Dynamic Ocean Management:
A New Direction for Ecosystem-Based *Fisheries* Management

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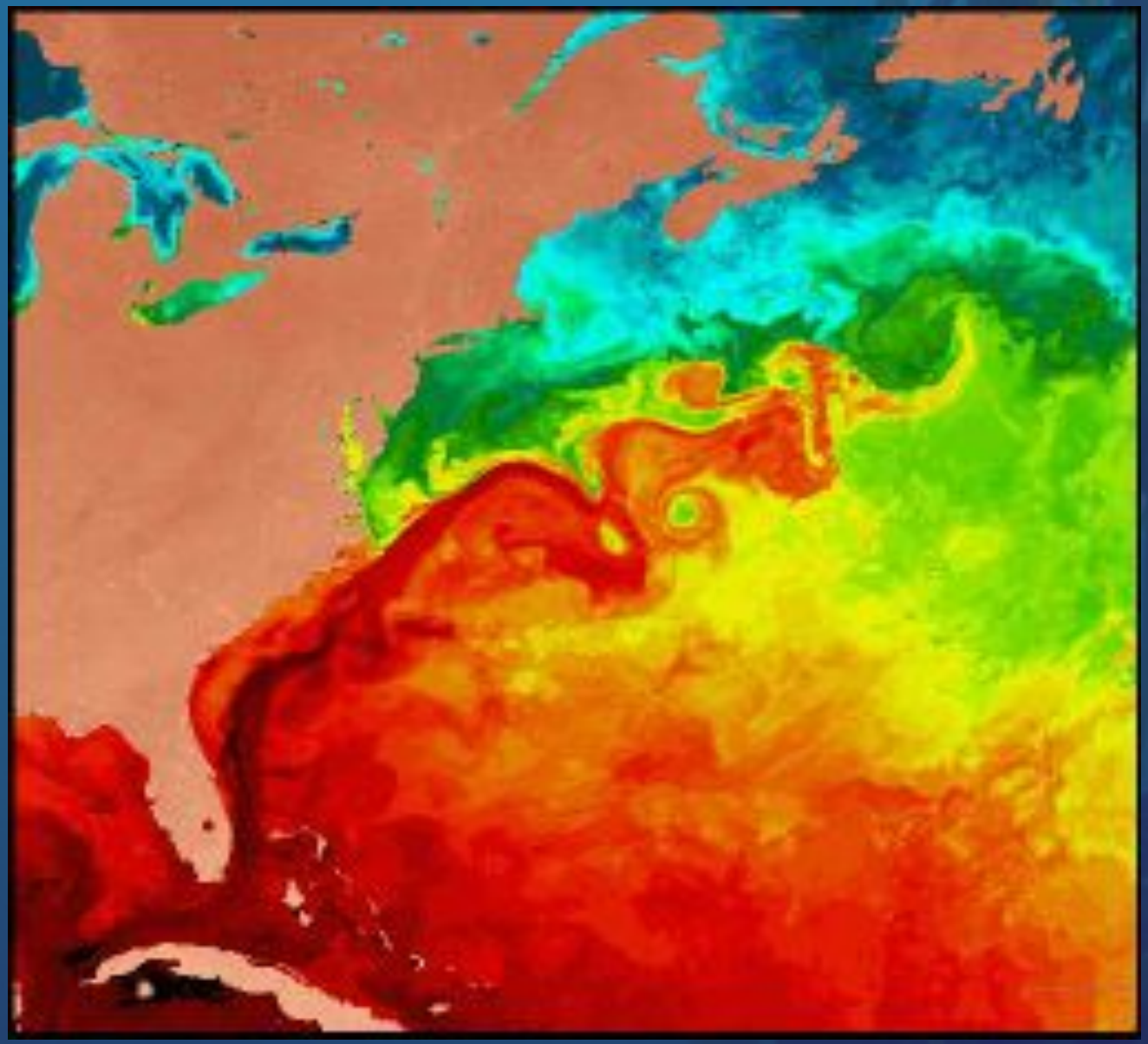
Pelagic Habitats Move



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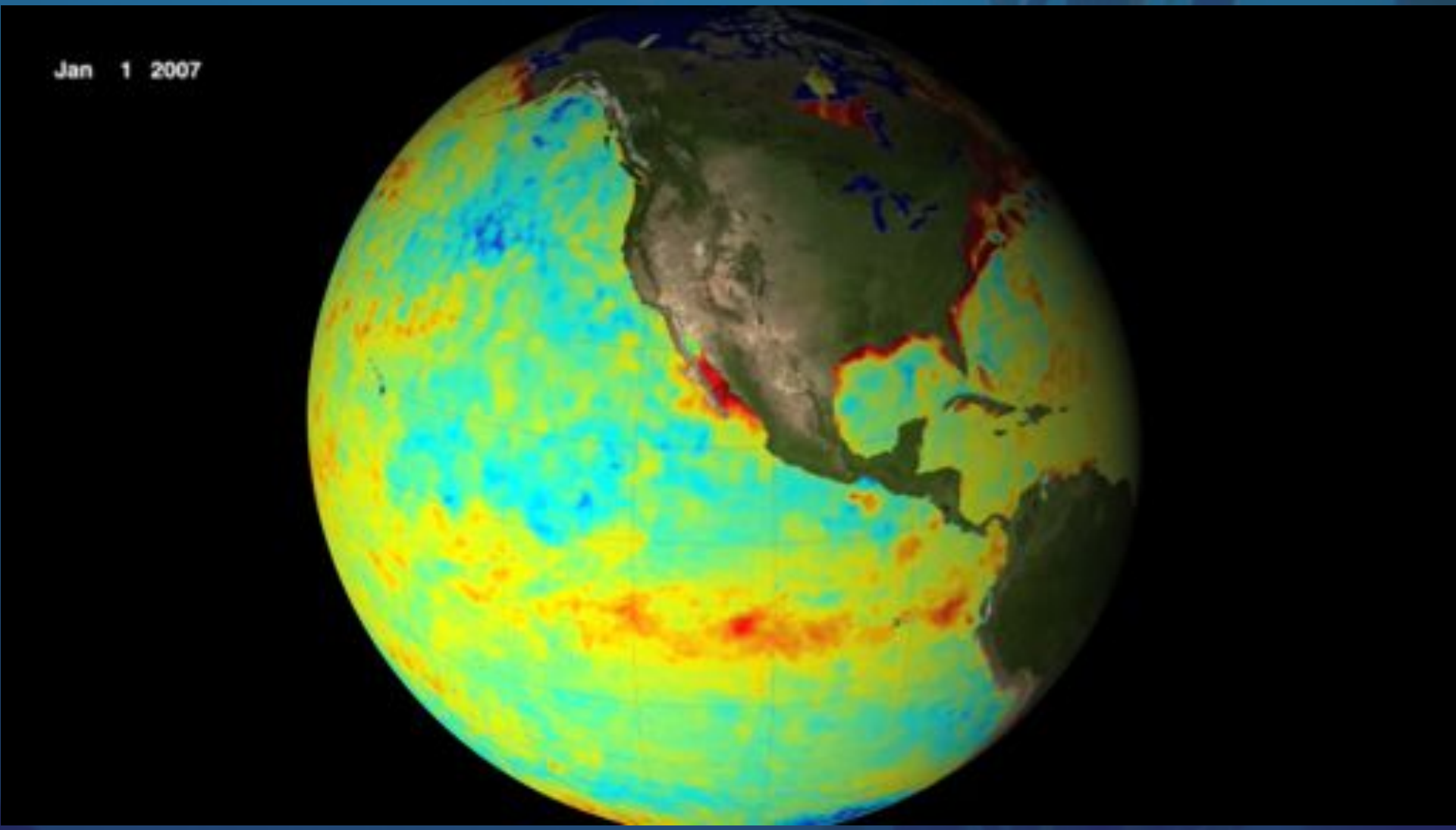
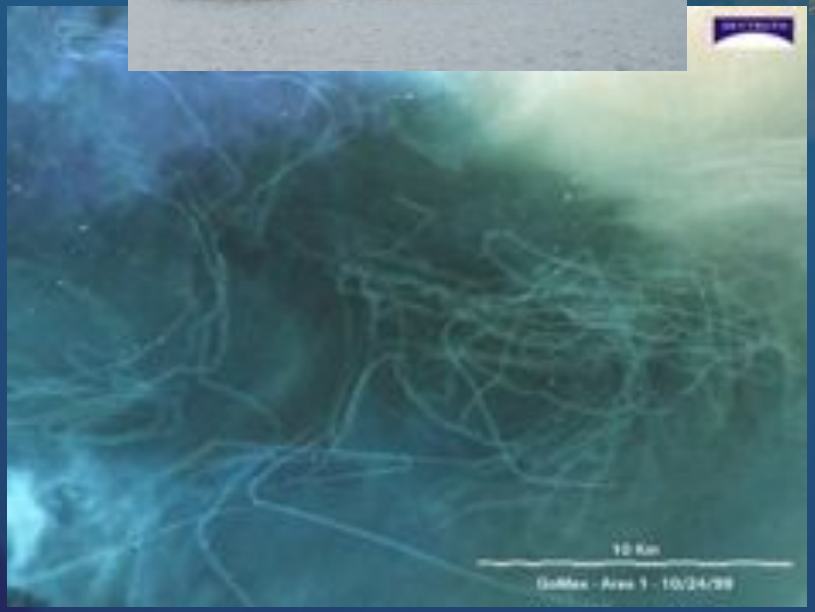


Human Activities Move



So Why is Management/Policy Static?

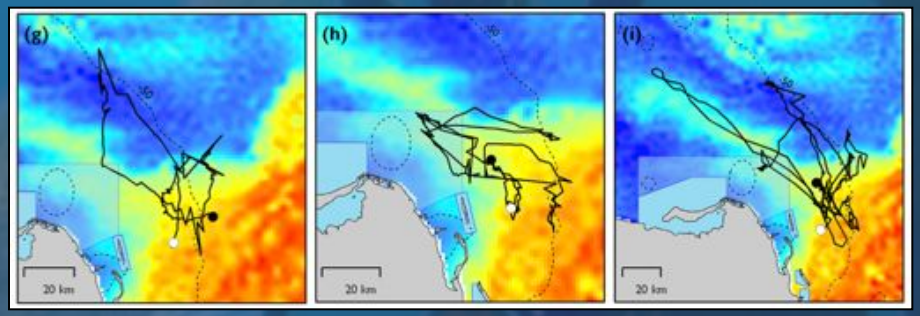
New Vision: Dynamic Ocean Management

Pelagic protected areas would need to move seasonally or even daily, based on tagging and/or oceanographic data on animal movements and on the dynamics of human activities

Maxwell et al *in prep*

Traditional Spatial Management

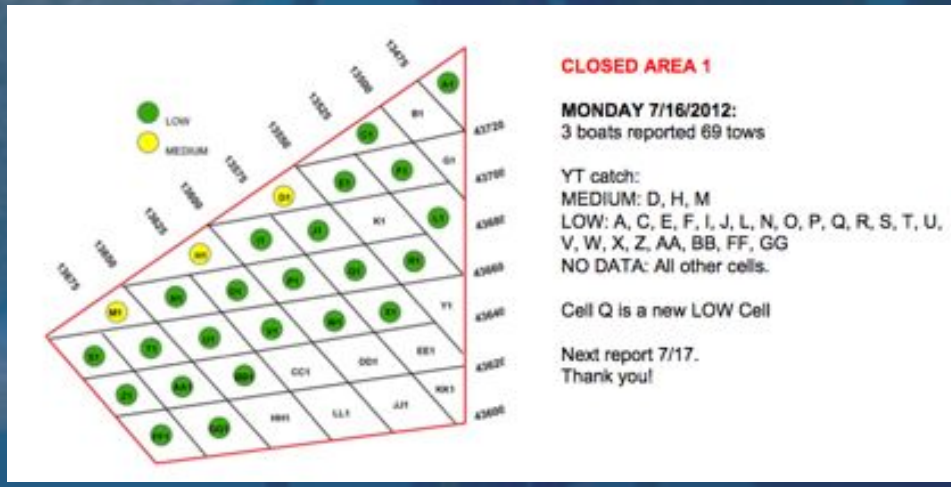
- MPAs, time area closures etc
- Lack flexibility to follow dynamic ocean processes
- Catch fish with real-time technology; management is static



Graham et al., 2012

Dynamic Ocean Management

- Scallop fishery avoiding yellowtail bycatch
- Daily input of effort and bycatch
- Next day report with areas to avoid
- Only 30% of yellowtail quota used in 2010 and 2011

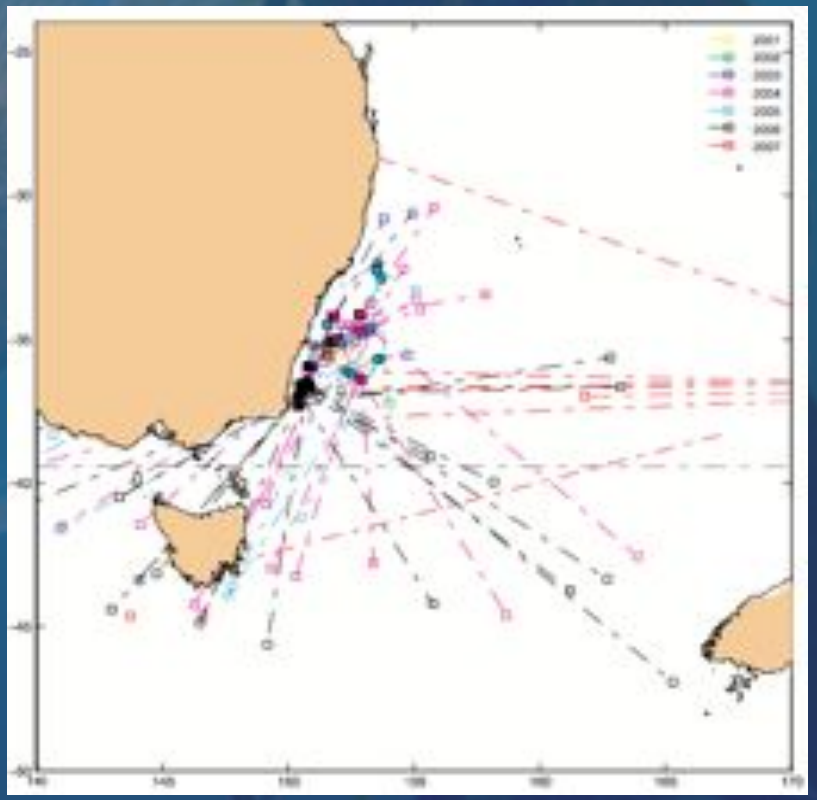


Eastern Australian Longline Fishery

Avoiding southern bluefin tuna (SBT)

1. SBT temperature-dependent habitat preferences
2. Real-time predicted maps of SBT habitat
3. Forecasted habitat up to 4 months ahead

Pop-up tagging data to inform models



Hobday et al 2010 *Fisheries Oceanography*

Eastern Australian Longline Fishery

Avoiding southern bluefin tuna (SBT)

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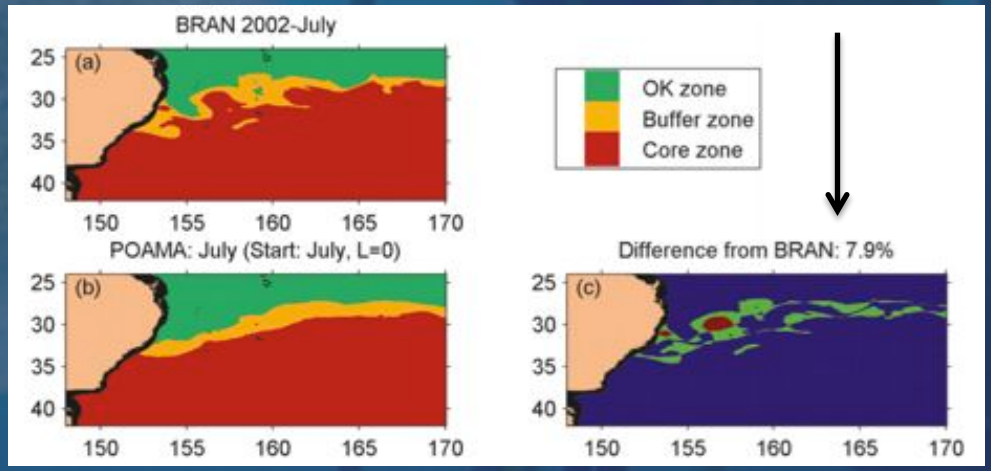
Nowcast

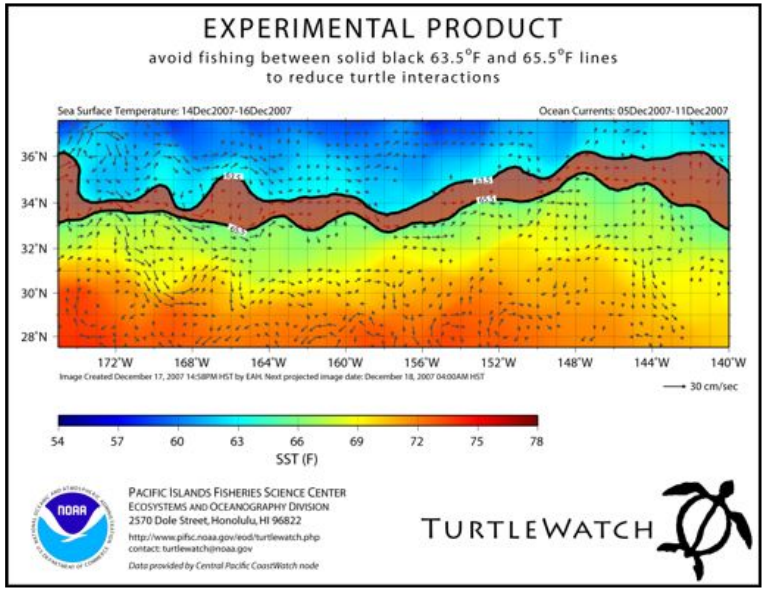
Difference



Forecast

Hobday et al 2011 *Canadian J of Fisheries & Aquatic Sciences*

TurtleWatch



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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

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ABSTRACT: Operational longline fishery characteristics, bycatch information, and loggerhead turtle satellite tracks were all used in conjunction with remotely sensed sea surface temperature data to identify the environmental area where the majority of loggerhead turtle bycatch occurred in the Hawaii-based longline fishery during 1994 to 2006. In the first quarter of each calendar year from 1994 to 2006, the majority of shallow longline sets and associated loggerhead turtle bycatch were above 28° N, which corresponds to the area near the North Pacific Subtropical Frontal Zone. Based on the thermal ranges of bycatch, sets and the satellite-tagged turtles, it was recommended that shallow sets should only be deployed in waters south of the 18.5°C (~65.5°F) isotherm to decrease loggerhead turtle bycatch. This recommendation formed the basis for the TurtleWatch tool, a map providing up-to-date information about the thermal habitat of loggerhead sea turtles in the Pacific Ocean north of the Hawaiin Islands. TurtleWatch was released to fishers and managers in electronic and paper formats on December 26, 2006, to assist in decision making during the first quarter of 2007. Fishery information from 2007 was later compared with data for the years 2005 to 2006 to assess the response of the fishery to TurtleWatch. The observed fleet movement during the first quarter of 2007 was to the north of the 18.5°C (~65.5°F) isotherm (i.e. in the area recommended for avoidance by the TurtleWatch product) with increased effort and lower bycatch rates. We discuss possible reasons for this decrease in turtle bycatch north of the frontal zone together with future research directions which may lead to refinement of the TurtleWatch product.

KEY WORDS: Loggerhead turtles · Bycatch · Remote-sensing · Sea surface temperature · Longline fishery · Transition zone · Swordfish

INTRODUCTION

The interactions of sea turtles with high seas fisheries are a global concern, with fisheries bycatch implicated as one of several factors in the population decline of many sea turtle species, including the loggerhead turtle *Caretta caretta* (Hatase et al. 2002, Hays et al. 2003, Peckham et al. 2007). The loggerhead is a circumglobal sea turtle species (Dodd 1988) that undergoes a series of ontogenetic shifts during its life cycle, with stages occupying a series of habitats that include nesting beach, oceanic, and neritic areas (Bjorndal 2003). In the North Pacific, loggerhead nesting beaches are only found in Japan, where, during the last half of the 20th century a substantial decline (50 to 90%) in the size of the annual loggerhead nesting population at nesting beaches was reported (Kamezaki et al. 2003). The importance of the oceanic stage to juvenile loggerheads was hypothesized first by Carr (1987) with recent work by Polovina et al. (2006) reporting that specific pelagic regions, such as the Kuroshio Extension Bifurcation Region of the North

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TurtleWatch: Background

Bycatch: Fishery data → **Fishery/Bycatch in specific area** → **Turtles/Sword assoc. fronts**[1]

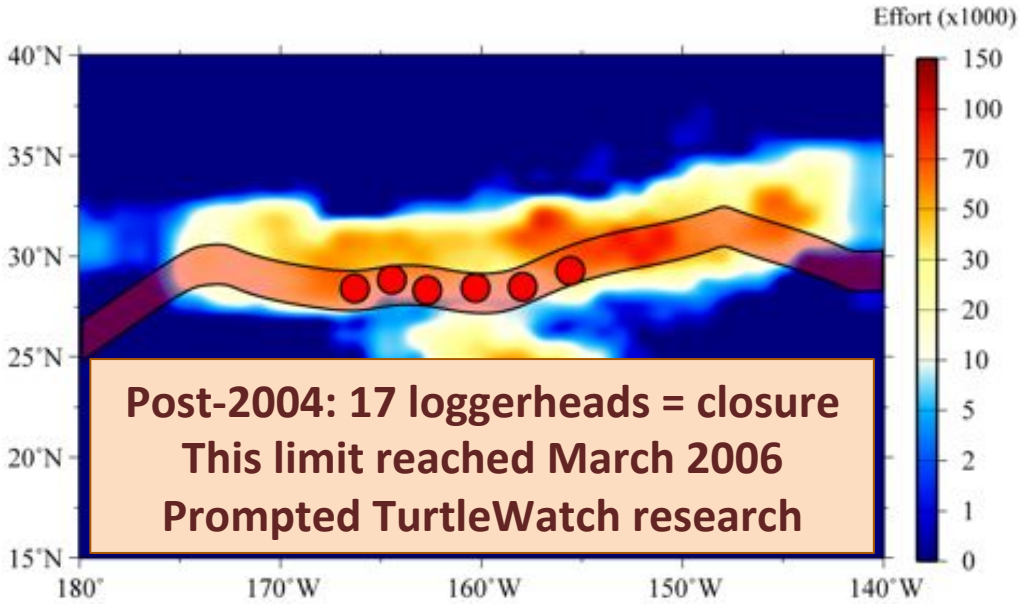
[1]Polovina (Seki) et al, 2001, (2002),2004, 2006

Response = MPA (closures) → **Static closures, dynamic fronts** → **Frontal/effort shifts (turtles)**

Desire: Method to create turtle avoidance areas from environment

"DYNAMIC HABITAT ZONE"

Distribute daily to fishery



First need to understand bycatch pattern (time/space)

TurtleWatch: Methods

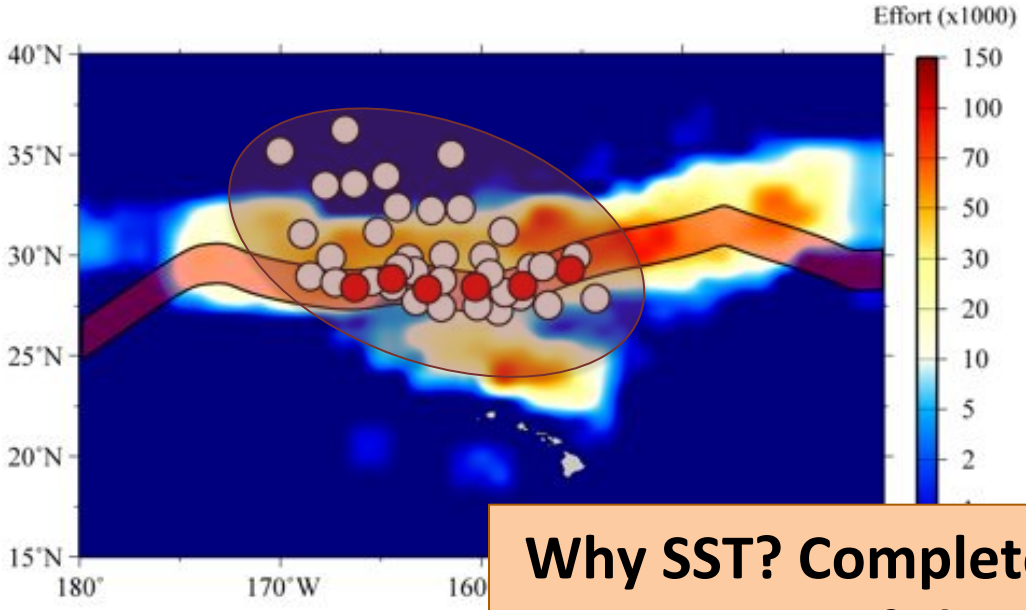
Fishery data

Non-fishery data

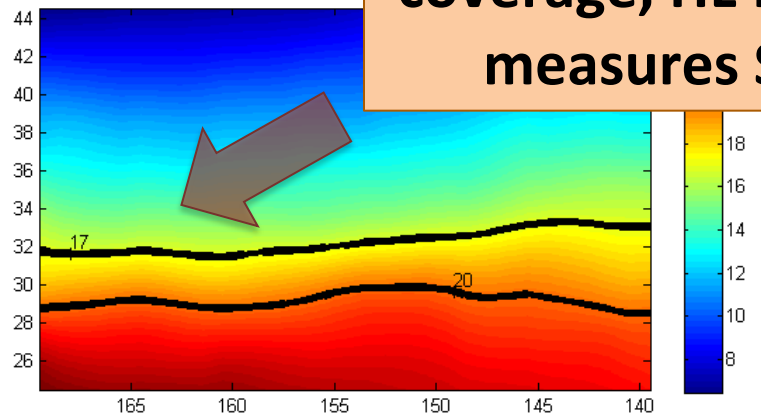
Extract SST values

Interquartile range SST (effort/bycatch)

Create Dynamic MPA



Why SST? Complete coverage, HL fishery measures SST



TurtleWatch: Loggerhead bycatch results

First quarter has > 60% of all bycatch

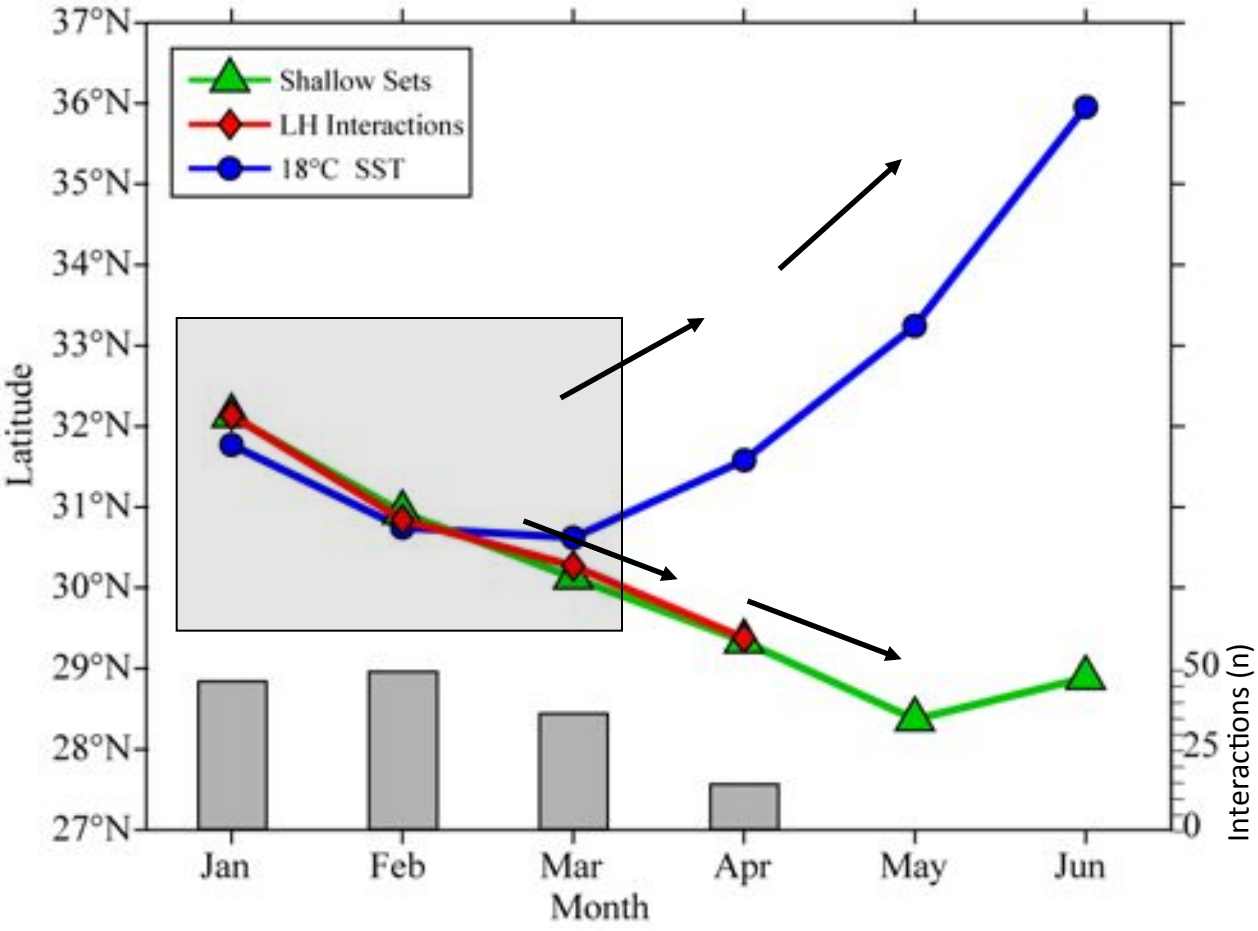
Bycatch/18°C SST (TZCF) correlated

SST front/effort (bycatch) split Q2

Turtles track front, intra/interannual movements

Q1: Use SST habitat proxy (MATCH)

Monthly mean Fishery and RS SST data (180°-160°W 1994-2006)



TurtleWatch: Loggerhead bycatch results

Use SST as habitat proxy

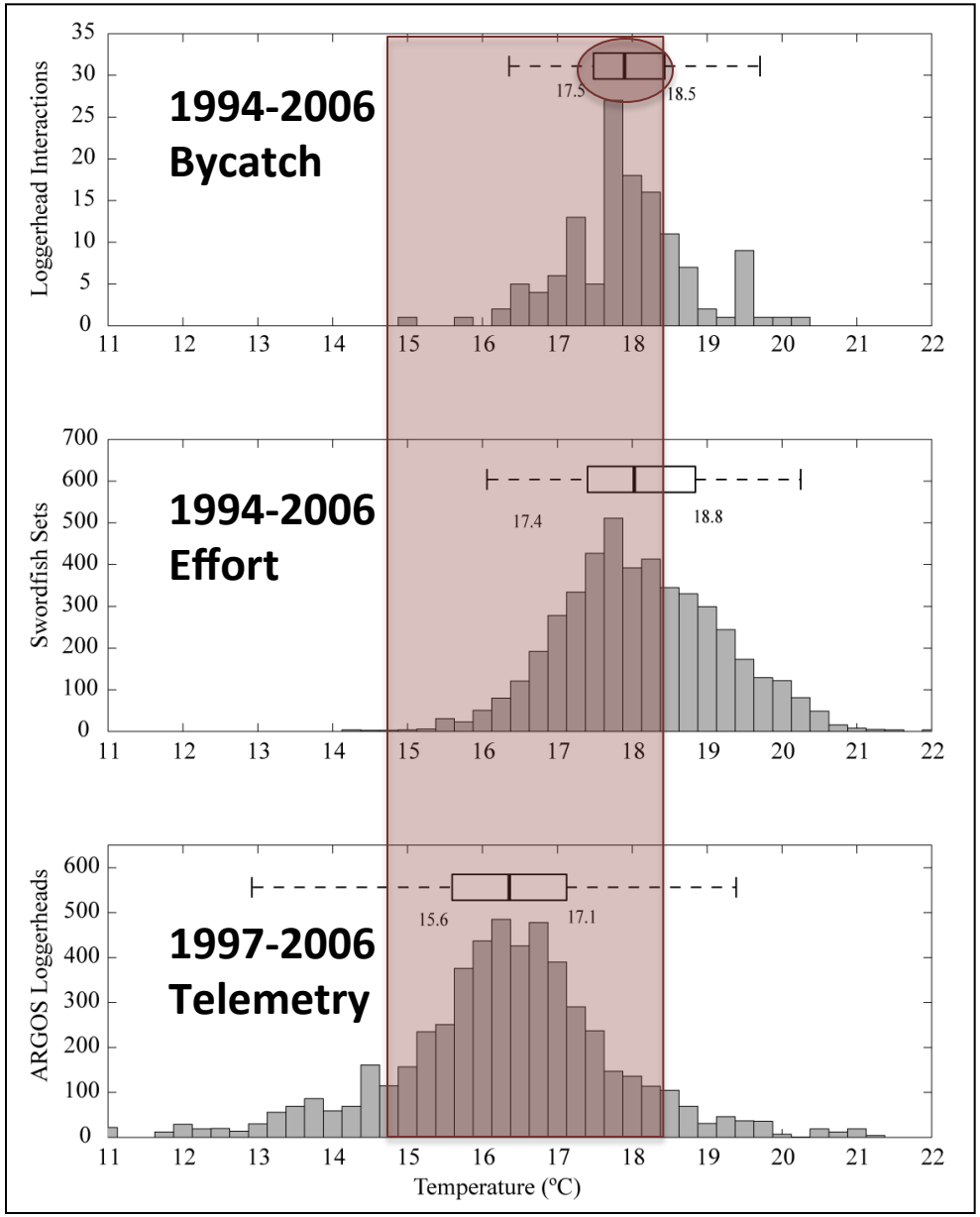
Bycatch range 17.5°-18.5°C

Top two Fishery dependent!

Telemetry range colder

18.5C chosen as lower thermal limit to fishery (initial recommendation)

TurtleWatch updated 2007 to recommend 17.5°-18.5°C range (tradeoff)



TurtleWatch: Final product / ongoing work

12/2006: TurtleWatch released

12/2007: TurtleWatch refined

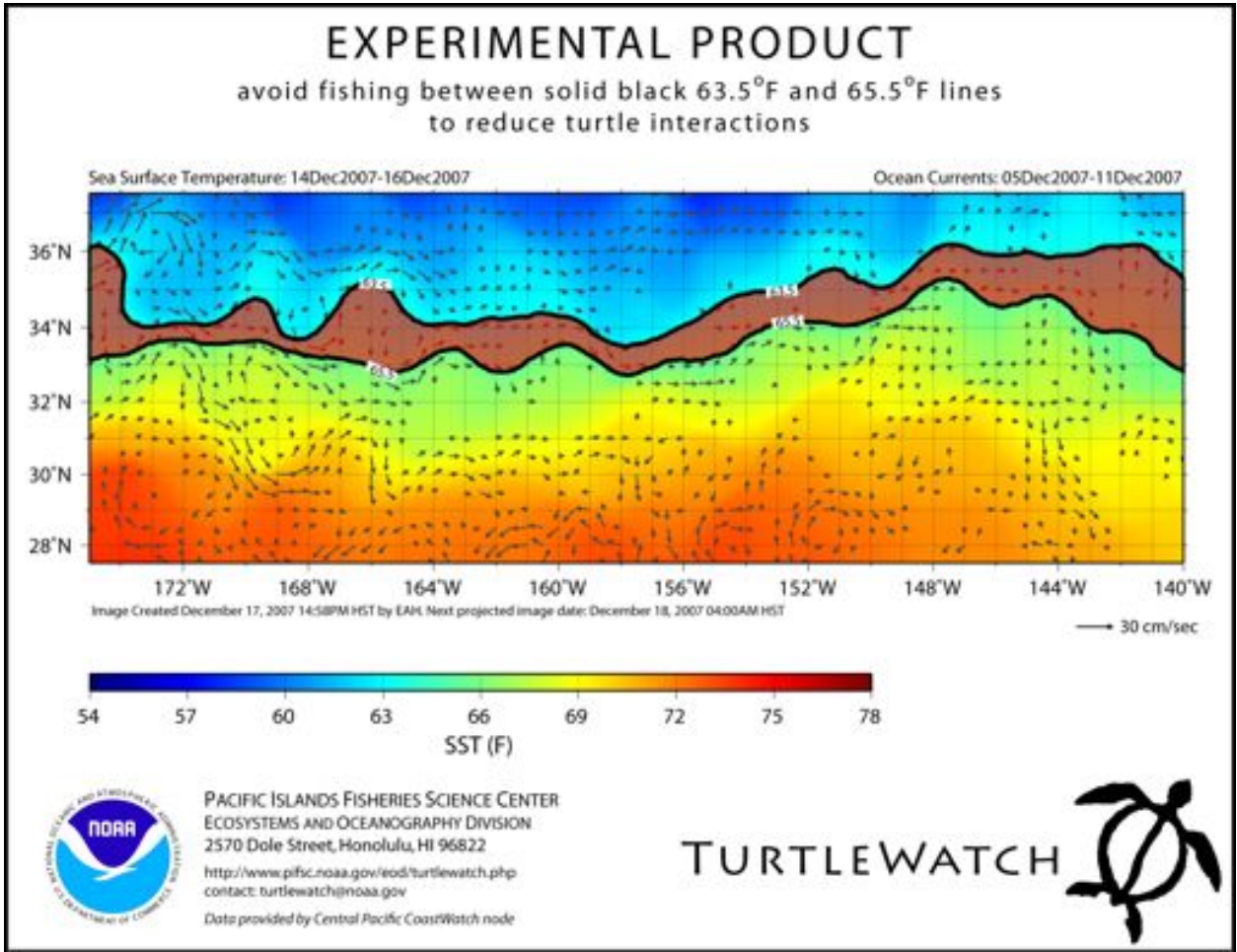
2006 recommended large area NO GEAR

2007 results no bycatch in NE + SST < 17.5°C

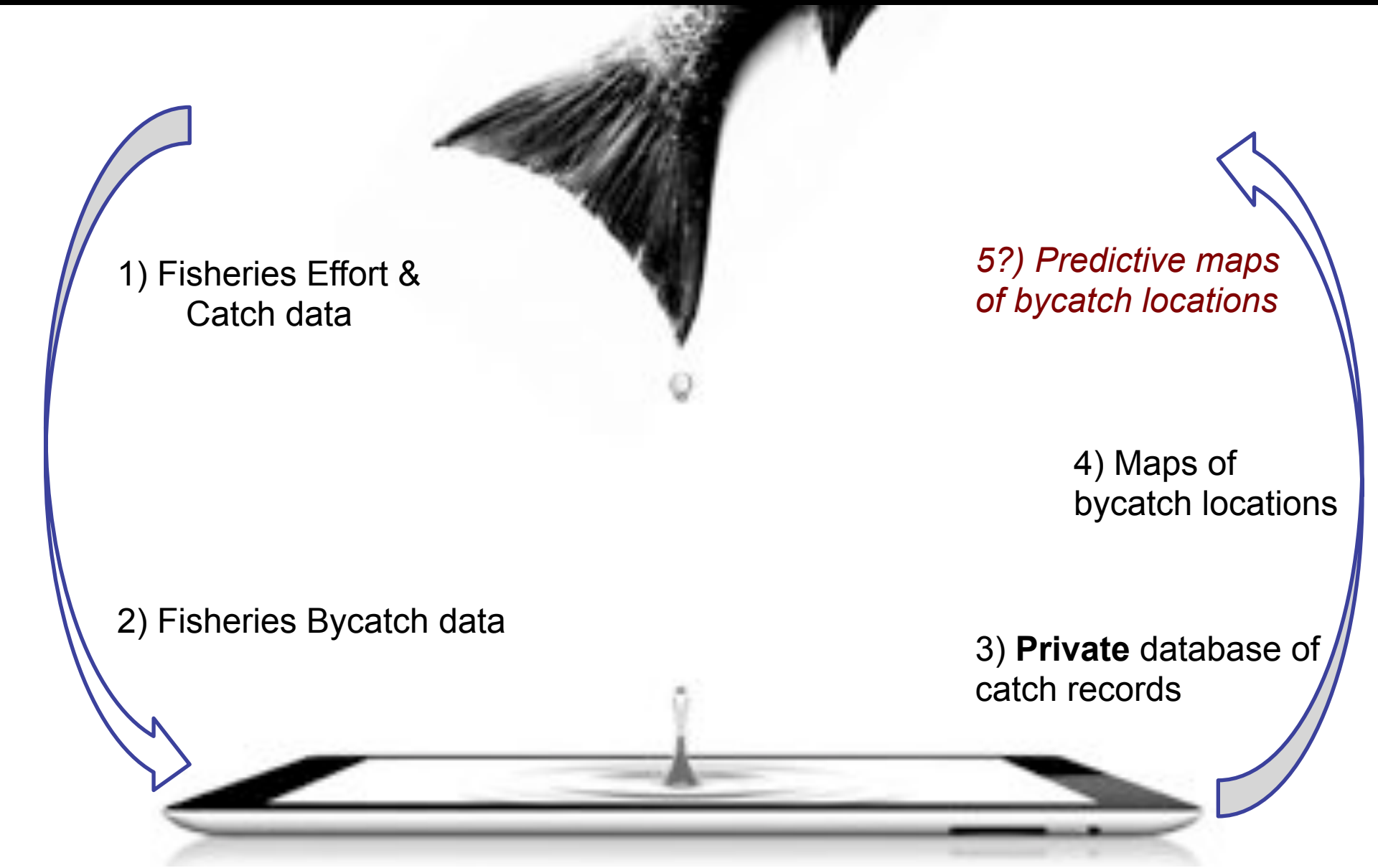
Based on lack of interactions changed to band

2011 Fishery closed (leatherbacks)

Additional refinement ongoing



eCatch & Morro Bay



1) Fisheries Effort & Catch data

2) Fisheries Bycatch data

3) **Private** database of catch records

4) Maps of bycatch locations

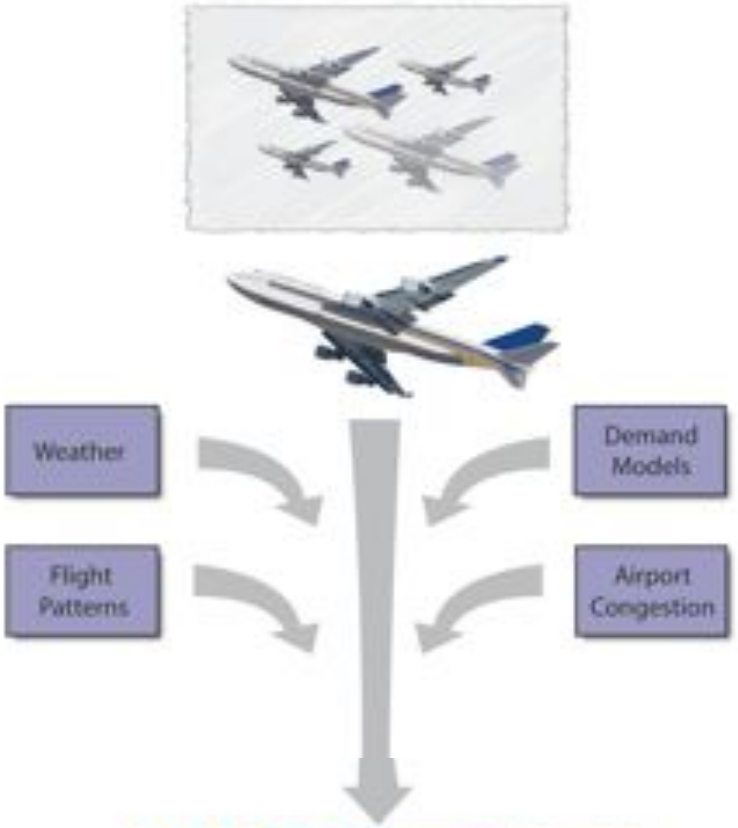
5?) Predictive maps of bycatch locations

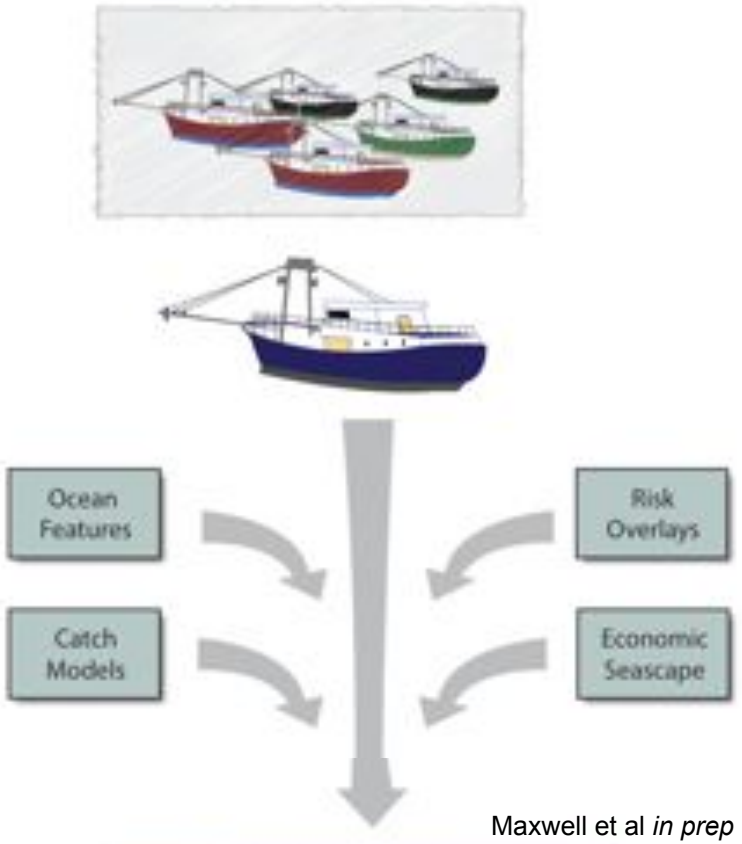
Principles of Dynamic Ocean Management

1. Management based on fixed and dynamic features
2. Based on the integration of new data such as:
   - ✓ Catch data & fisheries independent data
   - ✓ Bycatch data
   - ✓ Oceanographic data & species-environment models
   - ✓ Economic/Human Use data
3. Can reduce area or time when human activities are restricted
4. Fishermen (or stakeholder) participation from the beginning
5. Integration of multiple data types in the biophysical and human dimensions
6. Consideration of economic data, i.e. fishery profit and loss

WIN-WIN: Reduction of economic and *ecological impact*

Dynamic Ocean Management





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Thank you & Questions?

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