EcoCatch: Using remotely-sensed oceanographic data to develop a dynamic decision-making application for U.S. fisheries

Rebecca Lewison[1], Sara Maxwell[2], Elliott Hazen[3], Dana Briscoe[2], Sabrina Fossette[3], Helen Bailey[4], Stephen Bograd[3], Heidi Dewar[5]
Suzi Kohin[5], Scott Benson[,6], Tomo Eguhci[,6], Daniel Costa[7], Larry Crowder[2,8]

[1]San Diego State University [2]Stanford University, [3]NOAA SWFSC, Environmental Research Division, [4]University of Maryland, Center for Environmental Sciences, [5]NOAA SWFSC, Fisheries Resources Division, [6]NOAA SWFSC, Protected Resources Division, [7]University of California Santa Cruz, [8]Center for Ocean Solutions

BACKGROUND

Balancing ecological and economic objectives, including reduction of bycatch (accidental capture) is a challenge for fisheries managers. Many US fisheries harvests healthy stocks of a target species, however, bycatch of non-target species can lead to large-scale fishery closures to reduce bycatch. Using one such fishery as a case study, the California Drift gillnet fishery (DGN), our research team is working to develop a decision-making tool that pairs remotely-sensed data with animal telemetry and fisheries data. With our partners, the DGN fishers and NOAA/NMFS Southwest Regional Office, we are creating EcoCatch, a near real-time, multi-species fisheries management tool that couples ecological and fisheries data with remotely-sensed oceanographic data to support bycatch reduction and fisheries sustainability.

PROJECT OBECTIVES

The objectives of our project are to:

- ❑ **Use best-available science and remotely-sensed products**
- ❑ **Develop an decision-making application that**
  - **supports the implementation of responsive & adaptive fisheries management strategies**
  - **can meet changing management objectives or criteria (thresholds)**
  - **is relevant and applicable to other Pacific and US fisheries**
  - **supports multi-species, multi-objective solutions**

Table 1. Satellite products in EcoCatch

Variable	Product/Sensor	Grid	Res. (days)
SSH	Merged (Topex/Poseidon, ERS-1/-2, Geosat, GFO, Envisat, Jason-1/-2)	0.33 deg	1
Eddy kin. energy	Merged (Topex/Poseidon, ERS-1/-2, Geosat, GFO, Envisat, Jason-1/-2)	0.33 deg	7
Ekman upwell.	Seawinds/QuikSCAT	12.5 km	8
SST	AVHRR Pathfinder v.5 Blended(AVHRR/POES, Imager/GOES, MODIS/Aqua, AMSRE/Aqua)	4.4 km 11 km	5 5
SST gradient	AVHRR Pathfinder v.5	4.4 km	5
Chlorophyll -*a*	SeaWiFS/Orbview-2	8.8 km	8
Bathymetry (depth, slope, aspect, distance to shelf)	SRTM30_PLUS v.6.0 digital bathymetry	0.0083 deg	fixed

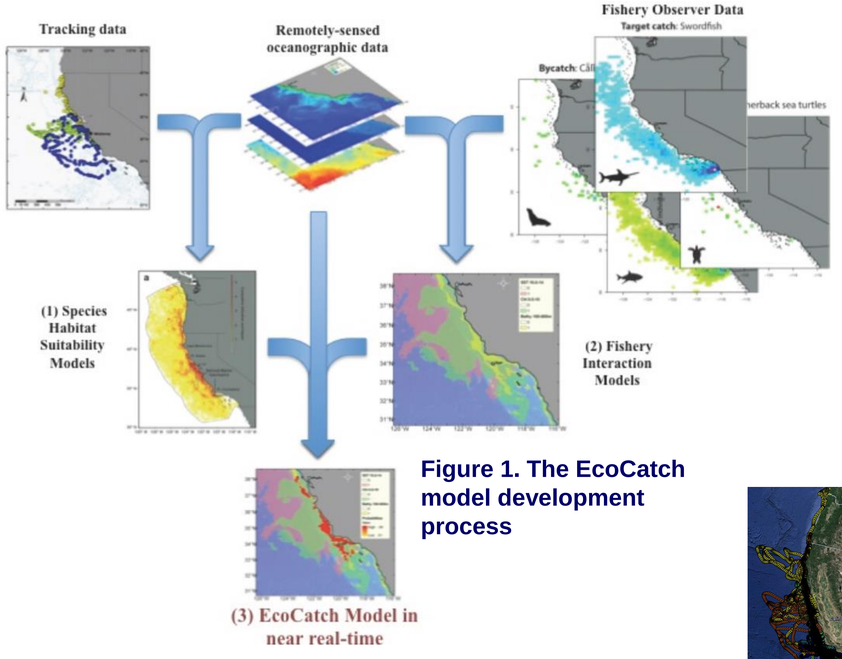


Figure 1. The EcoCatch model development process

DEVELOPMENT PROCESS

Three steps or stages of model development:

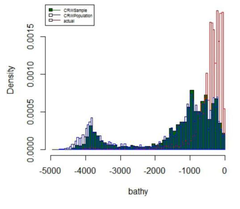
1) <u>Create predictive habitat models: Where are species likely to occur in space and time?</u>
Using Argos satellite-derived tracking data and fisheries observer data from NOAA, we create predictive habitat models (generalized additive models, maximum entropy or ensemble models)

2) <u>Define fishery interactions: Where are species likely to encounter fishing gear?</u>
We create density surfaces that characterize the occurrence and abundance of catch/bycatch based on association with environmental variables through time. Using similar spatial modeling techniques, we use observer data and remotely-sensed oceanographic data to determine the overall fishery interaction 'habitat'.

3)<u>Model Integration: EcoCatch</u>
Finally, we integrate the two models to determine where animals are likely to be found (habitat suitability) and where they are likely to be caught (fishery interaction). From the integrated model we can predict bycatch and catch in near-real time scenarios

END-USERS and PARTNERS

We have been working closely with stakeholder communities: fishers, industry groups, management agencies, NGOs. Engaging in both informal meetings and formal presentations at stakeholder venues, we have presented our project to a wide audience and solicit input and feedback from our targeted end-users. The support and feedback received has been extremely positive and all three segments of the stakeholder community have committed to working with our team.



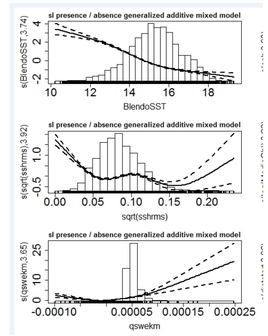


Figure 2. Model output

SIGNIFICANCE

Balancing conservation and economic objectives is a ubiquitous challenge for ocean users. However, in fisheries, few management tools exist that support multi-species, multi-objective management. Our project is working to develop a new tool to meet this challenge.

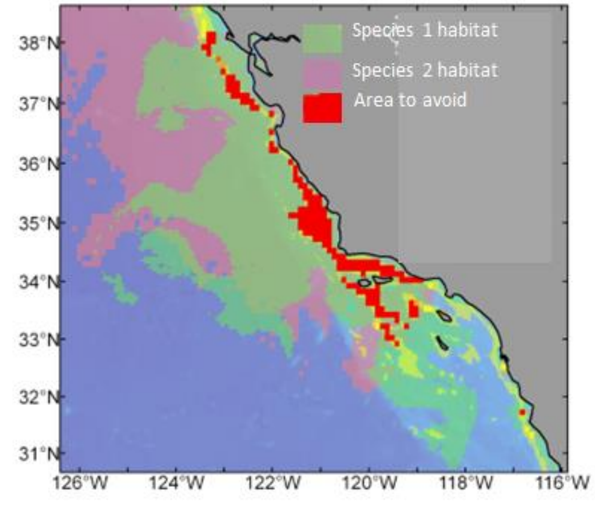


Figure 3. Prototype output from EcoCatch model