPEN ACCESS

TurtleWatch: a tool to aid in the bycatch reduction of loggerhead turtles *Caretta caretta* in the Hawaii-based pelagic longline fishery

Evan A. Howell[1,*], Donald R. Kobayashi[1,2], Denise M. Parker[1,3], George H. Balazs[1], Jeffrey J. Polovina[1]

[1]Pacific Islands Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 2570 Dole Street, Honolulu, Hawaii 97822-2396, USA
[2]Department of Environmental Sciences, University of Technology, Sydney, Broadway, New South Wales 2007, Australia
[3]Joint Institute for Marine and Atmospheric Research, 1000 Pope Road, University of Hawaii, Honolulu, Hawaii 96822-2396, USA

FISHERIES OCEANOGRAPHY
FISHERIES OCEANOGRAPHY
Fish. Oceanogr. 24:1, 57–68, 2015

Enhancing the TurtleWatch product for leatherback sea turtles, a dynamic habitat model for ecosystem-based management

EVAN A. HOWELL,[1,*] AIMEE HOOVER,[2,4] SCOTT R. BENSON,[3] HELEN BAILEY,[4] JEFFREY J. POLOVINA,[1] JEFFREY A. SEMINOFF[5] AND PETER H. DUTTON[5]

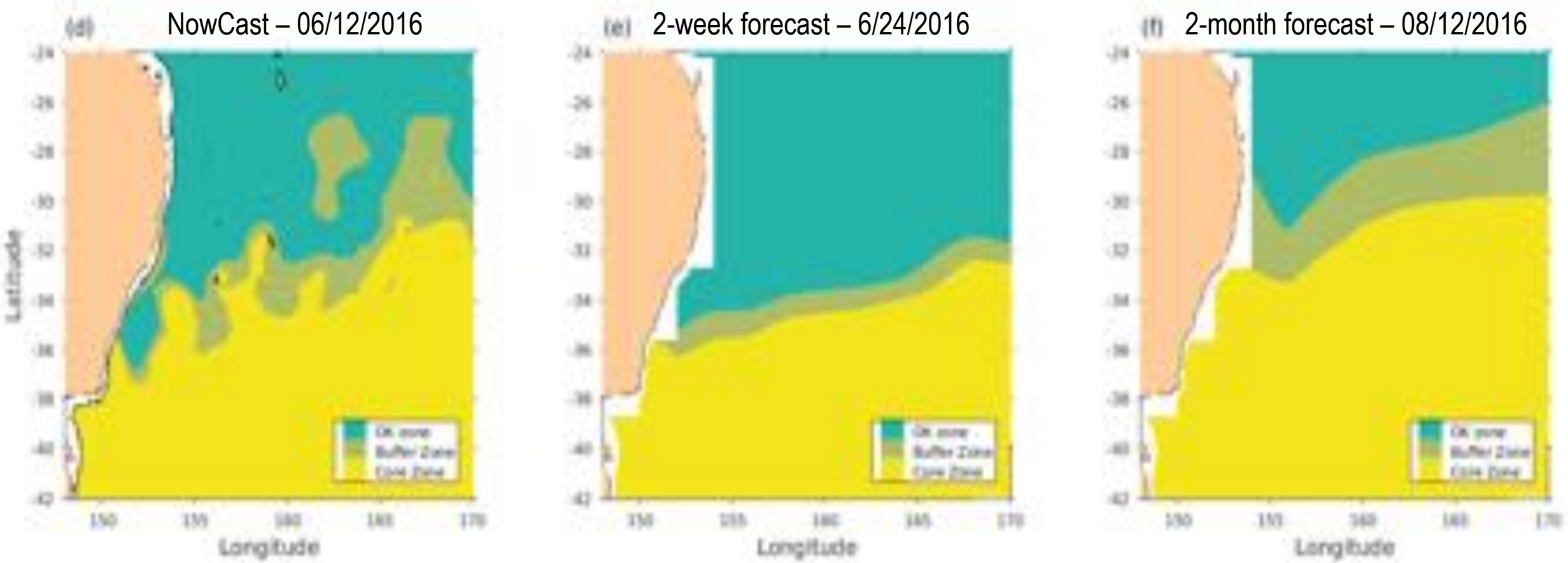
[1]*NOAA Pacific Islands Fisheries Science Center, 1845 Wasp Blvd., Building 176 Honolulu, HI, 96818, U.S.A.*
[2]*Joint Institute for Marine and Atmospheric Research, 1000 Pope Road, Honolulu, HI, 96822, U.S.A.*
[3]*NOAA Southwest Fisheries Science Center, 7544 Sandholdt Road, Moss Landing, CA, 95039, U.S.A.*
[4]*Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, 146 Williams Street, Solomons, MD, 20688, U.S.A.*
[5]*NOAA Southwest Fisheries Science Center, 8901 La Jolla Shores Dr., La Jolla, CA, 92037, U.S.A.*

centered at 17.2° and 22.9°C, occupied by leatherbacks on fishing grounds of the Hawaii-based swordfish fishery. This new information was used to expand the TurtleWatch product to provide managers and industry near real-time habitat information for both loggerheads and leatherbacks. The updated TurtleWatch product provides a tool for dynamic management of the Hawaii-based shallow-set fishery to aid in the bycatch reduction of both species. Updating the management strategy to dynamically adapt to shifts in multi-species habitat use through time is a step towards an ecosystem-based approach to fisheries management in pelagic ecosystems.

Key words: Central North Pacific, dynamic management, fisheries, leatherback sea turtles, sea surface temperature, swordfish

ABSTRACT

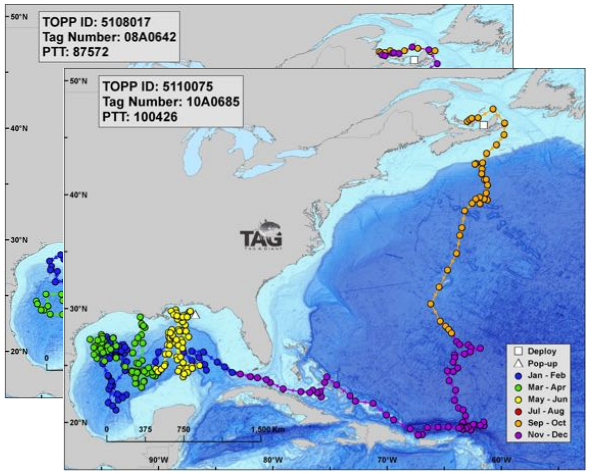
Southern Bluefin Tuna in Australia



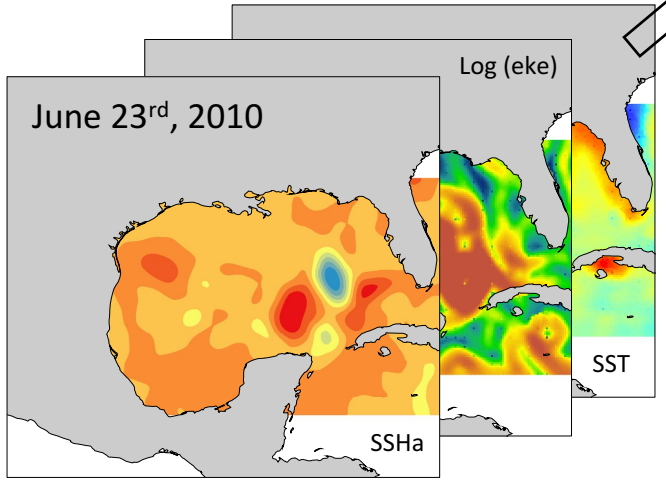
Hobday and Hartmann 2006, Hobday et al. 2011, Hobday et al. *in review*

Species Distribution Modeling

Distribution / behavioral data
e.g. sightings data, tag data, foraging events



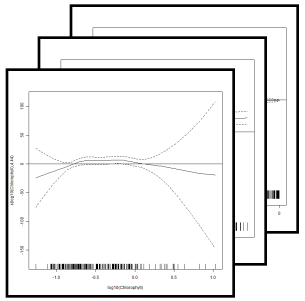
Sampled predictive data



Fit

Statistical models

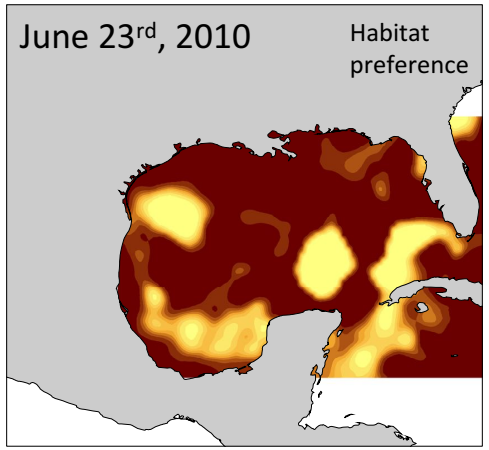
$$g(\mu) = \beta_0 + \beta_1 x_1 + \cdots + \beta_m x_m$$

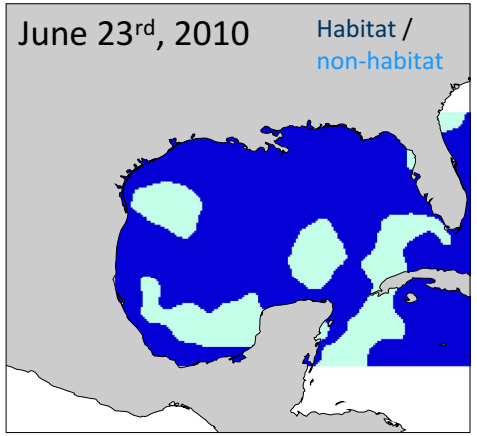


e.g. Generalized Additive Mixed Models, Boosted Regression Trees

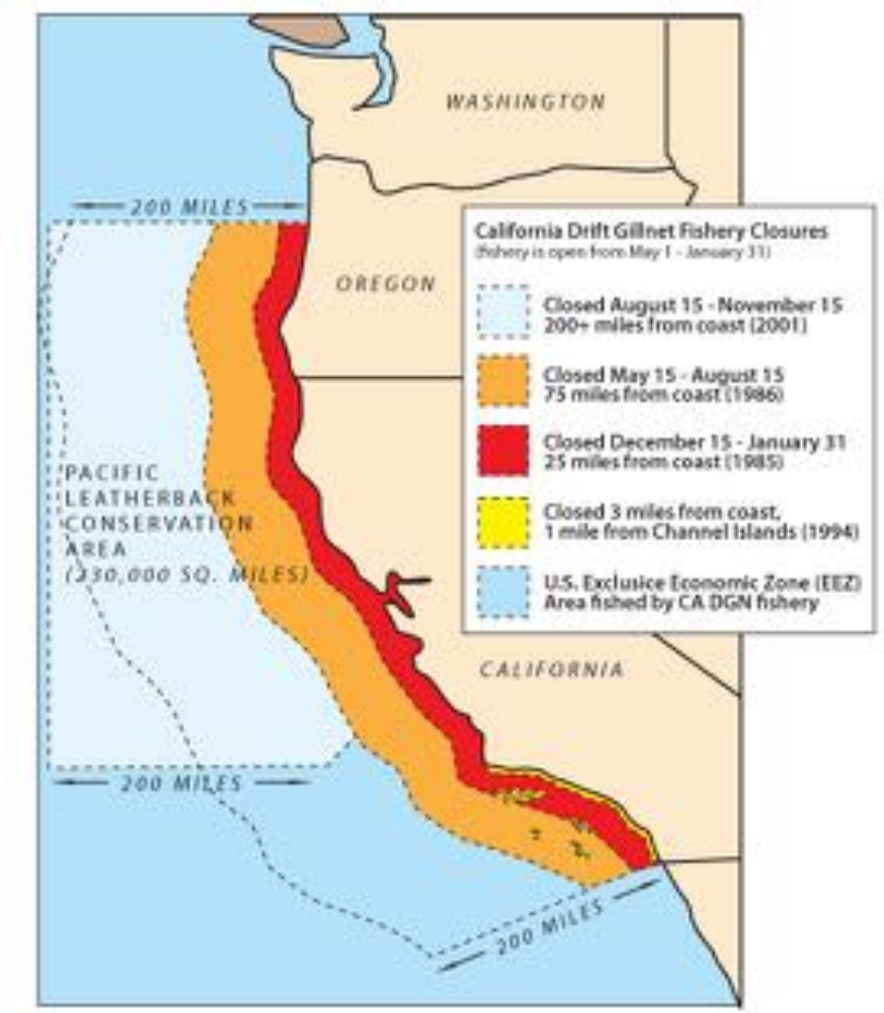
Predict

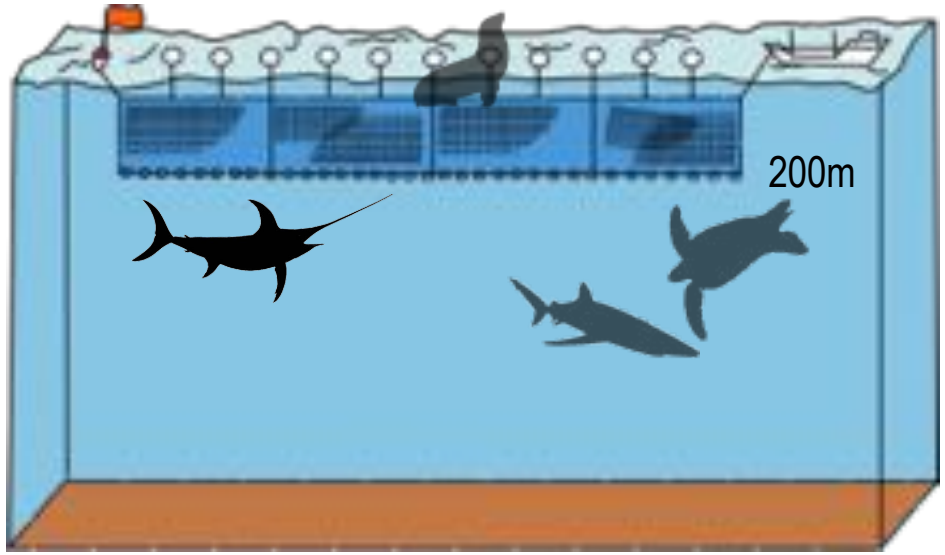
Probability of occurrence predicted from environmental covariates

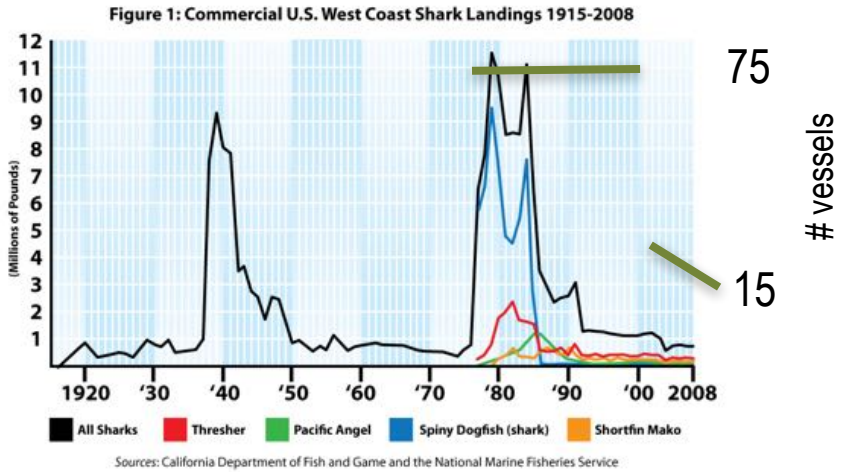




California Drift Gillnet Fishery







EcoCast

Fishing zones predicted based on ocean features, catch potential, and weighted by bycatch risk

Good fishing zones served via web and mobile devices

Models to include: hard cap species, risk weightings, seasonal forecasting

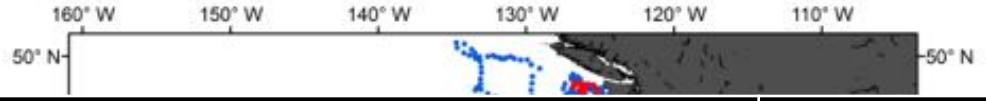
California Drift Gillnet Fishery

Data Types:

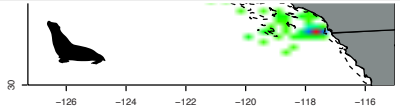
Satellite tracking data

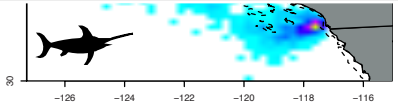
Fishery observer data

+ NOAA marine mammal survey data



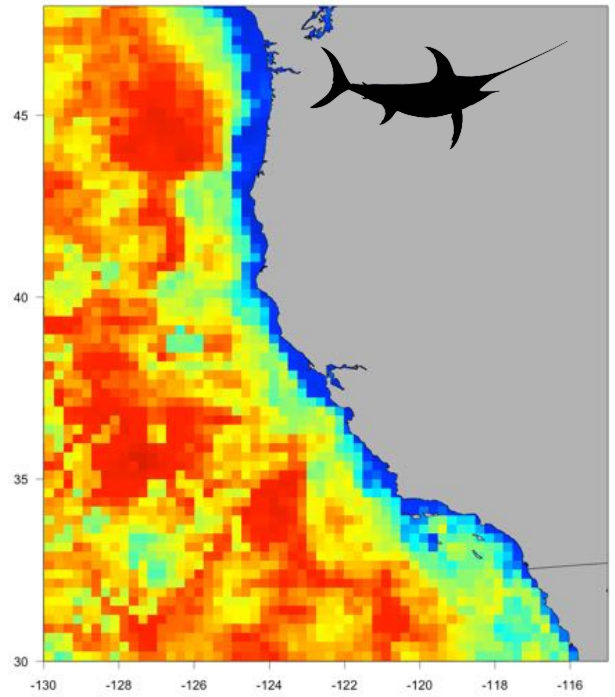
Data Products	
SST and Standard Deviation	Daily – JPL GHRSST
Chl	8-day – SeaWIFS, MODIS, VIRRS composite
EKE	Daily – AVISO at 25km
SSHa and SD	Daily – AVISO at 25km
Y winds	8-day – QSCAT and ASCAT at 25km
Bathymetry and SD	ETOPO1 at 1’



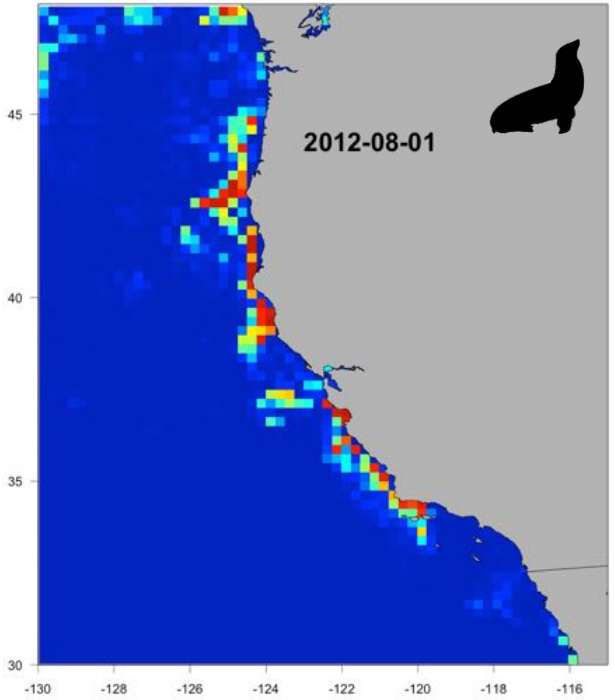


California Drift Gillnet Fishery

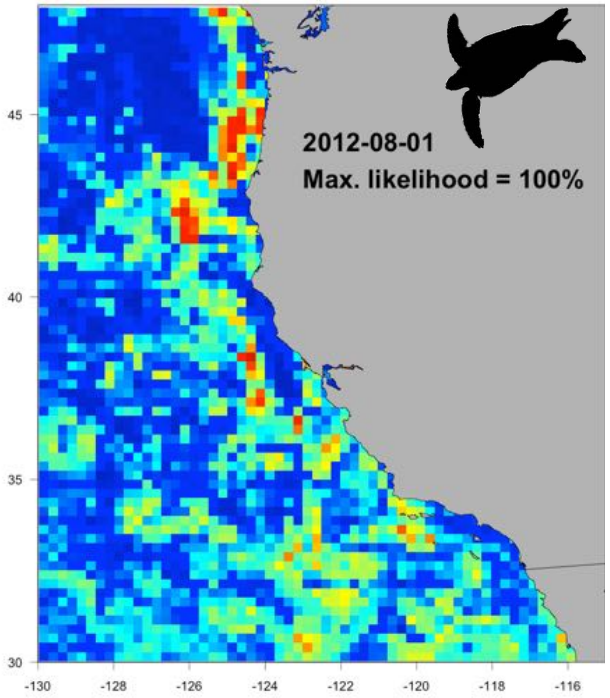
Swordfish Observer



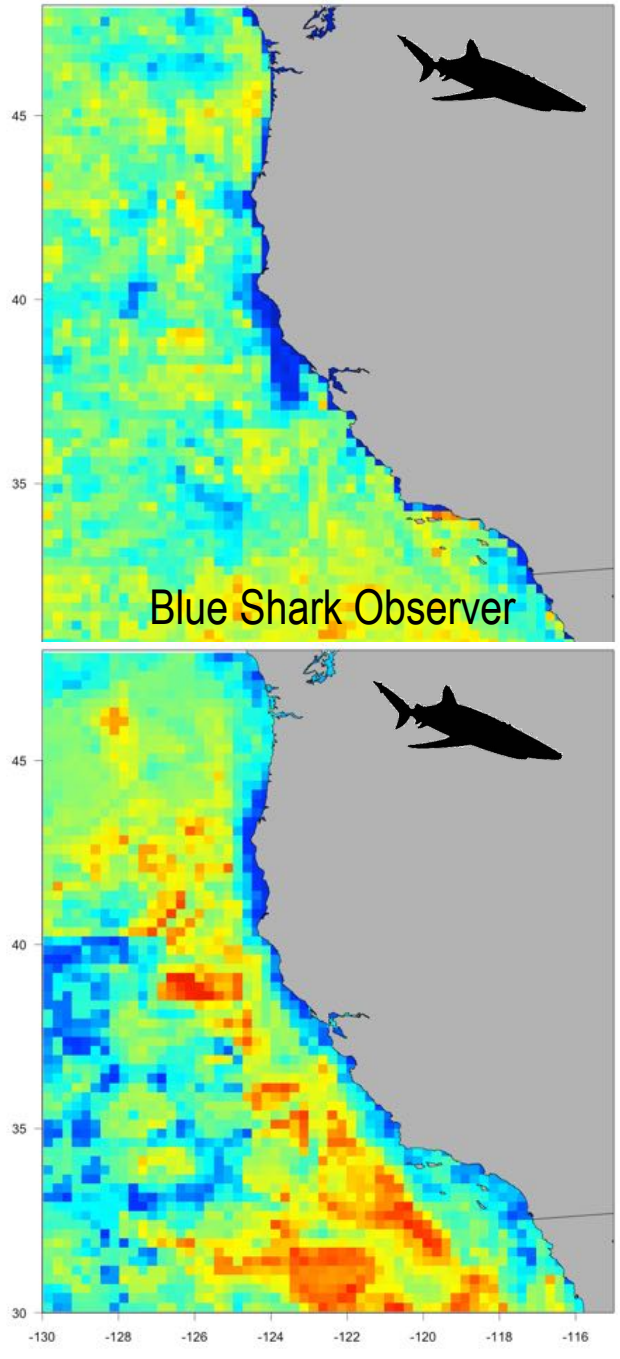
California Sea Lion



Leatherback Turtle



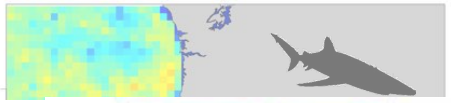
Blue Shark Tracking



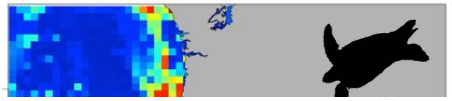
California Drift Gillnet Fishery – 2012 bycatch predictions

Blue Shark Observer

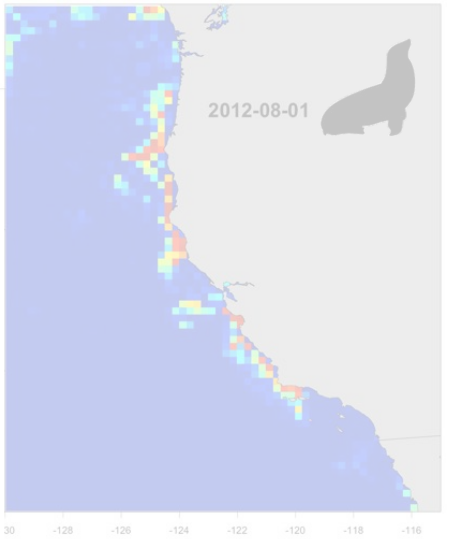
Blue Shark Tracking

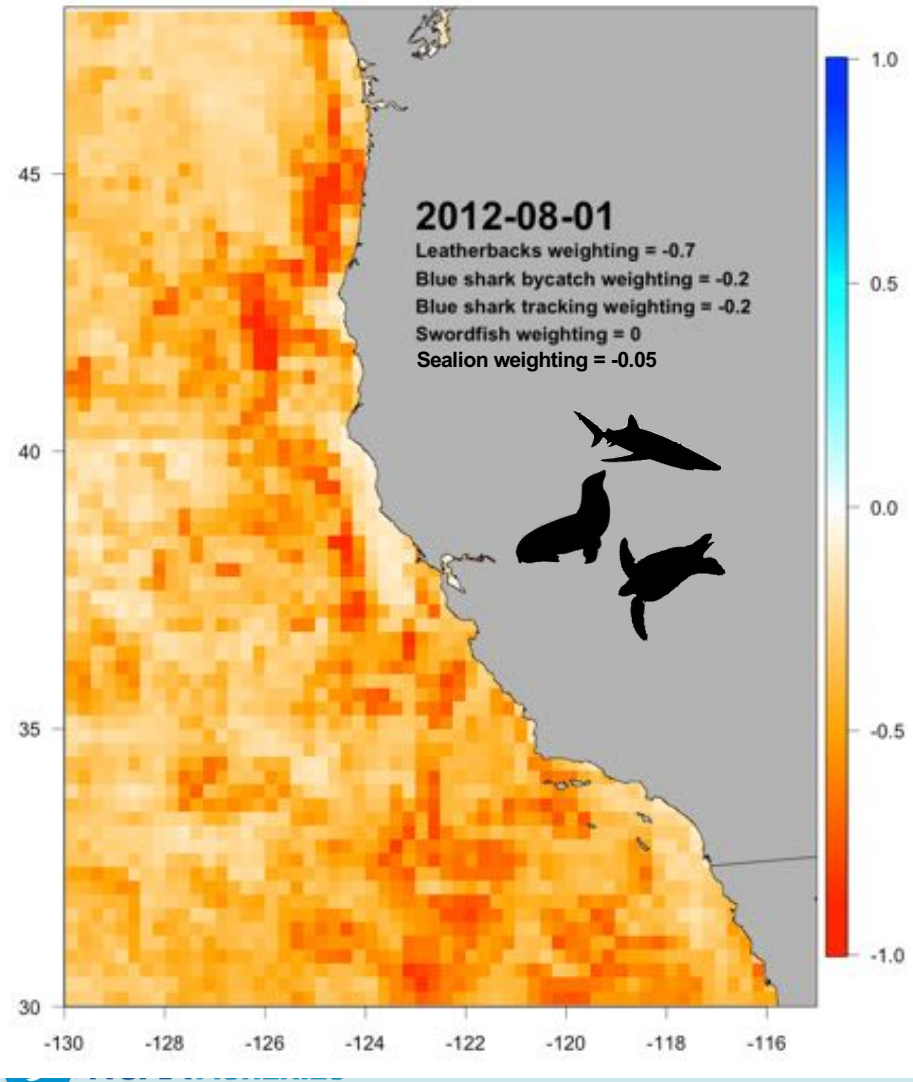


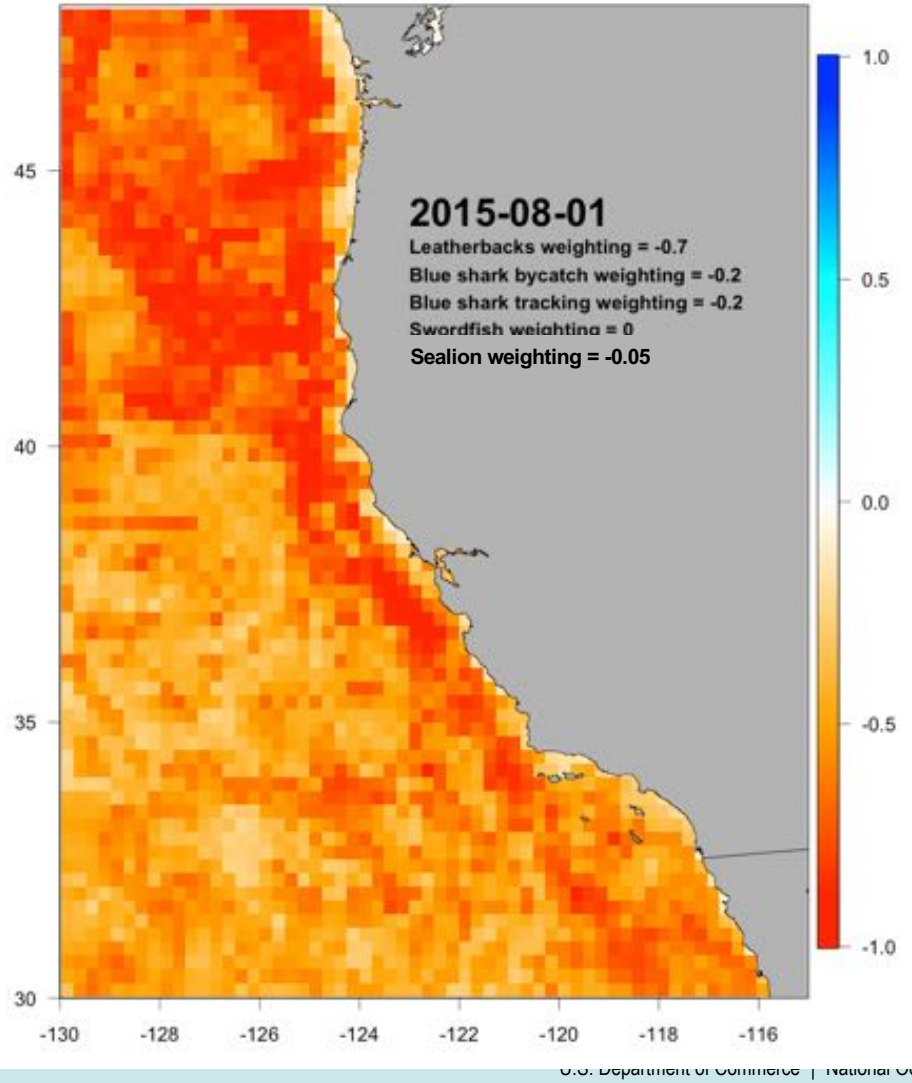
Leatherback Turtle



California Sea Lion

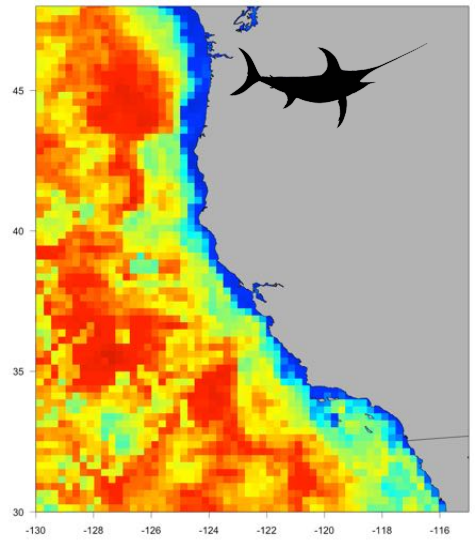




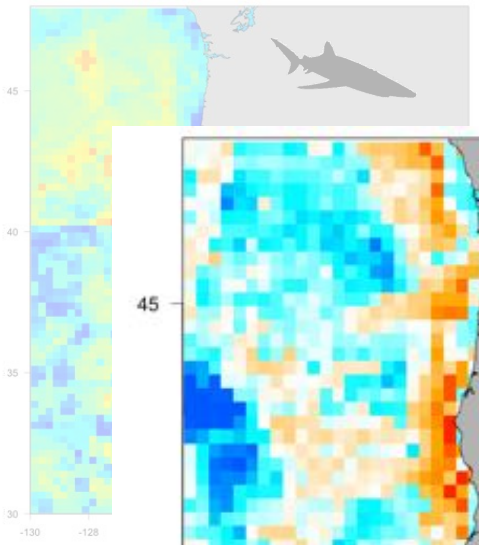


California Drift Gillnet Fishery – 2012 EcoCast predictions

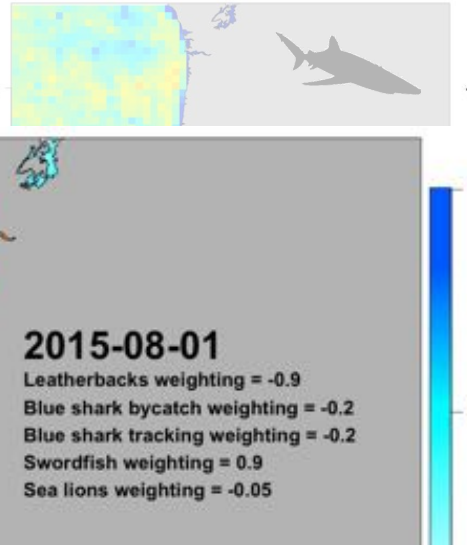
Swordfish Observer



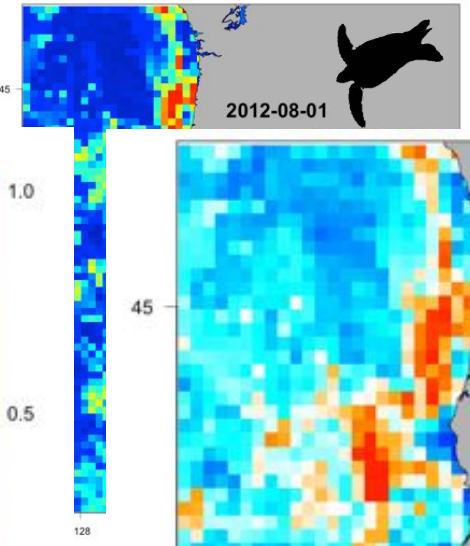
Blue Shark Observer



Blue Shark Tracking



Leatherback Turtle

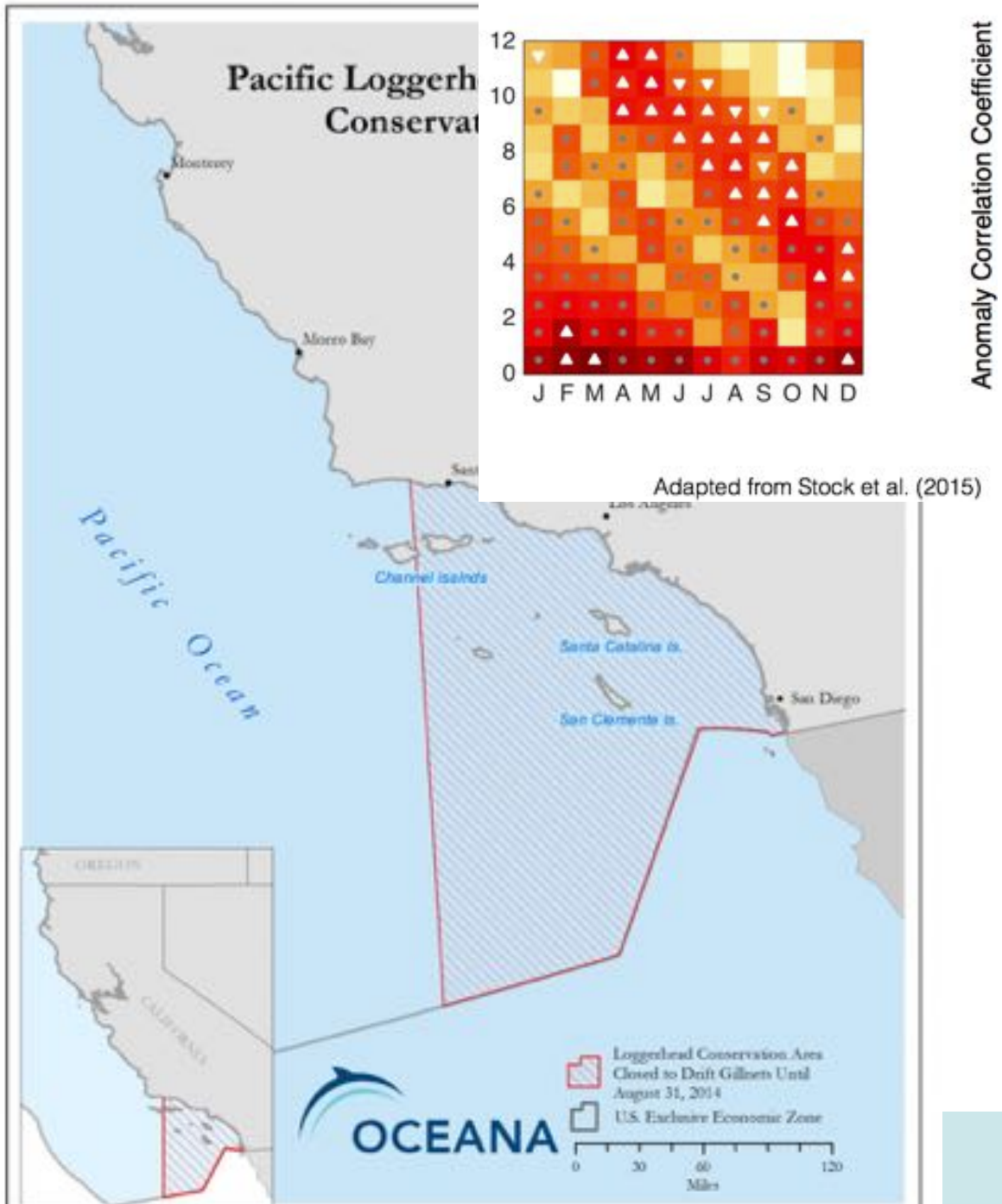


California Sea Lion

NOAA FISHERIES

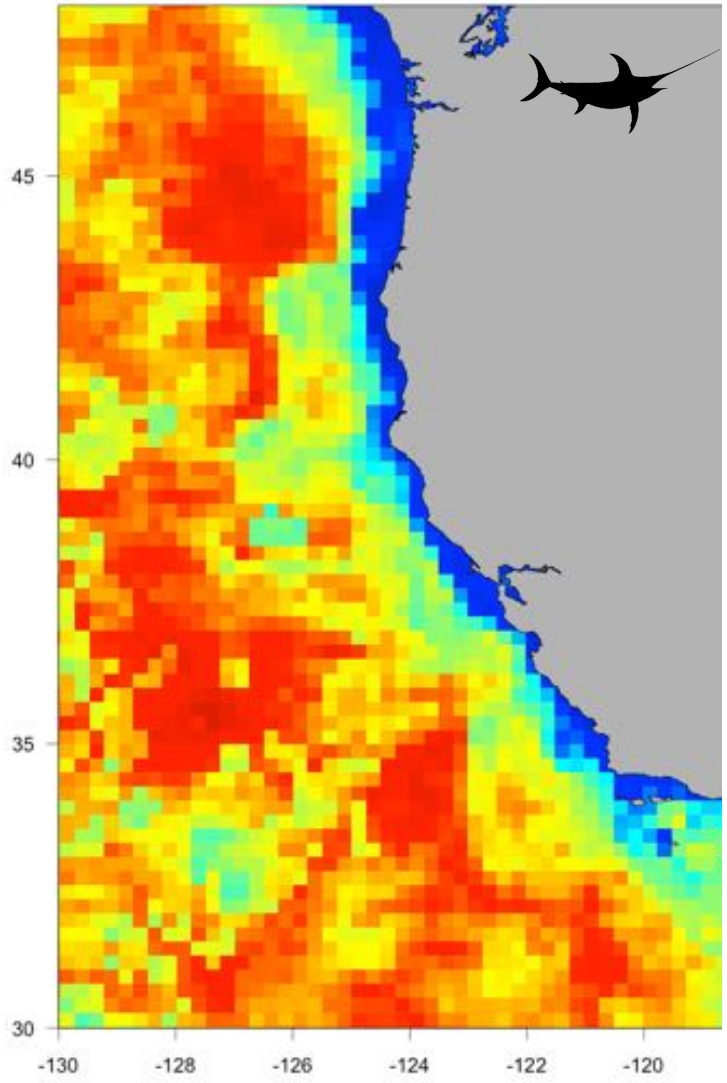
Dynamic Ocean Management – N

1. Data-assimilative ROMS instead of Satellite fields
2. Derived frontal products (Scales et al. 2014) and Finite Size / Time Lyapunov Exponents from Aviso for mesoscale activity
3. Explore forecasting models (e.g. NMME) for use in pro-active planning, risk analyses, and management strategy evaluations.



Adapted from Stock et al. (2015)

Questions?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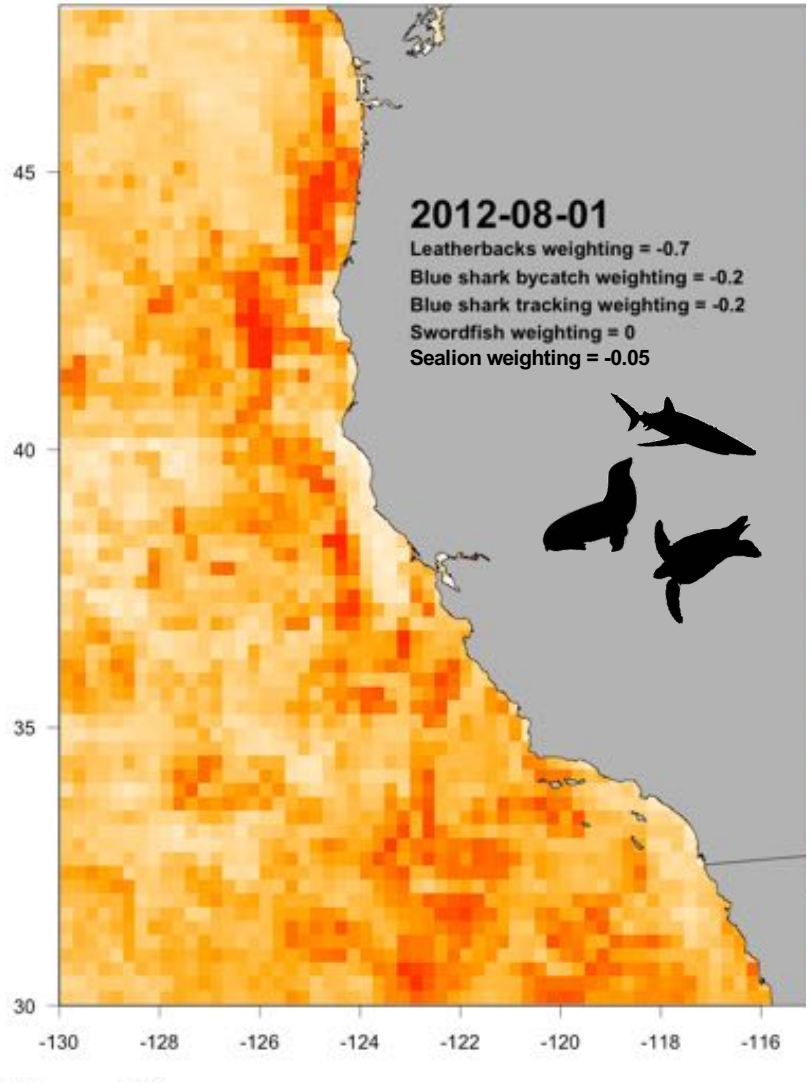
-124
-122
-120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Blue shark bycatch weighting = -0.2
Blue shark tracking weighting = -0.2
Swordfish weighting = 0
Sealion weighting = -0.05
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-124
-122
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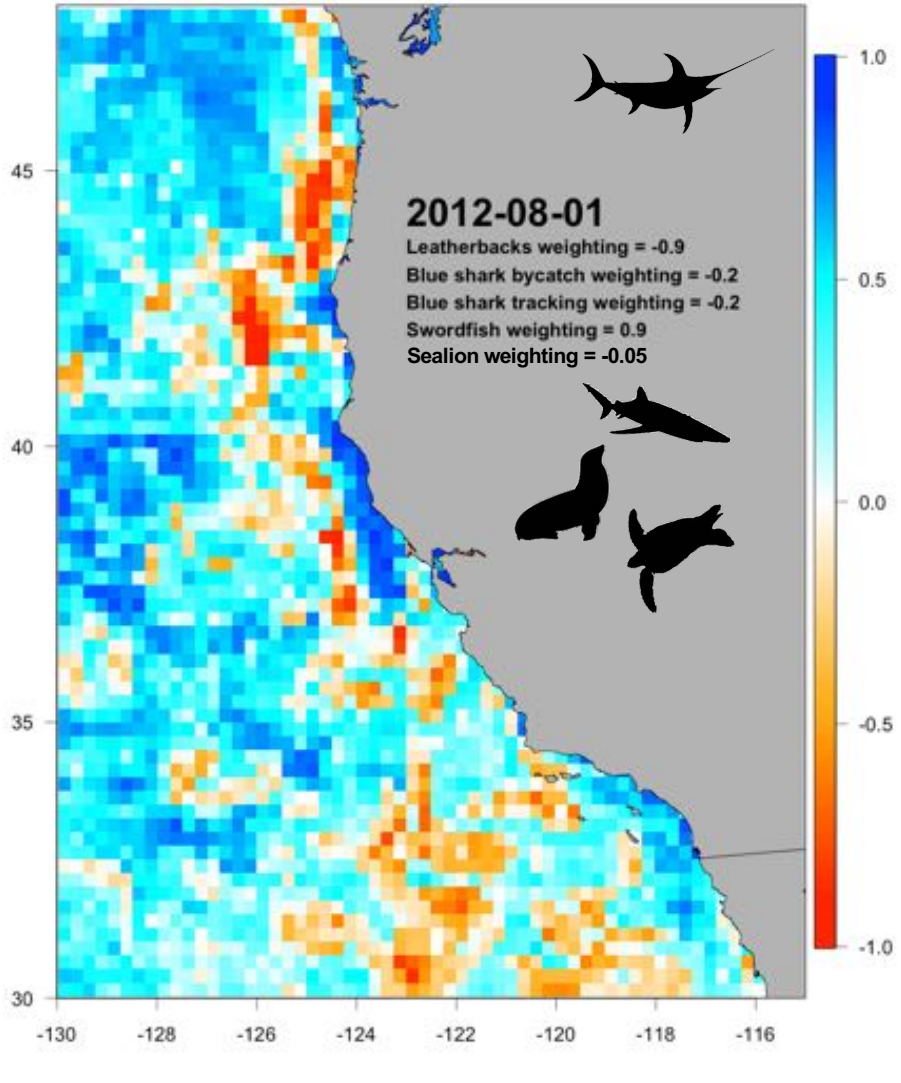
-118
-116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Blue shark bycatch weighting = -0.2
Blue shark tracking weighting = -0.2
Swordfish weighting = 0.9
Sealion weighting = -0.05
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-116
1.0
0.5
0.0
-0.5
-1.0