Agenda Item J.1.a
NMFS Report 2 (**Electronic only**)
September 2017

NOAA FISHERIES

NMFS-WCR Updates

Pacific Offshore Cetacean Take Reduction Team Meeting

June 15, 2017

This presentation is intended to support deliberations of the Federally-appointed Pacific Offshore Cetacean Take Reduction Team. Information presented here is not considered "final" unless specifically noted as such.

I've finished life's chores assigned to me,
So put me on a boat headed out to sea.
Please send along my fishing pole
For I've been invited to the fishin' hole.

Where every day is a day to fish,
To fill your heart with every wish.
Don't worry, or feel sad for me,
I'm fishin' with the Master of the sea.

We will miss each other for awhile,
But you will come and bring your smile.
That won't be long you will see,
Till we're together you and me.

To all of those that think of me,
Be happy as I go out to sea.
If others wonder why I'm missin'
Just tell 'em I've gone fishin'

Steve Fosmark

June 26, 1951-
March 13, 2017

TRT-related agency activities
membership appointments/changes

- Fishing industry reps – Kathy Fosmark requested to step down from serving on the the TRT; suggestions for a replacement include David Haworth (currently an alternate)
- Environmental reps – Chuck Cook (TNC) requested that Tom Dempsey (TNC) serve as his alternate

- TRT Orientation provided by NMFS for new members (open anytime for existing or prospective TRT members)

Skipper Workshops

- Spring 2017: NMFS held mandatory skipper workshops (last mandated in 2014) – 3 new skippers
- Also attending: OLE, observer program, SWFSC
- Reviewed MMPA and ESA mandates (reporting, etc.)
- Reviewed TRT-related requirements and effectiveness of Plan (e.g., pingers, extenders)
- Reviewed sea turtle handling/resuscitation requirements

- Presentation by SWFSC on data collection/research results

- Presentation by Catalina Offshore Seafoods/chefs on how DGN fishermen might sell regularly discarded seafood to specialty restaurants

General Agency Activities

- Humpback whale status review (reclassification under the ESA)
- ESA take coverage in the DGN and status of MMPA 101(a)(5)(E) authorization
- List of Fisheries
- Loggerhead El Niño closure review
- Observer Data updates
- Monitoring/Enforcement

Humpback whale – revised listing

- September 8, 2016 – NMFS published a final rule to revise listing status of humpback whales (originally globally listed as endangered)
- Identification of humpbacks into 14 distinct population segments (DPSs)
- 2 DPSs forage off CA:
  - one breeding off Mexico (now *threatened*)
  - one breeding off Central America (now *endangered*)

Humpback whale revised listing (cont'd)

- Mexico DPS (threatened)
  - Feeds across a broad geographic range, from CA to the Aleutians
  - Abundance estimate: 3,264 individuals, unknown population trend
- Central America DPS (endangered)
  - Feeds almost exclusively off CA/OR
  - Abundance estimate: 411 individuals, unknown population trend

- **MMPA stock lineation for humpbacks are currently not defined**
  - **Default: PBR = 11 (2016 SAR for CA/OR/WA Humpback whale stock)**

Endangered Species Act
(Incidental Take Statement in 2013 Biological Opinion)

Species	Annual Take	5-year take total	Expected mortalities during 5-year period
Fin Whale	Up to 1	Up to 2	Up to 1
Humpback whale	Up to 2	Up to 4	Up to 2
Sperm whale	Up to 2	Up to 8	Up to 6
Leatherback turtle	Up to 3	Up to 10	Up to 7
Loggerhead turtle	Up to 3	Up to 7	Up to 4
Olive ridley turtle	Up to 1	Up to 2	Up to 1
Green turtle	Up to 1	Up to 2	Up to 1

MMPA Sec. 101(a)(5)(E) Permit

- Requires NMFS to allow take (serious injury or mortality) of endangered/threatened marine mammals incidental to Federal commercial fishing if:
  - Negligible impact determination (NID) can be made
    - Takes into account *all human related injury/mortality, including non-Federal fisheries, rec. fisheries, ship strikes, etc.*
  - A recovery plan(s) has been developed or being developed for each affected marine mammal stock
  - A monitoring plan is established and a take reduction plan is in place or in development

MMPA 101(a)(5)(E) permit

- Issued for up to three years
- The DGN fishery has had a permit to take endangered/threatened marine mammals (fin, humpback and sperm whales) since 2000
- The most recent permit **expired on 9/4/2016**
- In January, 2017, NMFS proposed to issue a permit to the CA DGN fishery for the take (M/SI) of humpbacks and sperm whales (30 day public comment period)
- NMFS assessed two periods (2001-2014 and 2010-2014) to make a draft Negligible Impact Determination for both stocks

Major comments received:

- NMFS should include 2015 humpback M/SI in the NID (2015 serious injury determinations were not made in time for the proposed rule stage)
- NMFS should account for unidentified whales in the NID, based on historical entanglements of known whale species ID
- NMFS should take into account the revised listing for humpback whales, considering the threatened Mexico DPS and the endangered Cen. Am DPS
- *NMFS is currently evaluating responses to comments*

List of Fisheries

Category I

Frequent incidental mortality and serious injury

- annual take (M/SI) in a given fishery is ≥ 50% of PBR

Category II

Occasional incidental mortality and serious injury

- annual take (M/SI) in a given fishery >1 to < 50% of PBR

Category III

Remote likelihood of incidental mortality and serious injury

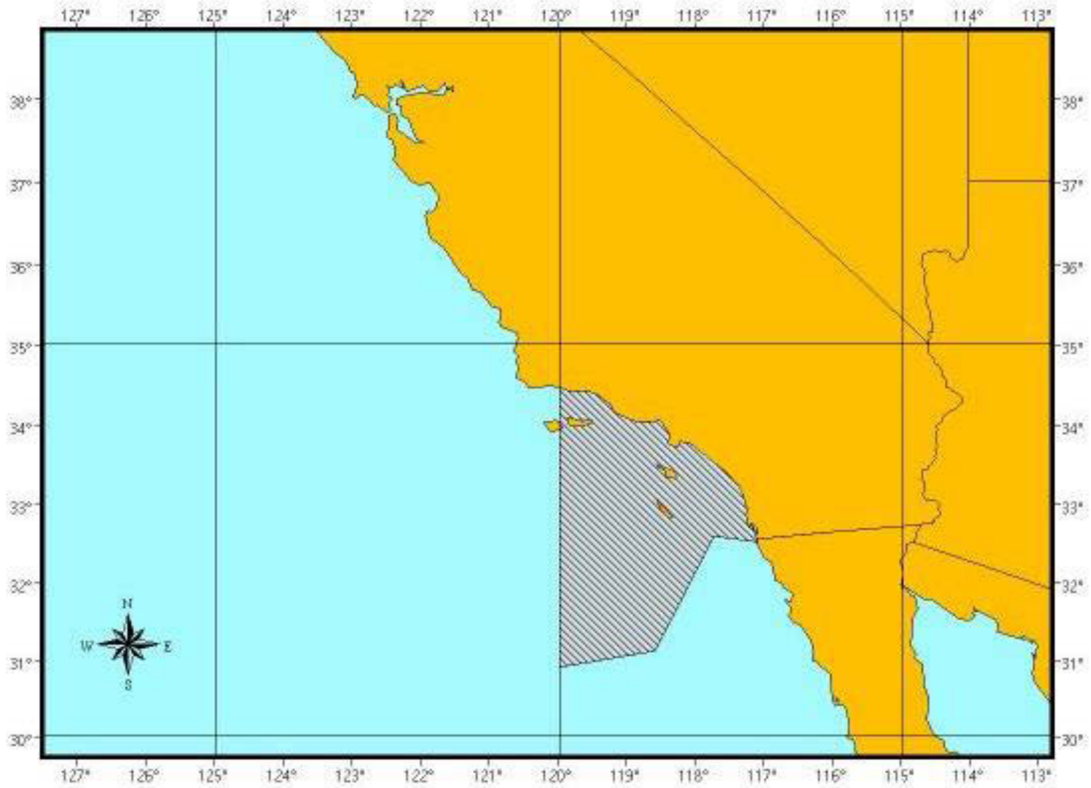
- annual M/SI across all fisheries is ≤ 10% of PBR
- annual M/SI by itself ≤ 1% of PBR

CA DGN -- List of Fisheries

- 2009 LOF – **Category I** (S-F pilot whales drove the categorization
- 2010 LOF – **Category I** (“)
- 2011 LOF – **Category III** (infrequent takes)
- 2012 LOF – **Category II** (self-report of a humpback, SI)
- 2013 LOF – **Category I** (sperm whales driving the categorization)
- 2014 LOF – **Category I** (“)
- 2015 LOF – **Category I** (“)
- 2016 LOF – **Category I** (“)
- 2017 LOF – **Category I** (“)

Loggerhead sea turtle time/area closure

Southern California time-area closure when El Niño is predicted or occurring between June 1 and/or August 31

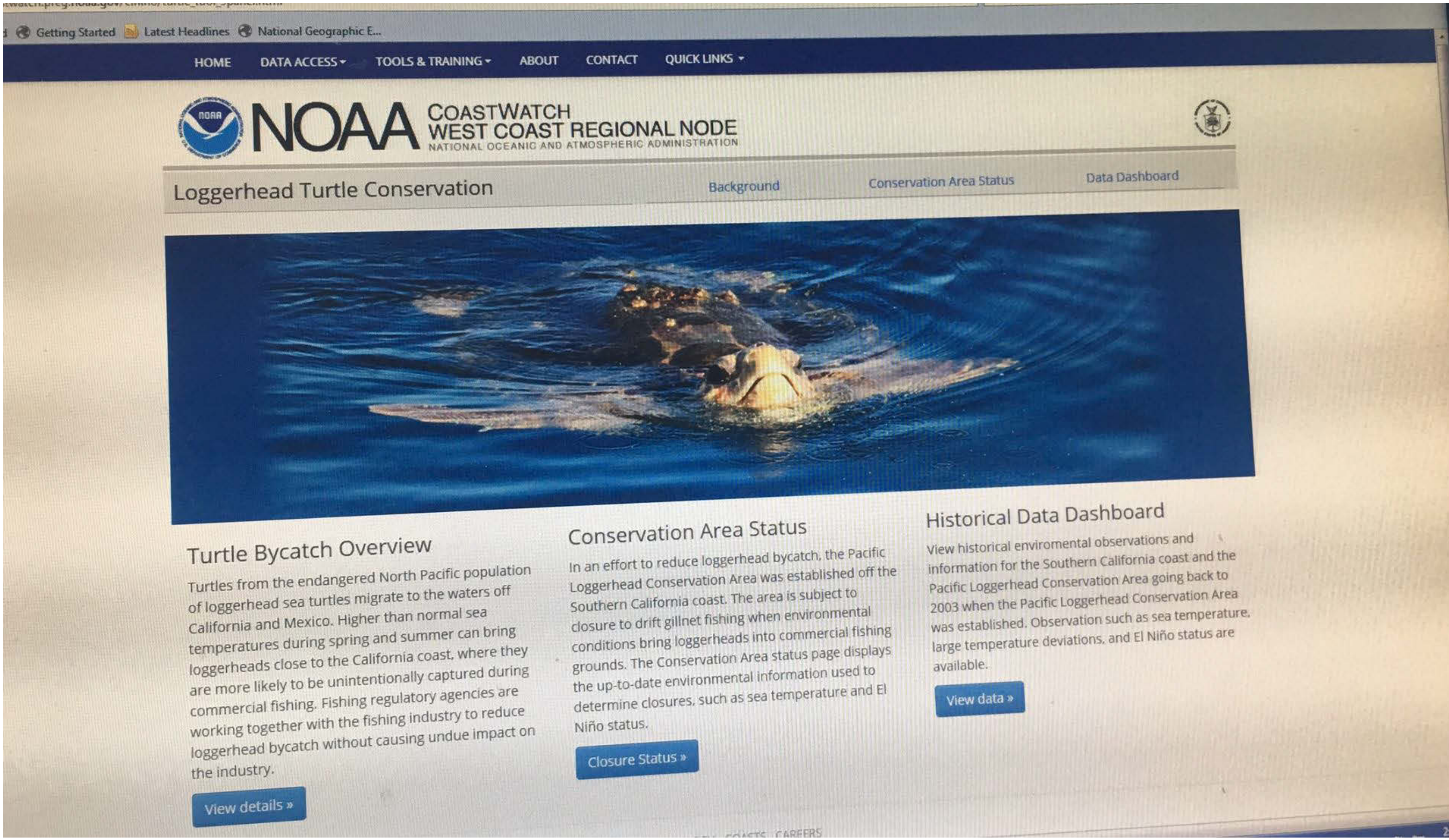


Regulations were *not* implemented (conditions were not present) until 2014, when: a) chances of El Nino exceeded 65% in summer; b) SSTs were warmer than normal in SCB; c) reports of stranded loggerheads and sightings at sea off SoCal. Closure implemented in 2015, and 2016. We do not anticipate it will be implemented in 2017.

Challenges for NMFS-West Coast Regional Office

- Should the existing loggerhead rule be changed?
  - Is a forecast or existing El Niño an appropriate indicator for the presence of loggerheads or is the anomalously high SSTs in the SCB the appropriate indicator?
  - Is the current time/area closure appropriate?
  - Is there a temperature range or oceanographic indicator other than El Niño we should be looking for to predict higher risk to loggerheads in the DGN fishery?
  - Can we develop a TurtleWatch for the DGN fishery?

Loggerhead website (in dev't)



2016/2017 Observer Data

Monitoring*/Enforcement Update

Drift Gillnet Observer Summary

	Calendar Year 2016	2016-2017 Season
Number of Active Vessels	20	19
Number of Valid Permits	68	68
Number of Observable Vessels	13	12
Number of Unobservable Vessels	7	7
Total Estimated Sets	737	714
Observed Sets	134	160
Unobservable Sets	247	237
% Unobservable	33.50%	33%
% Coverage	18.10%	22.40%
Observed Trips	23	26
Protected Species		
California Sea Lion	0	1
Northern Right Whale Dolphin	5	6
Short-Beaked Common Dolphin	4	10
Long-Beaked Common Dolphin	1	1

Law enforcement

- No violations reported by OLE during the 2016-17 fishing season, including boardings of unobservable vessels (2 of 7 vessels, one with majority of effort)
- Challenges:
  - DGN v. deep-set buoy gear (EFP) fishing declaration
  - Pingers – fishermen told OLE they were activated at depth v. water-activated (mis-information)
  - VMS – CDFW lacks offshore satellite internet data capability, so challenging to track vessels far offshore ($) – one unit: $22K

SWFSC UPDATE

Pacific Fishery Management Council Recommendations (September 2015 Council meeting)

- Impose "hard caps" for high-priority protected species under MSA authority
- Adopt "performance metrics" for non-ESA-listed species
- Increase monitoring coverage rates at a minimum of 30%, remove the unobservable vessel exemption, and achieve 100% by 2018 (through electronic monitoring, etc.)

“Hard Caps” (Council Recommendation)

- Under MSA authority, bycatch (M/SI) would be reduced below the level currently documented in the fishery, through the implementation of “hard caps” for high priority protected species (fin, sperm, humpback whale, S-F pilot whales, common bottlenose dolphin)
- 2-year rolling hard caps
- The DGN fishery closes immediately when estimated M&SI equals the cap for any capped species.
- Fishery will re-open when the rolling two-year total falls below the cap level.

Response to Council's Recommendation

- TRT letter to Sobeck
- MMC letter to Sobeck
- October, 2016: NMFS published proposed rule that would impose "hard caps"
- Public Comment (60 days)
- June 2017: DGN Hard Caps Decision (Enriquez)

Performance metrics (established in 2015)

- Non-regulatory
- Means for Council to monitor bycatch of non-ESA-listed marine mammals in the DGN fishery compared to historic levels (2004-2014)
- Metrics chosen using the highest estimated bycatch for any one year during that period
- If interactions levels are consistently higher than one of the performance objectives, the Council could consider whether additional management measures are necessary
- Observed interactions extrapolated using ratio estimator

Performance metrics (cont'd)

Species/Stock	PBR	Performance metric**	2016-17 Fishing Season Results***
Minke whale	*3.5**	5	0
Short-beaked common dolphin	*8,393**	66	44.6
Long-beaked common dolphin	*657**	24	4.5
Risso's dolphin	*4.6**	7	0
Northern right whale dolphin	***179****	**11**	**26.8**
ENP Gray whale	*624*	5	0
Pacific white-sided dolphin	*191**	22	0
CA sea lion	*9,200*	97	4.5
Northern elephant seal	*4,882*	6	0

*From Draft 2016 SAR

**Derived from a simple ratio estimator, given observed takes and coverage for highest year of bycatch for each marine mammal stock during 2004-2014

***Derived from ratio estimator based on observed interactions and 22.4% observer coverage

NMFS response to 100% monitoring recommendation

- NMFS currently targets 30% observer coverage
- 100% monitoring via observers may have to be borne by industry as NMFS does not have appropriated funds
- NMFS is currently pursuing a combination of observer coverage and electronic monitoring to address Council's recommendation
- NMFS plans to hold a joint WCR-PIRO electronic monitoring workshop for HMS in late-summer 2017

Exempted Fishery Permits

- 1) Allow 2 vessels to conduct pelagic longlining for HMS off CA (w years) and OR (only in the 2nd year)
  - Includes both shallow-set and deep-set
  - Fishing allowed west of the 50 nm contour from mainland/offshore islands; no fishing in the SoCal Bight
  - Hard caps set for leatherbacks and loggerheads
  - NEPA and ESA Section 7 in review
- 2) Deep-set buoy gear EFP
  - Multiple existing vessels currently participating and ~20 new applications as of June 2017
  - Council considering alternatives to authorize under federal HMS FMP

TRP immediate and long-term goals (Sec 118)

Short-term goal

To reduce, within 6 months of implementation, the incidental M&SI of strategic marine mammal stocks taken during commercial fishing to below a stock's PBR level.

Long-term goal

To reduce, within 5 years of implementation, the incidental M&SI to insignificant levels approaching a "zero M&SI rate"*, taking into account economics, availability of existing technology, and existing state or regional FMPs.

NMFS can amend the Take Reduction Plan as necessary to meet the requirements under the MMPA

*NMFS policy: 10% of PBR

NOAA FISHERIES

SWFSC

Predicting Overlap between Drift Gillnet Fishing and Leatherback Turtle Habitat in the California Current Ecosystem

Tomo Eguchi, Scott Benson, Karin Forney, Dave Foley

Southwest Fisheries Science Center

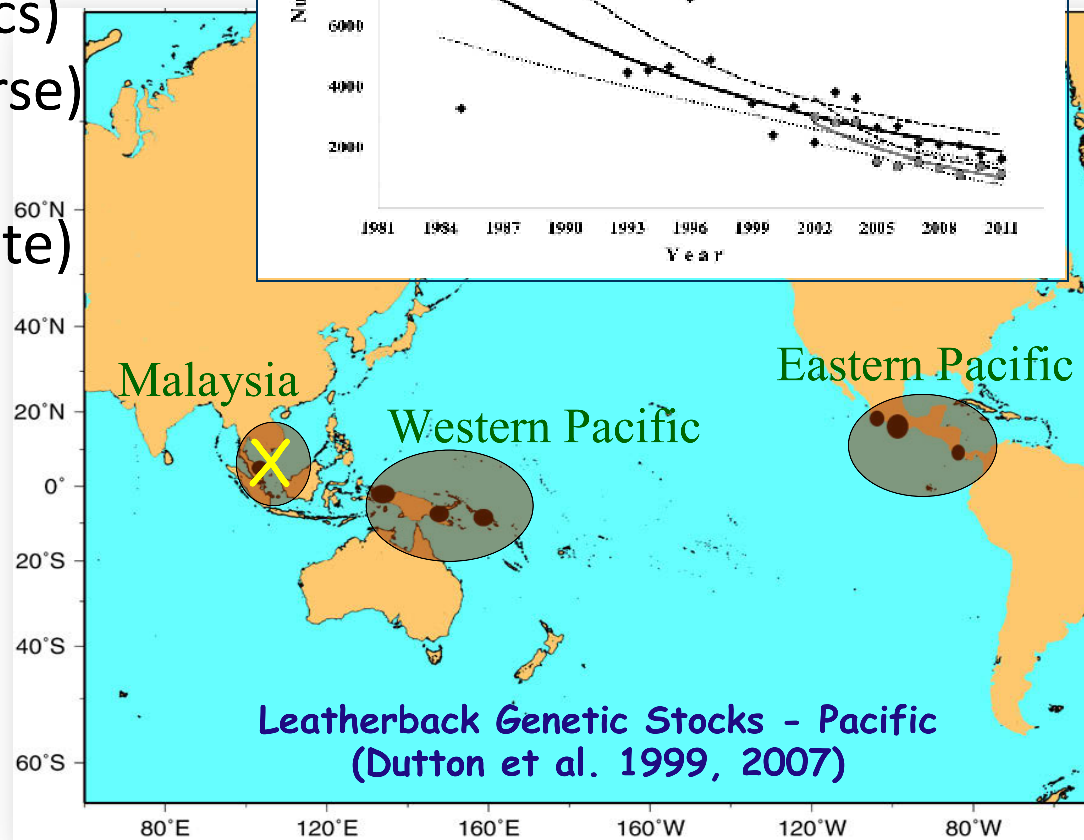
California, USA

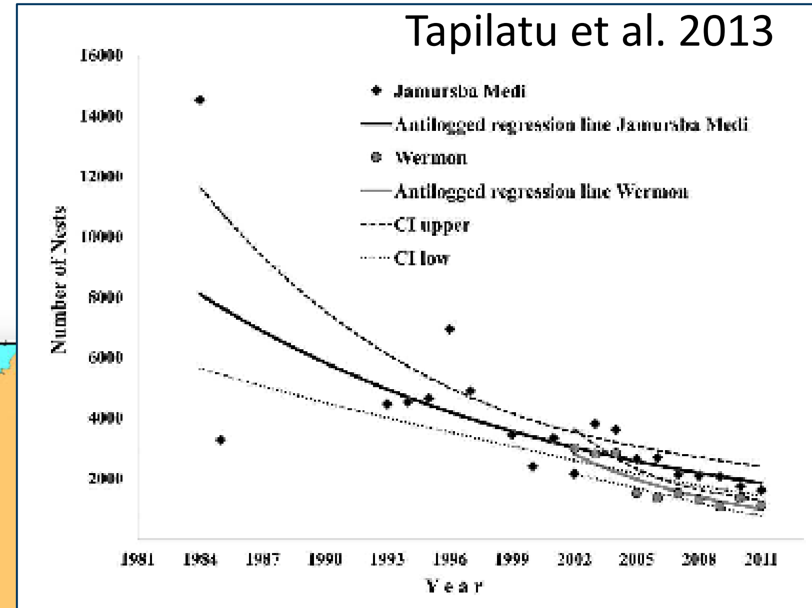
June 2017

Eguchi et al. 2017. Fishery Oceanography 26:17-33

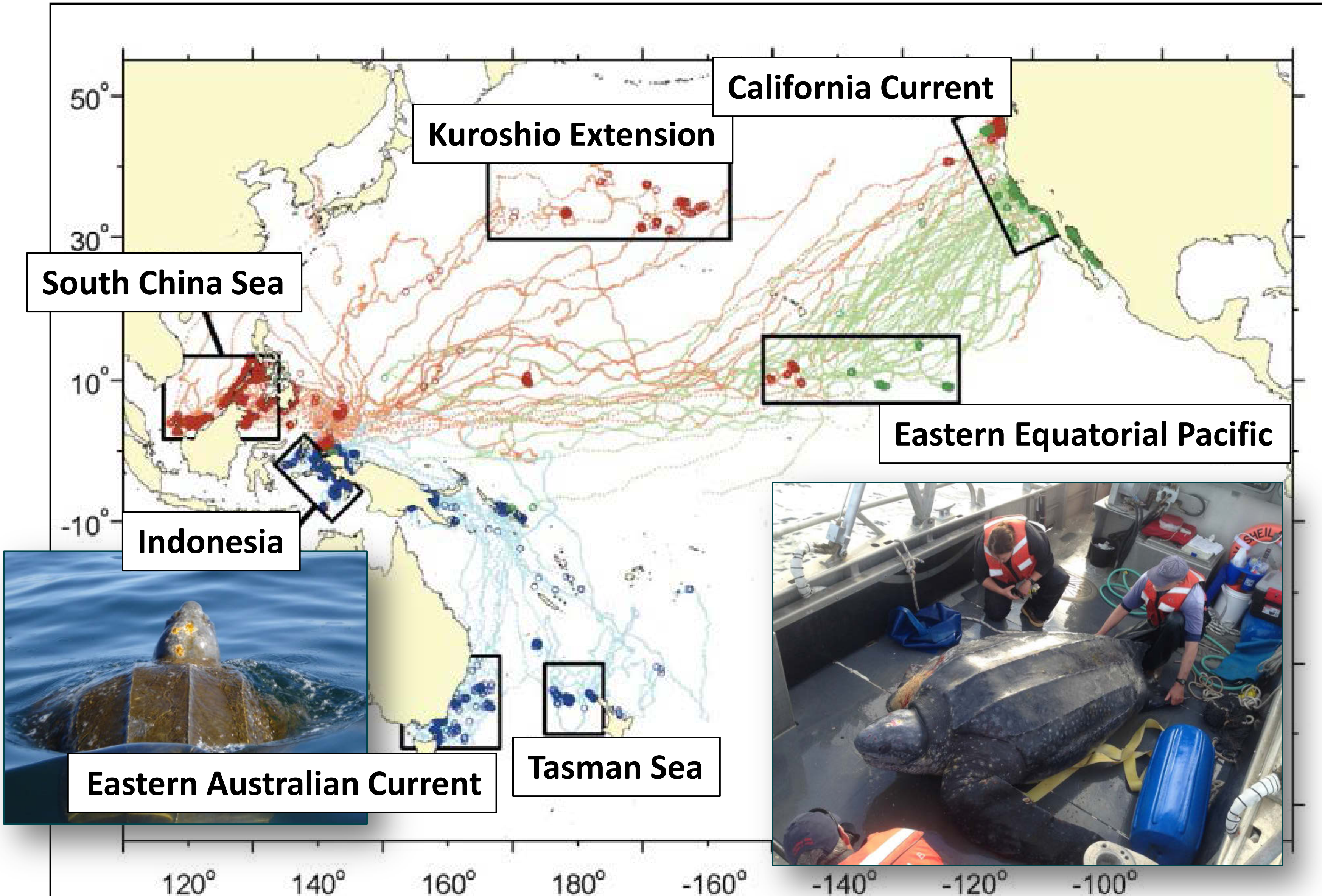
Pacific leatherback turtles (*Dermochelys coriacea*)

- Endangered
- 2 genetic stocks
- Ranges into temperate waters
- Three areas of vulnerability…
  - nesting beaches (tropics)
  - migration routes (diverse)
  - foraging grounds (tropical and temperate)
- Jelly-vore
- Declining

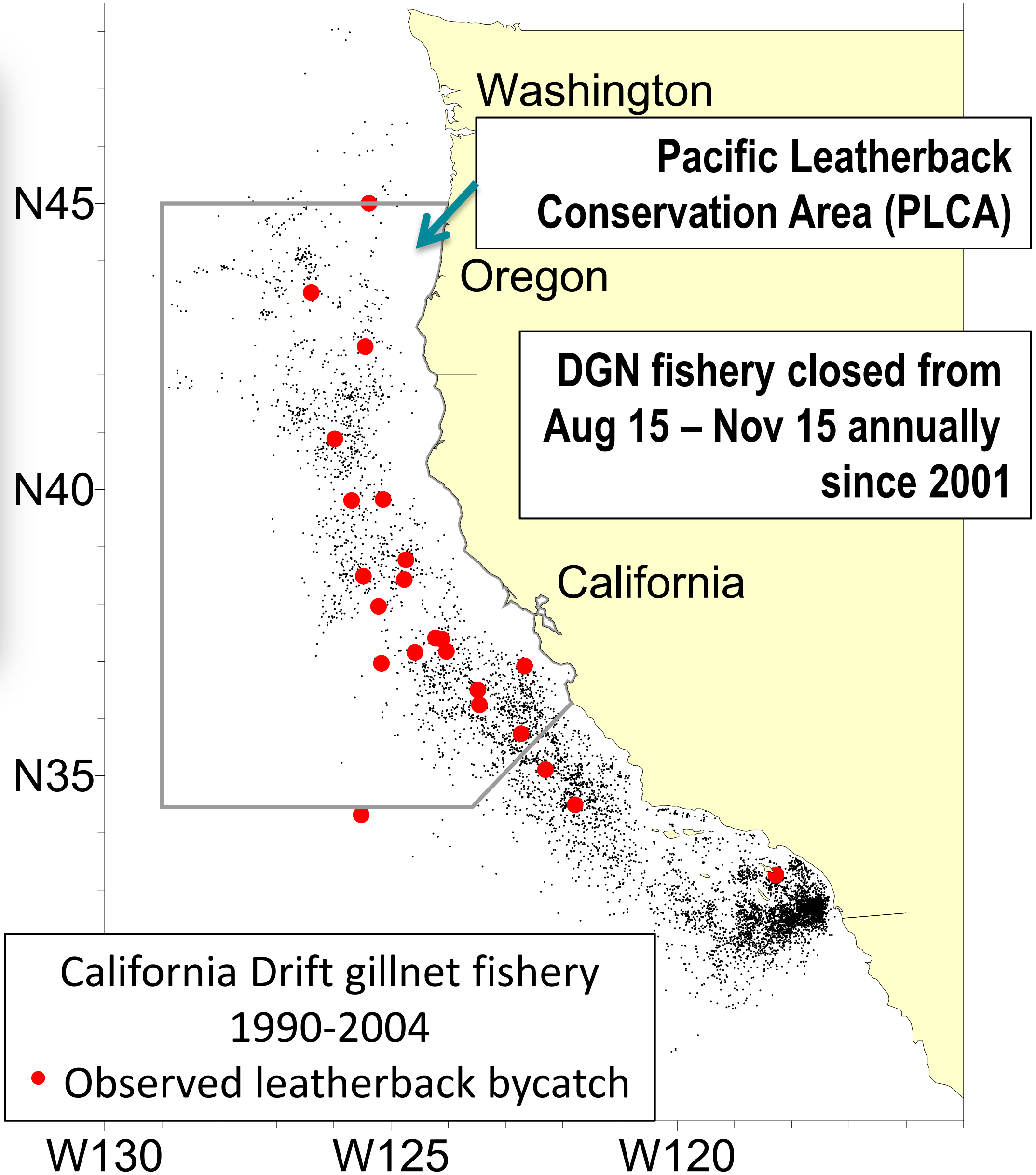




Western Pacific leatherback turtles



Drift gillnet fishery and leatherback turtles



Objectives

1. To predict leatherback turtle occurrence in PLCA
    - Can we come up with a statistical approach that provides the same level of protection as the current static closure?

Objectives

1. To predict leatherback turtle occurrence in PLCA
   - Can we come up with a statistical approach that provides the same level of protection as the current static closure?
2. To predict co-occurrence of leatherback turtle foraging habitat and DGN fishery
   - Spatial prediction of leatherback turtle foraging habitat given some ‘known’ foraging areas in the study area
   - Spatial prediction of DGN fishery in the study area from observer data – presence only
   - Compute co-occurrence likelihood of turtle habitat and DGN habitat

1. Predict leatherback turtle occurrence in PLCA

- Turtles; satellite telemetry tracks (n = 15)
- Split the tracks into entry and departure from PLCA
- Predictors: Upwelling index (UWI) at various latitudes, Northern Oscillation Index (NOI), Pacific Decadal Oscillation index (PDO) with time lag (8, 14, 30 days)
- Random Forest to select variables, then mixed-effects logistic regression models

1. Predict leatherback turtle occurrence in PLCA

- Turtles; satellite telemetry tracks (n = 15)
- Split the tracks into entry and departure from PLCA
- Predictors: Upwelling index (UWI) at various latitudes, Northern Oscillation Index (NOI), Pacific Decadal Oscillation index (PDO) with time lag (8, 14, 30 days)
- Random Forest to select variables, then mixed-effects logistic regression models

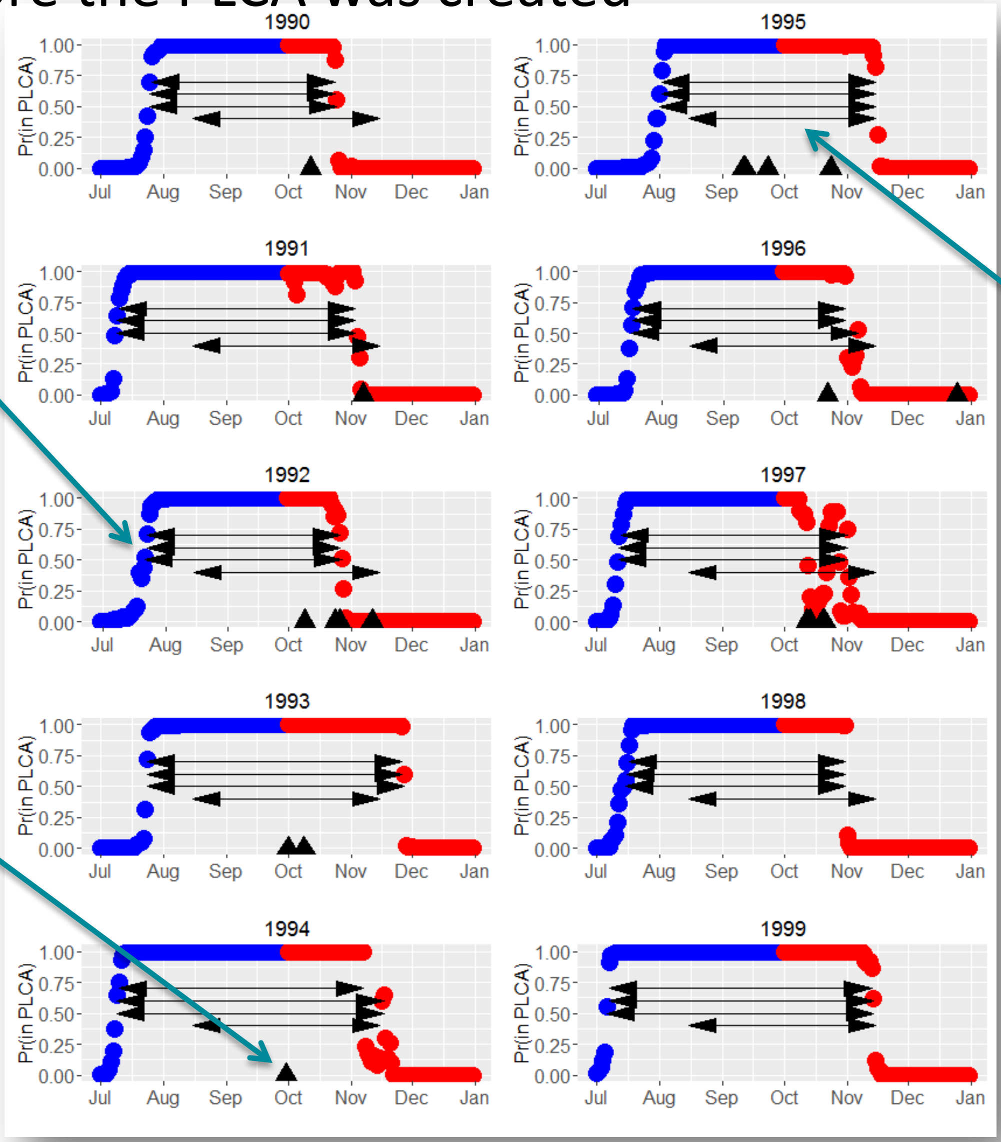
Entry	P(entry)	Departure	P(departure)
SD(UWI) at 36N	–	PDO	+
Sum(UWI) at 39N	+	Mean(UWI) at 48N	–

Probability of leatherback turtles in PLCA

For years before the PLCA was created

Closure duration if P(in PLCA) > 0.5, P(in PLCA) > 0.6, P(in PLCA) > 0.7

Observed bycatch

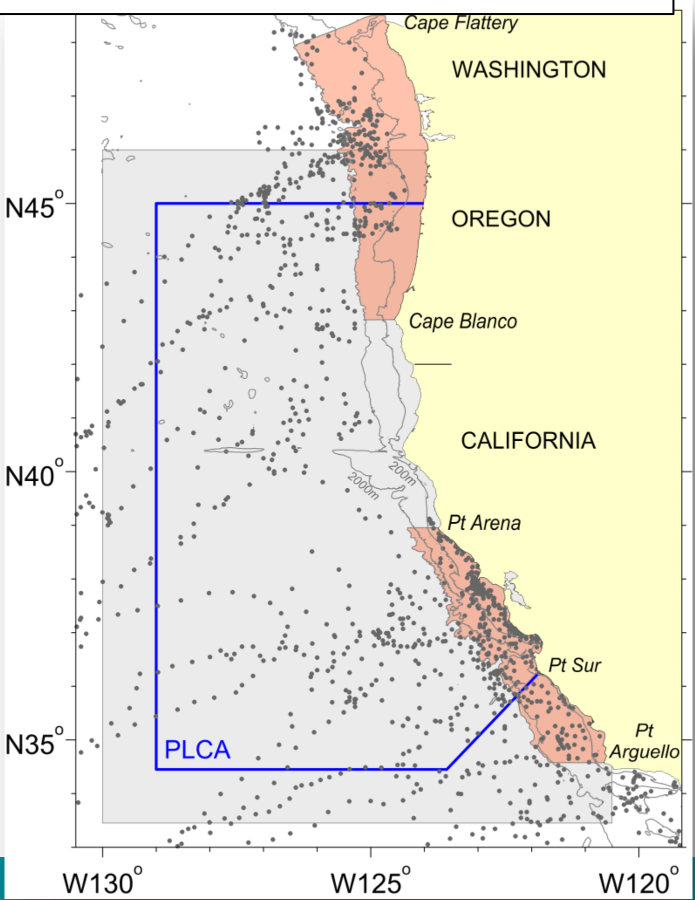


Current closure; established in 2001

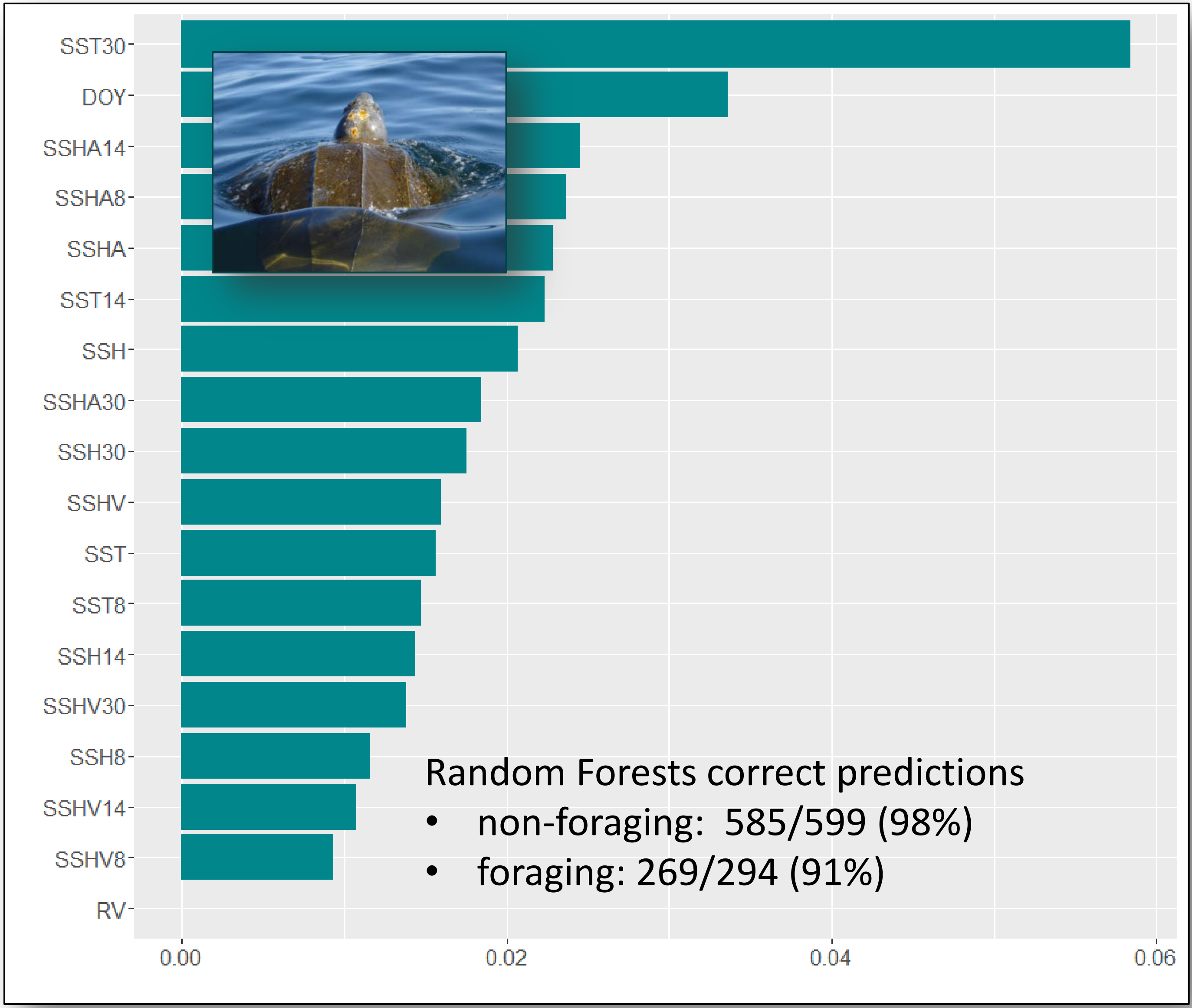
2. Co-occurrence of leatherback foraging habitat and DGN fishery

- Turtles: satellite telemetry tracks (n = 15) in the area; inside or outside of the presumed foraging areas --- Random Forest
- Fishery: observed set locations (~20%) --- Maxent
- Environmental data with time lag (8, 14, 30 days)
- Resolutions: 0.5 x 0.5 degree and 2-week
- Predictions: 2001-2010
- Overlap likelihood = turtle x DGN
- Feasibility of dynamic management

Leatherback turtle telemetry data



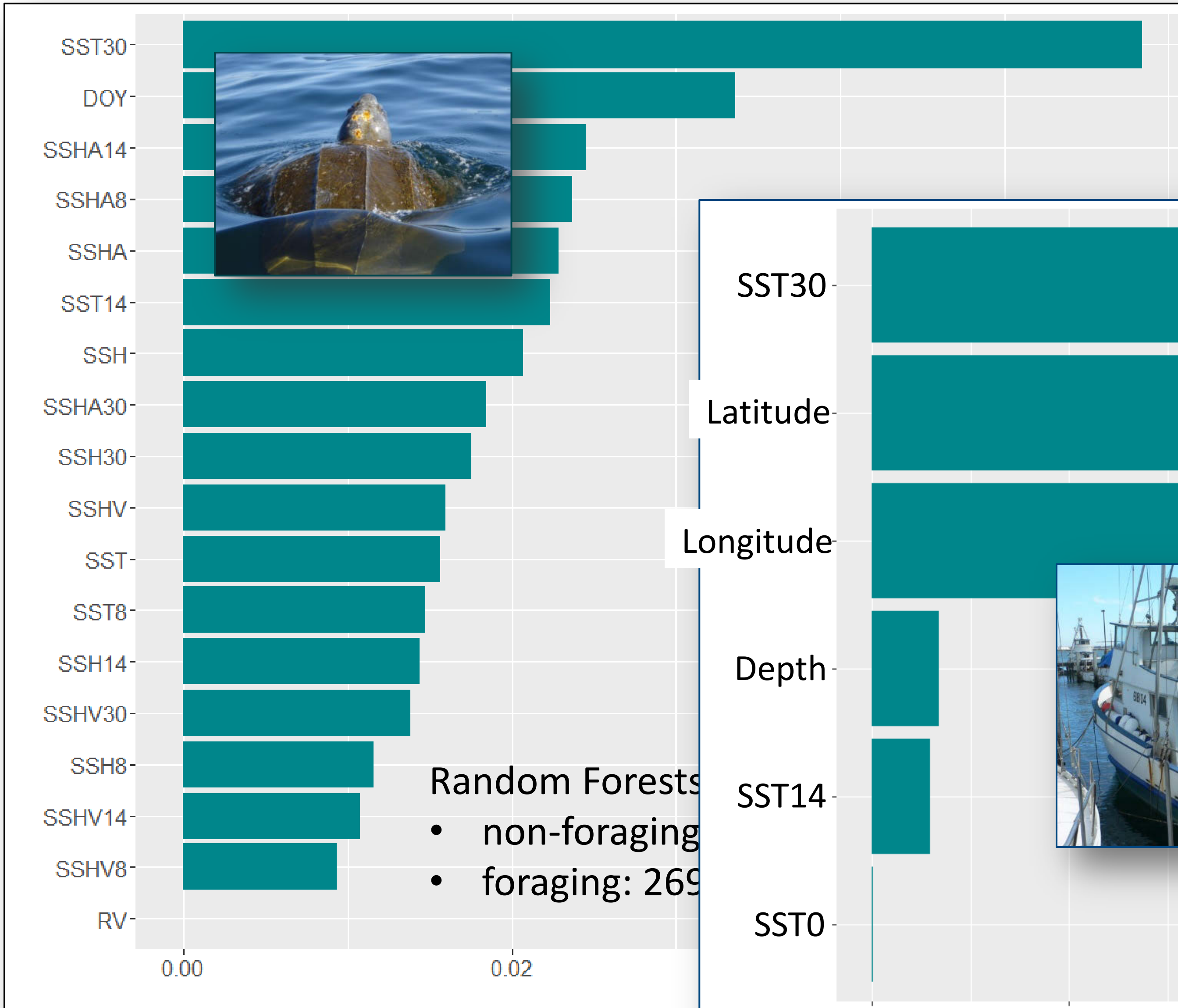
Variable importance and performance



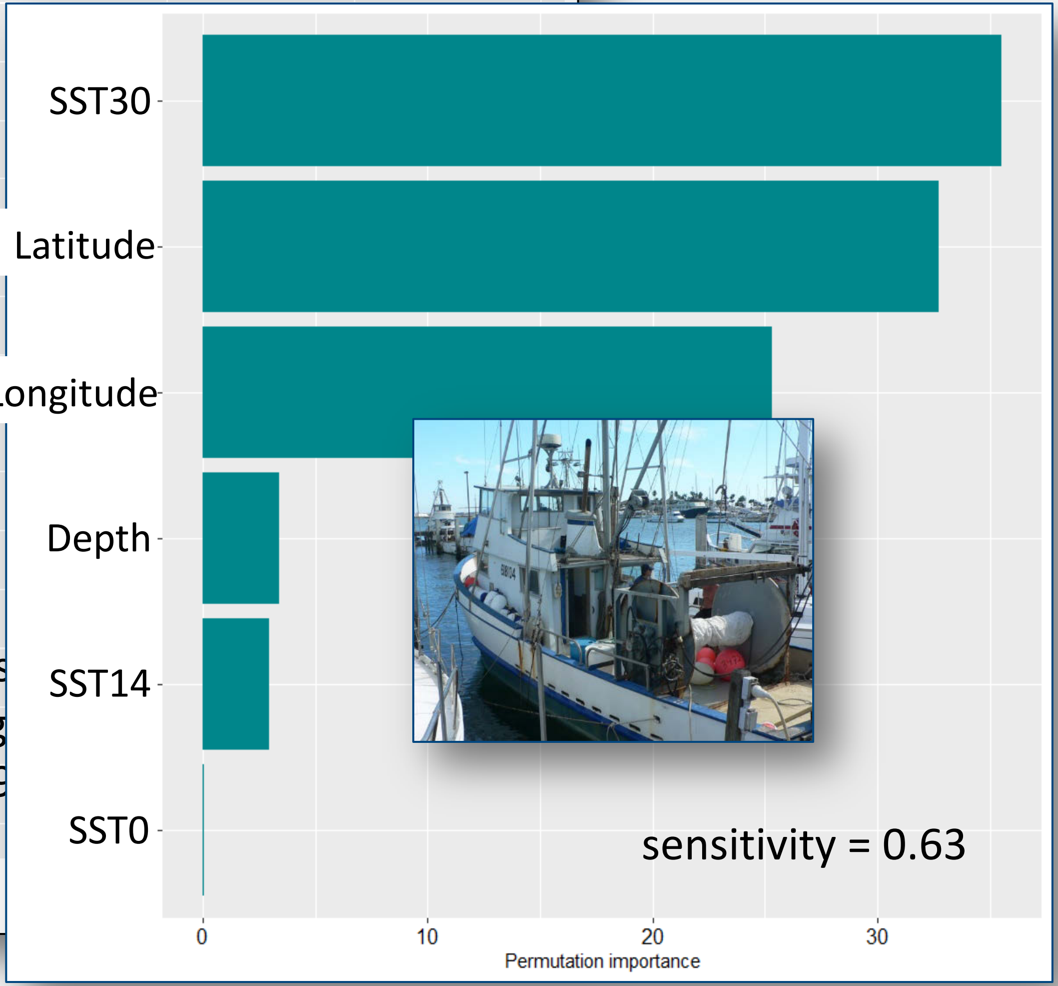
Random Forests correct predictions

- non-foraging: 585/599 (98%)
- foraging: 269/294 (91%)

Variable importance and performance

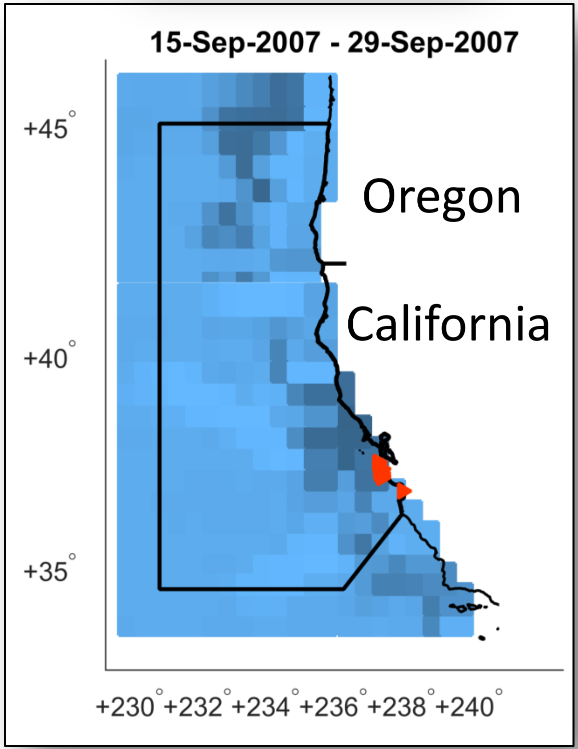


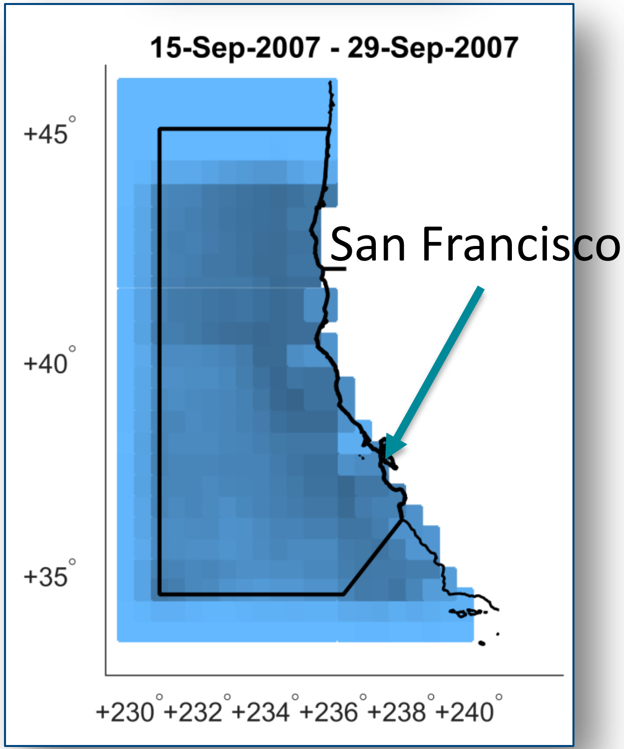
Random Forests
- non-foraging
- foraging: 269

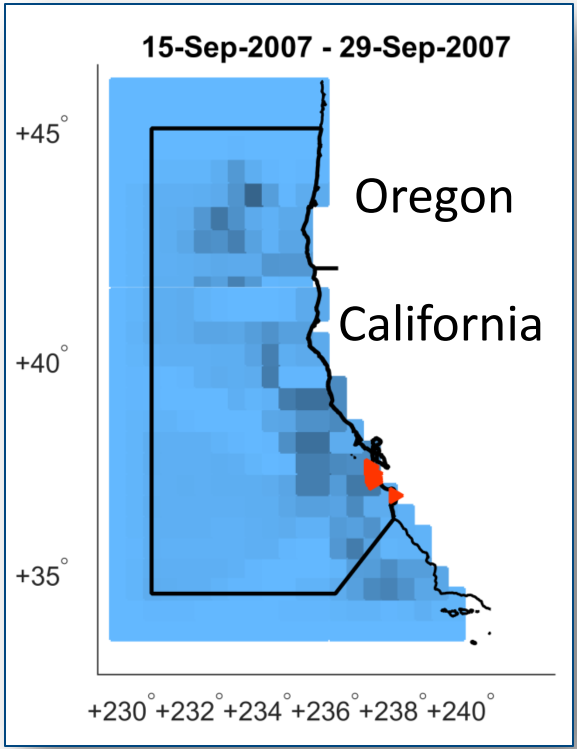


Overlap of leatherback foraging habitat and DGN fishery

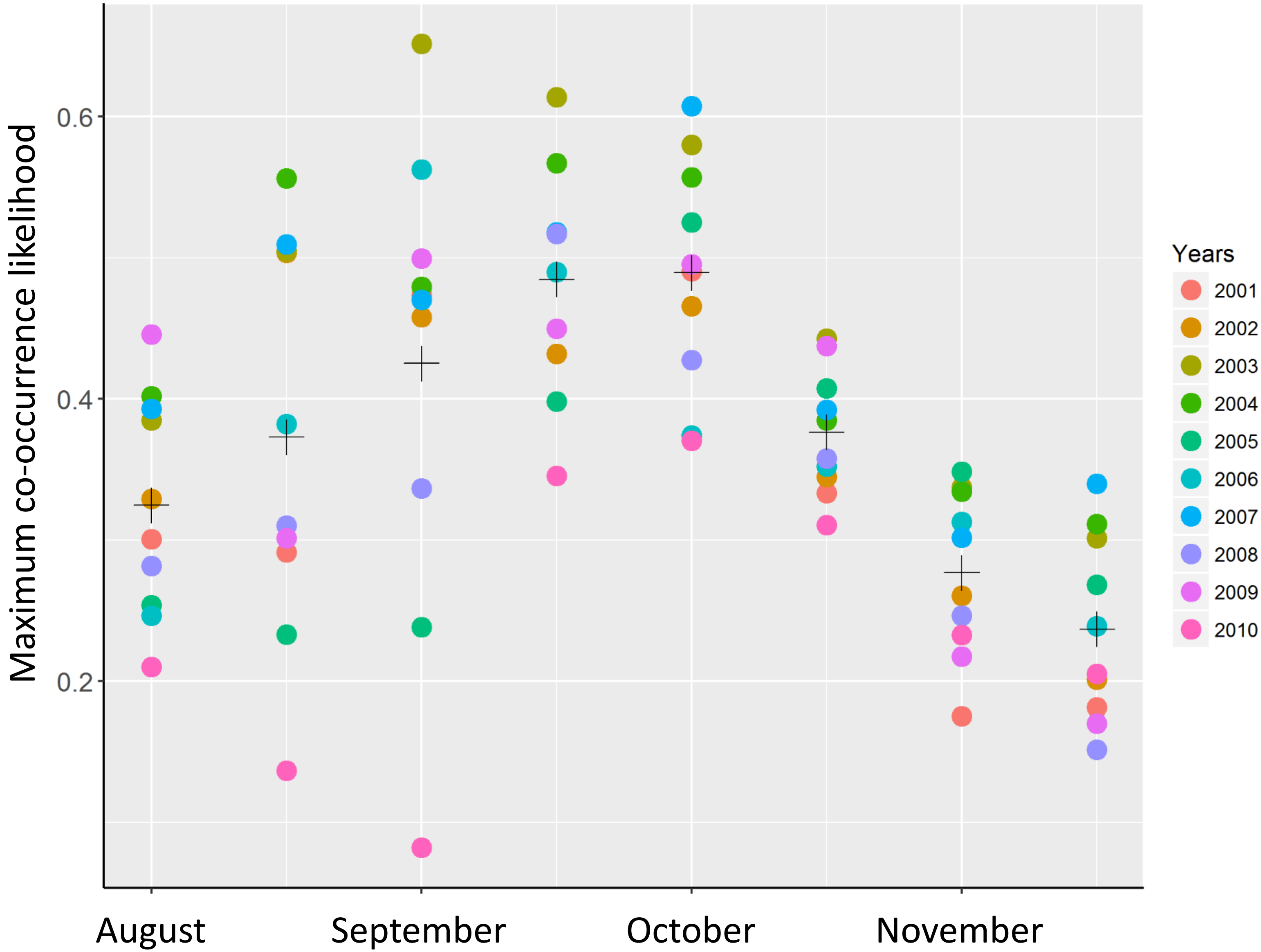
Overlap



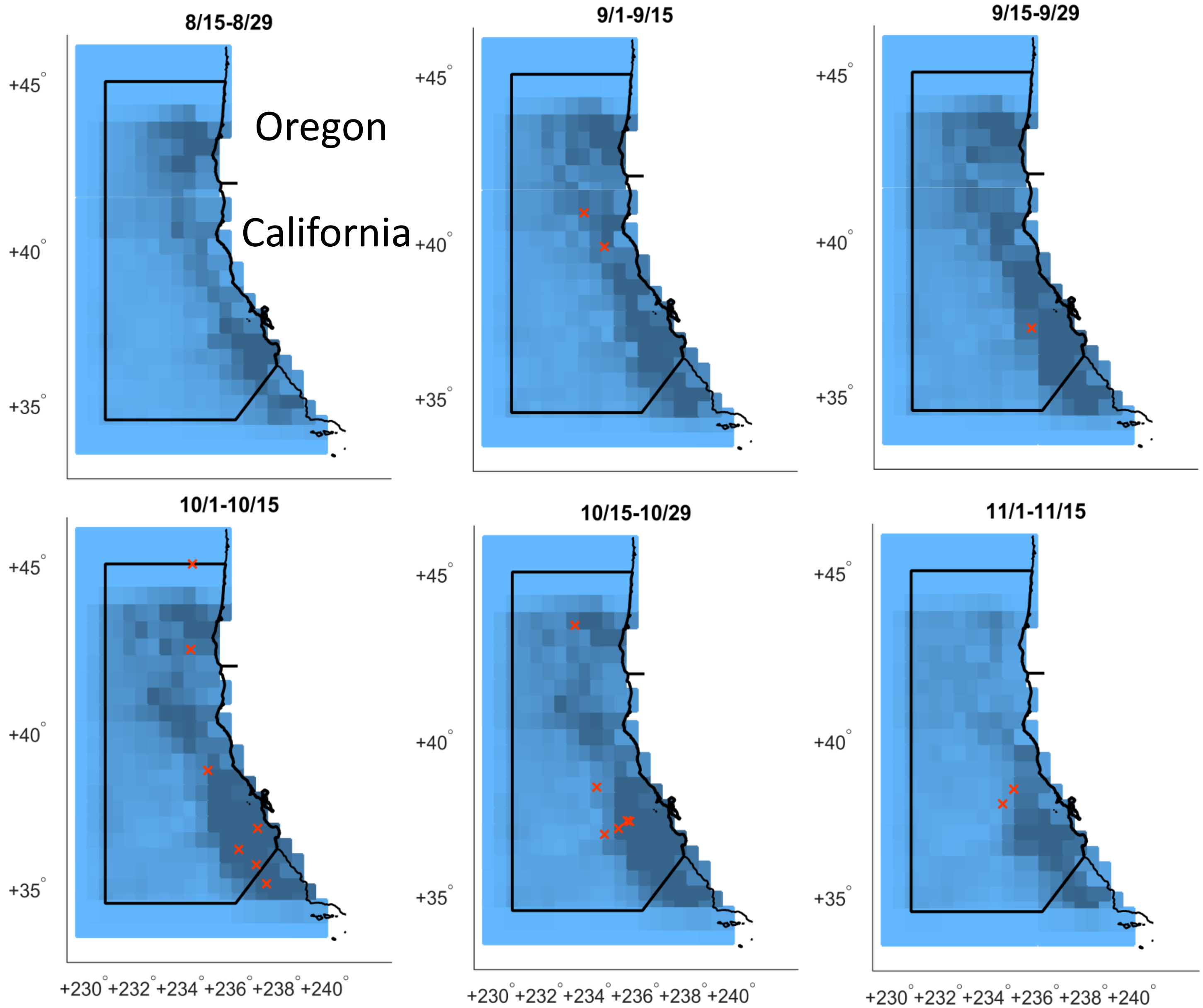




Maximum co-occurrence likelihood



Average co-occurrence likelihood (2001-2010)

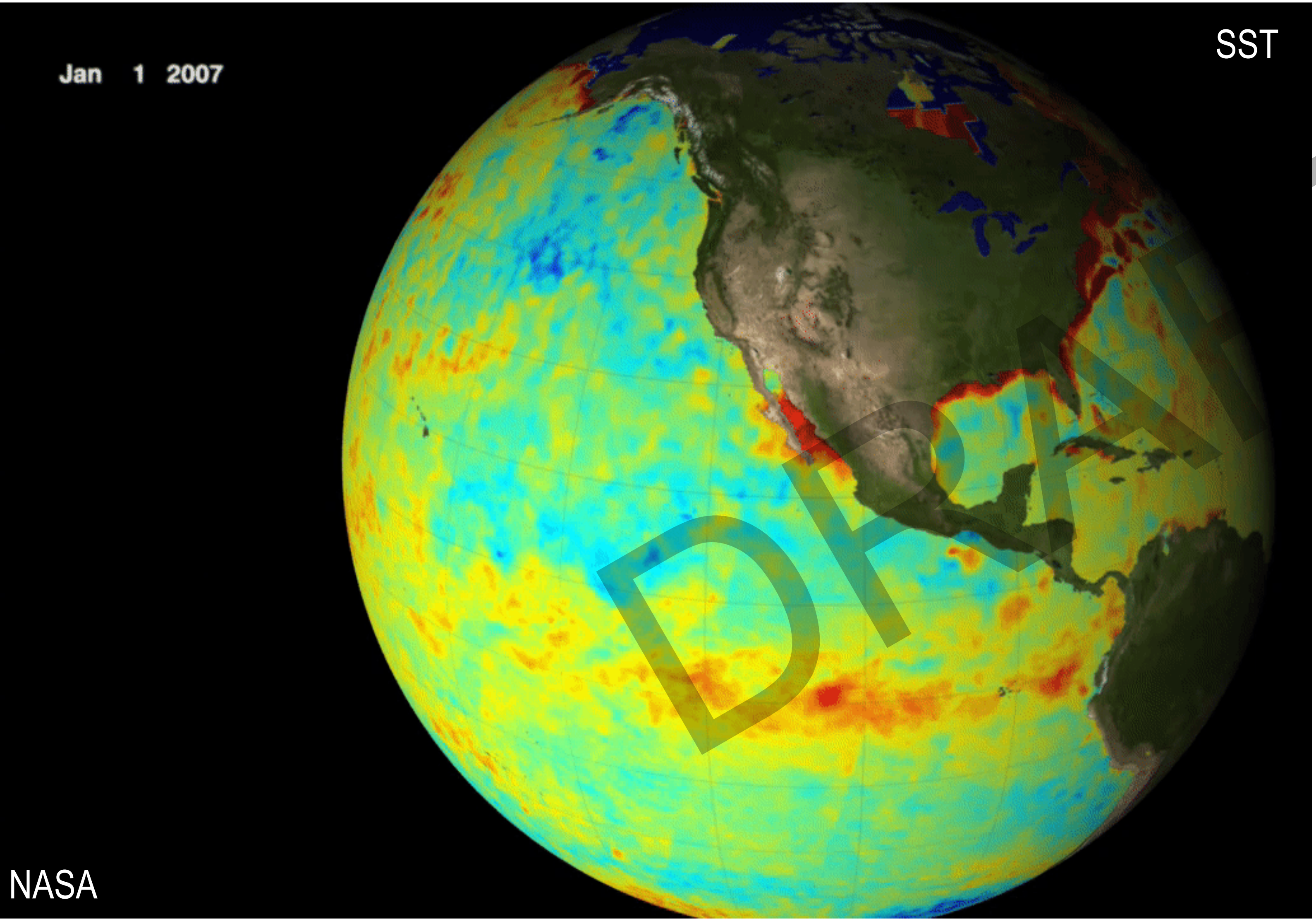


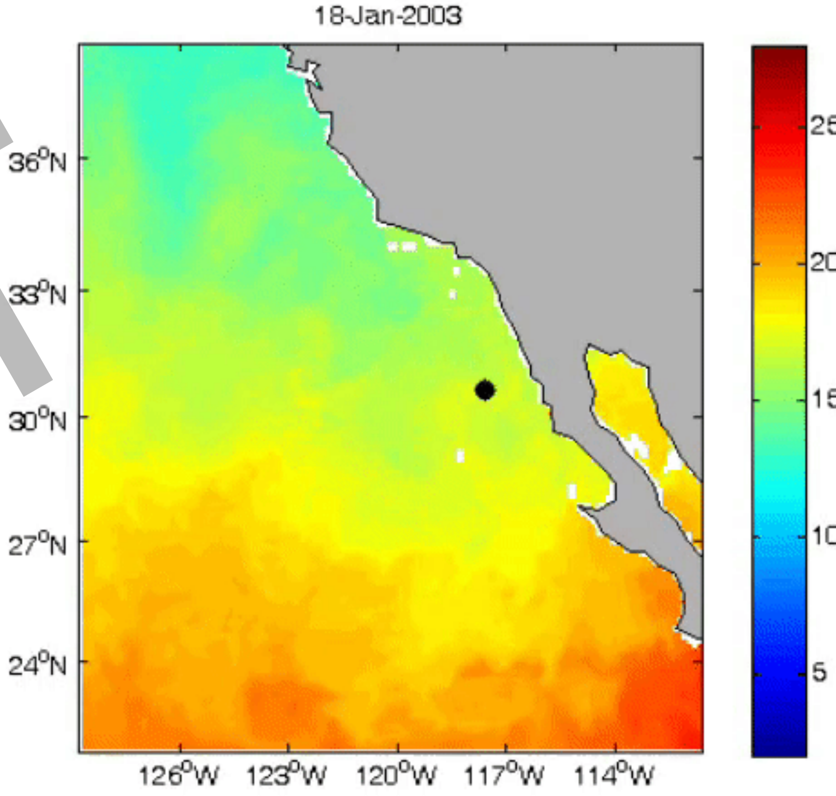
Modeling DGN fishery - leatherback turtle occurrence

- **Leatherback turtles' arrival to and departure from the PLCA can be predicted – with some errors – need to be improved**
- **More data (telemetry, survey, and sightings) of leatherback turtles are necessary to refine the models**
- **Current closure period roughly corresponds to predicted high probability of leatherback occurrence in PLCA; current closure period is effective and shorter than statistical prediction**
- **Cost effective methods needed for surveying offshore environment**


Thanks!

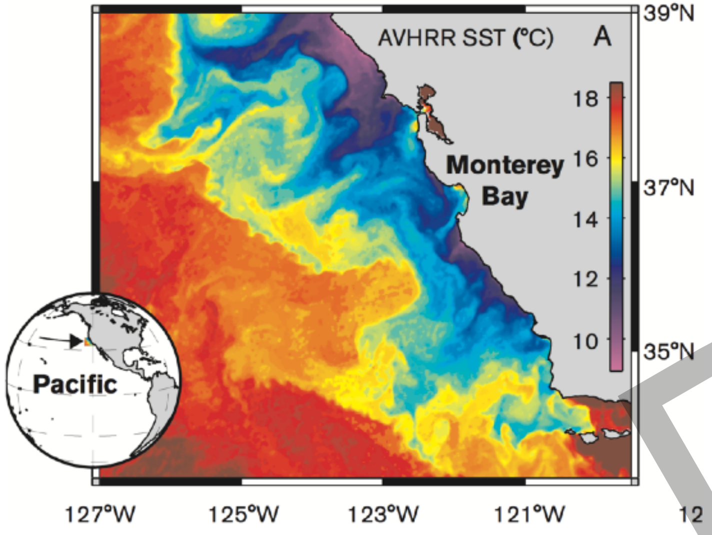
Dynamic Oceans and Dynamic Ecosystems



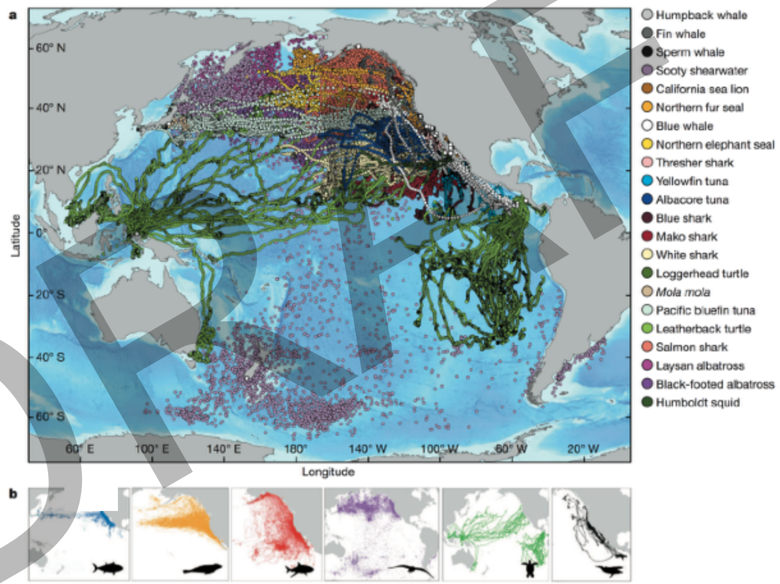


Southwest Fisheries Science Center,
Environmental Research Division
UCSC – Cooperative Institute for Marine Ecosystems and Climate
elliott.hazen@noaa.gov

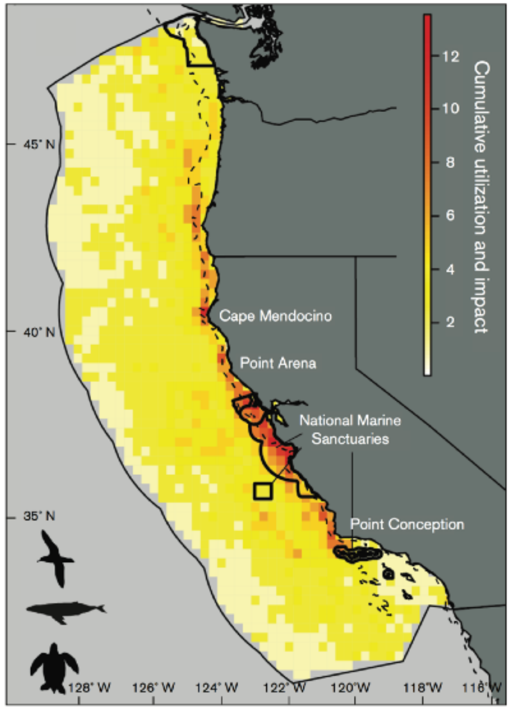
Dynamic Ocean Management



Ryan et al. 2005



Block et al. 2011

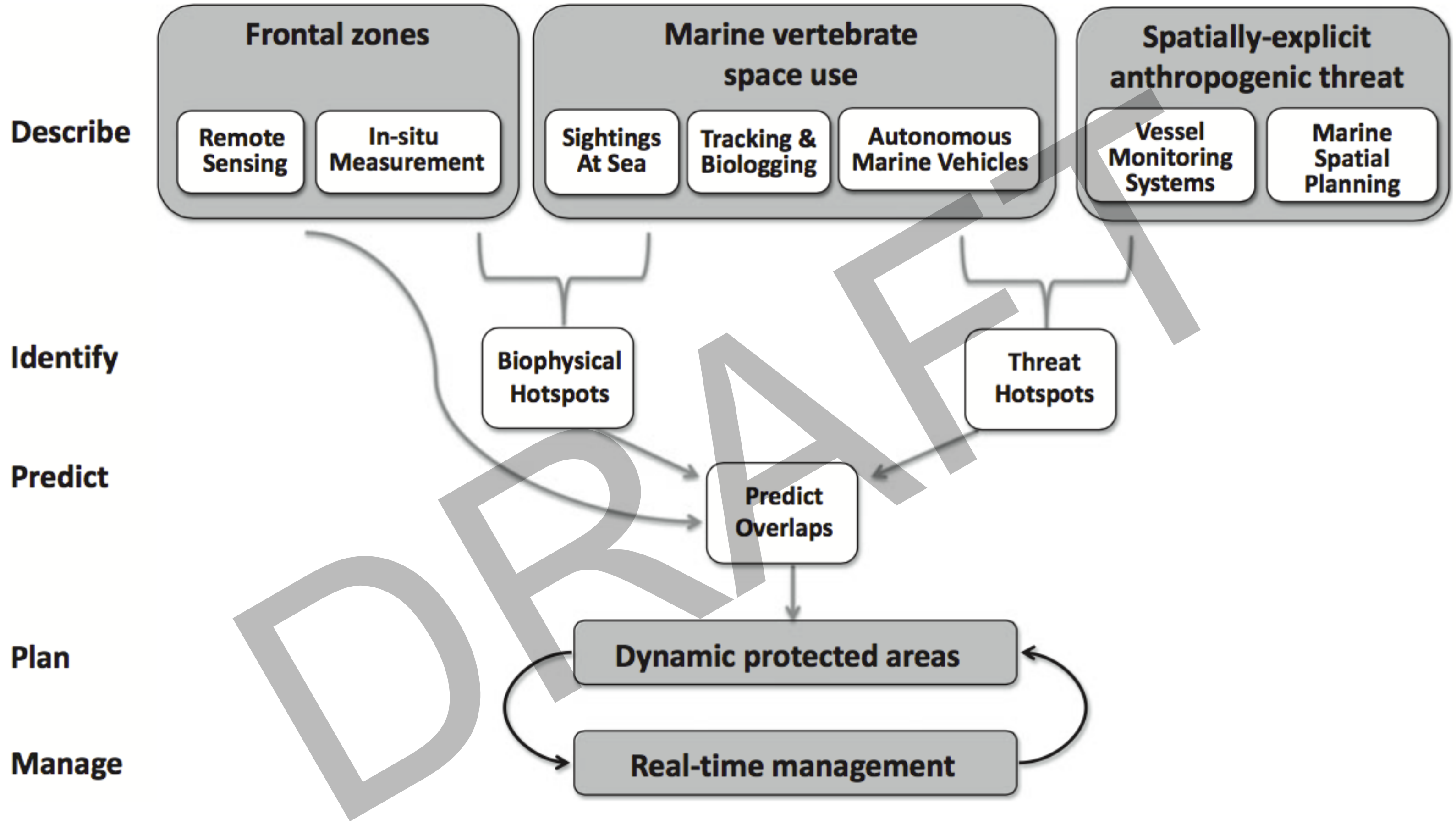


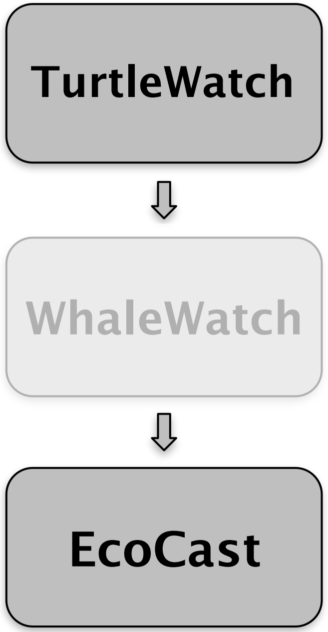
Maxwell et al. 2013

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

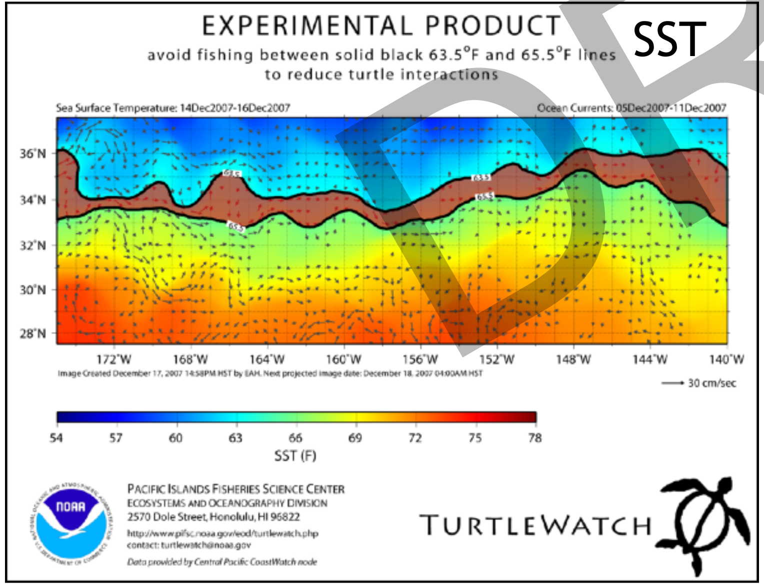




Scales et al. 2014 J Appl Ecol

TurtleWatch

Voluntary,
yet effective



Vol. 5: 267–278, 2008
doi: 10.3354/esr00096

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.*

ABSTRACT

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.

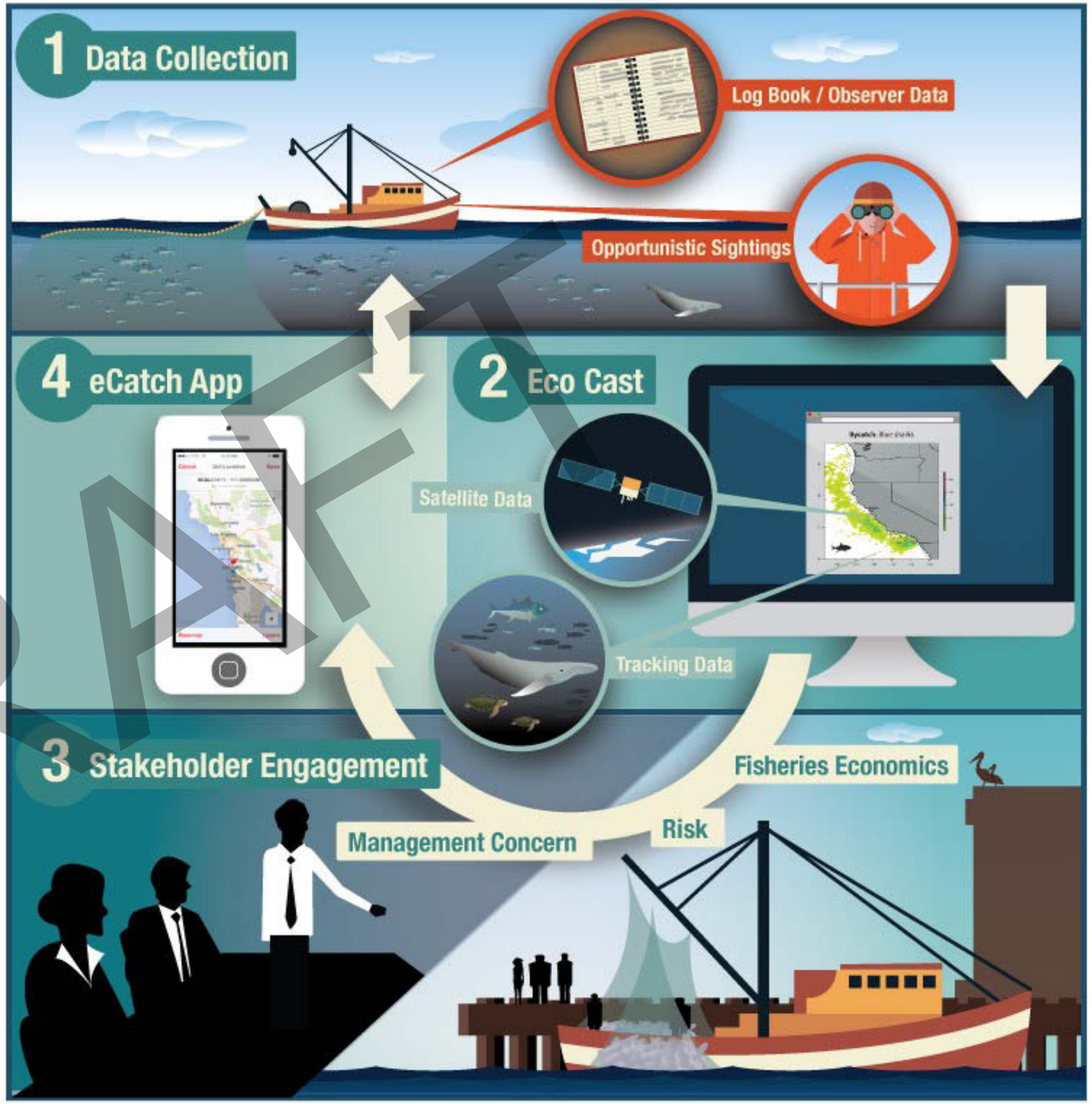
Key words: Central North Pacific, dynamic management, fisheries, leatherback sea turtles, sea surface temperature, swordfish

EcoCast

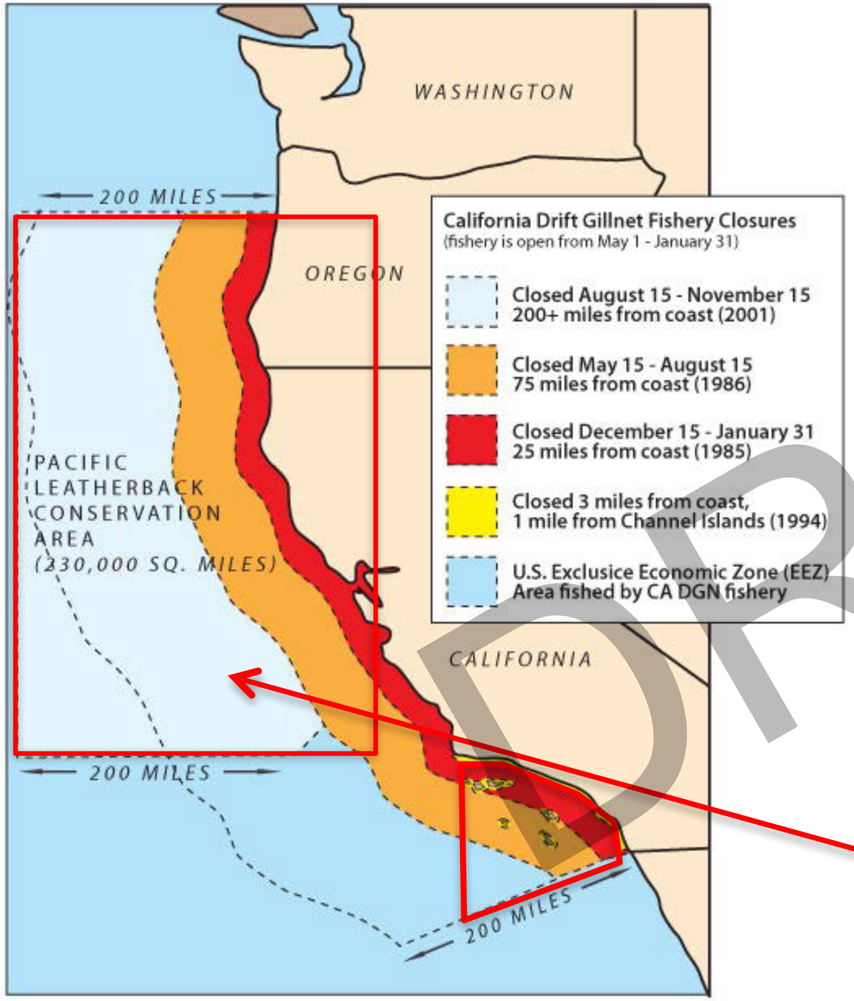
Fishing zones predicted based on ocean features, catch potential, and weighted by bycatch risk

Good fishing zones served via web and mobile devices

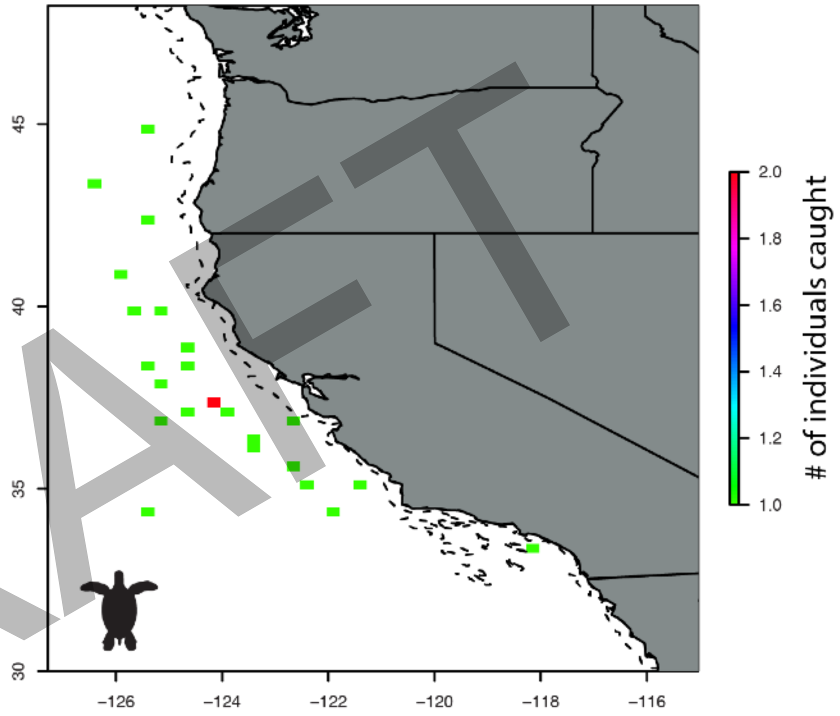
Models to include: hard cap species, risk weightings, seasonal forecasting

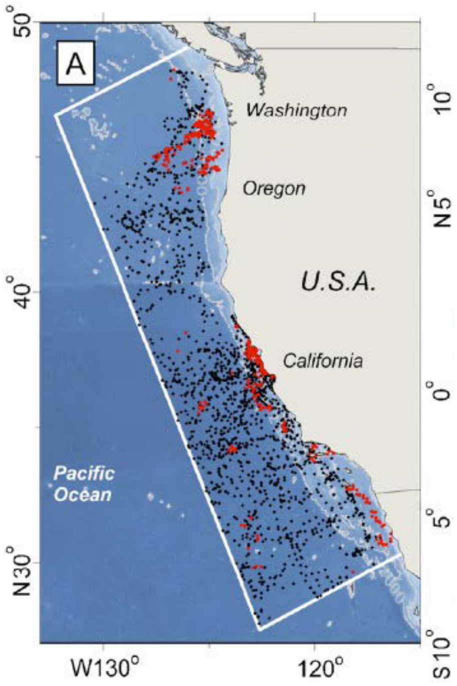


California Drift Gillnet fishery



Bycatch: Leatherback sea turtles





Benson et al 2011 *Ecosphere*

Large seasonal closure put into place in 2001 to protect critically endangered leatherbacks

….leatherback bycatch dropped significantly since closure, but large economic cost

….loggerhead closure during El Niño events

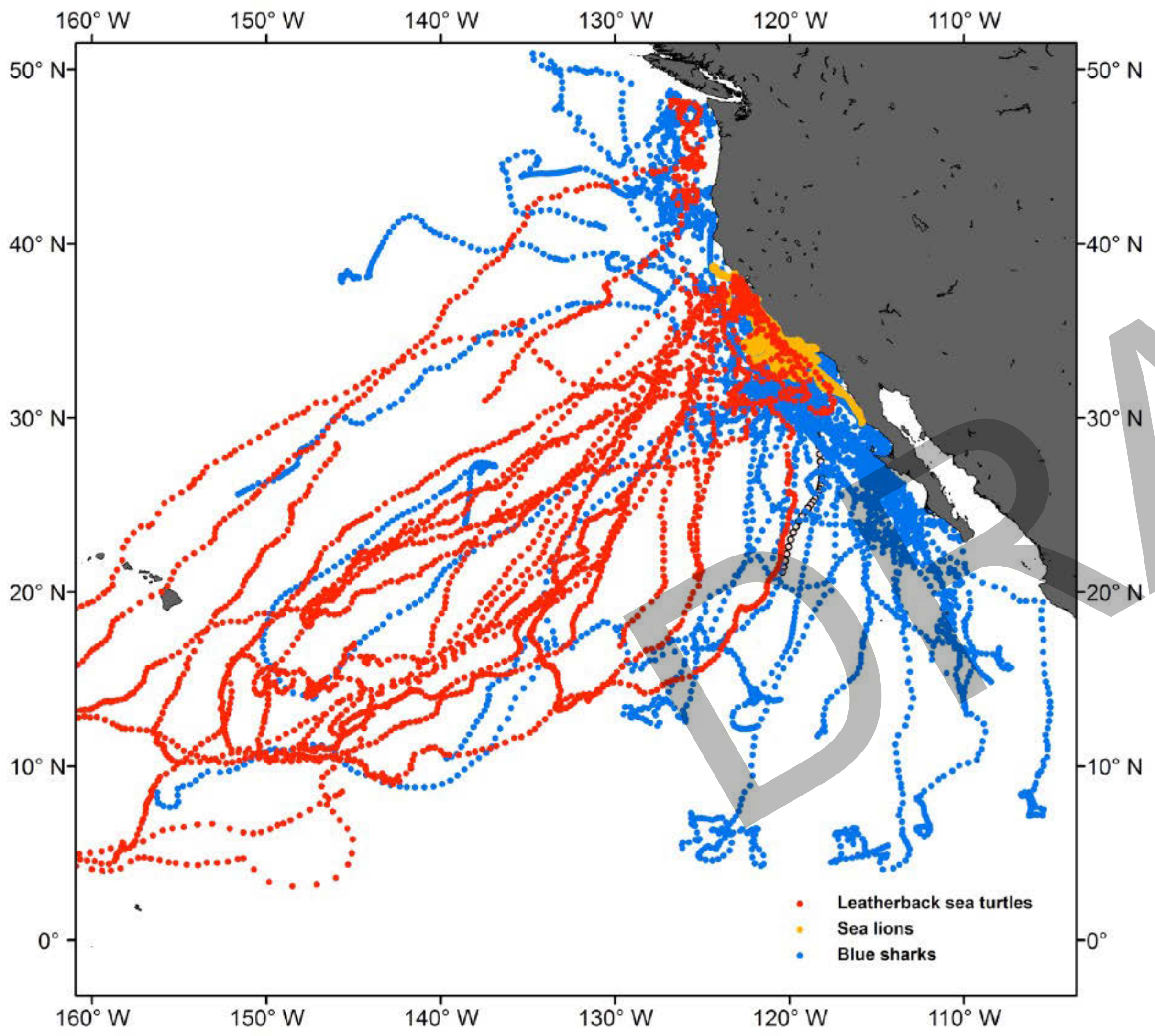
EcoCast: Datasets

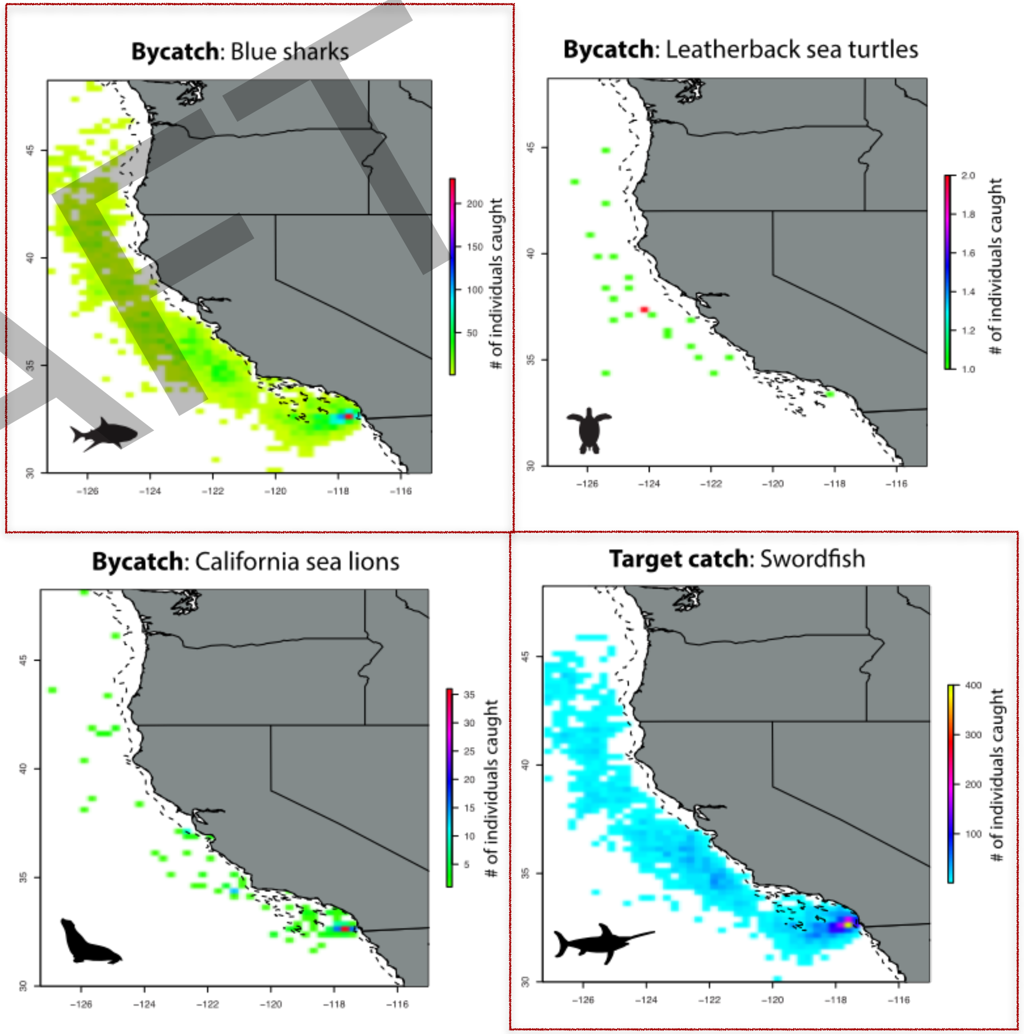
Data Types:

Satellite tracking data

Fishery observer data

+ NOAA marine mammal survey data





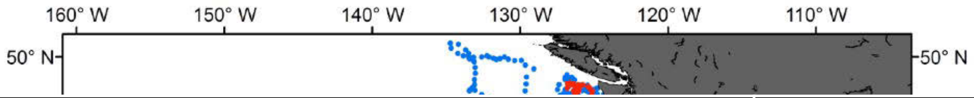
EcoCast: Datasets

Data Types:

Satellite tracking data

Fishery observer data

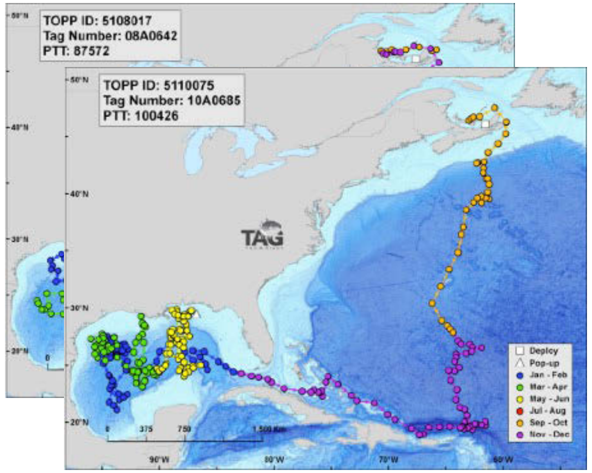
+ NOAA marine mammal survey data



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

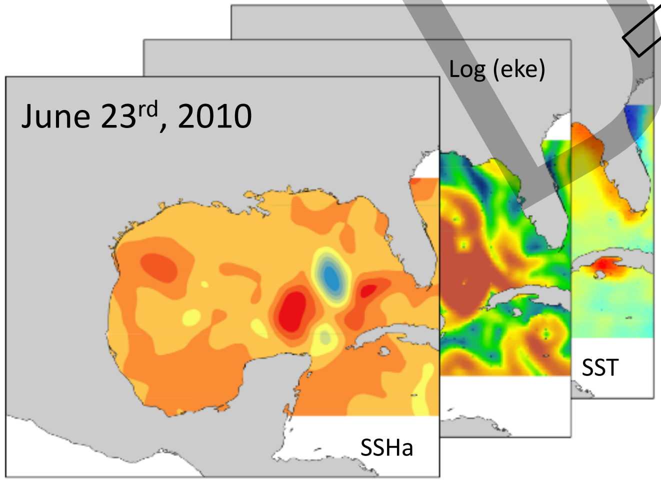
Species Distribution Models

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



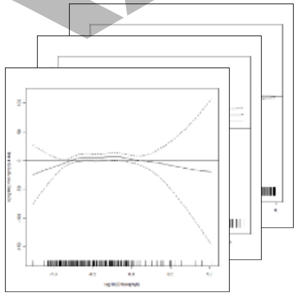
Fit

Sampled environmental data



Statistical models

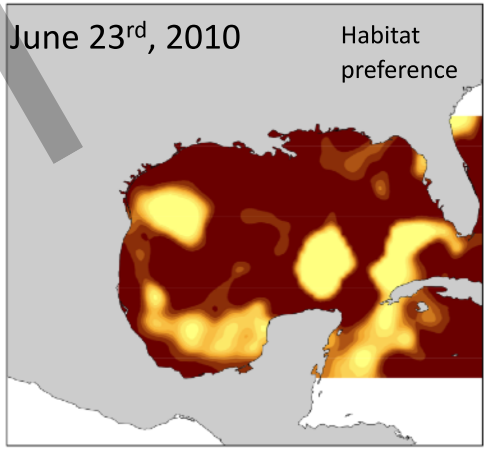
$$g(\mu) = \beta_0 + \beta_1 x_1 + \cdots + \beta_m x_m$$

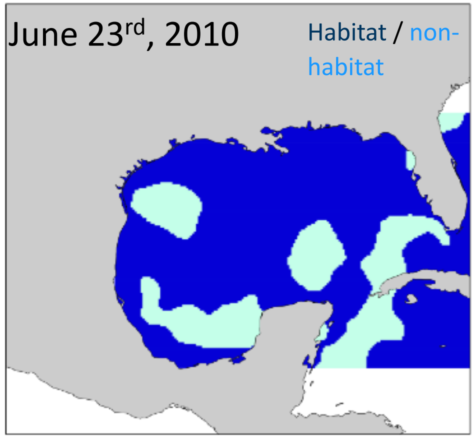


e.g. Generalized Additive Mixed Models,
Boosted Regression Trees

Predict

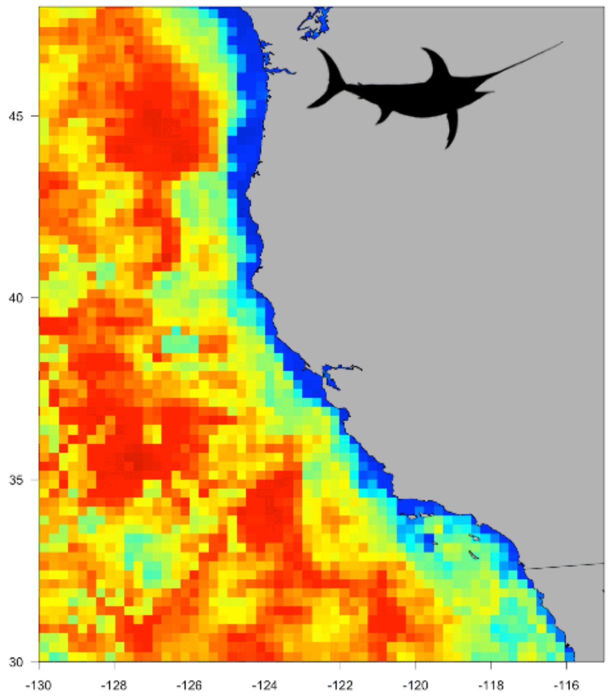
Probability of occurrence predicted from environmental covariates



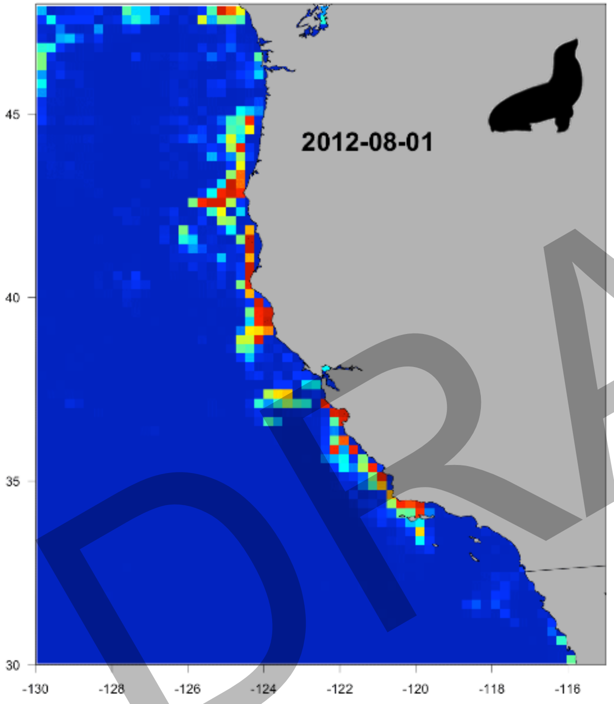


Single Species Predictions

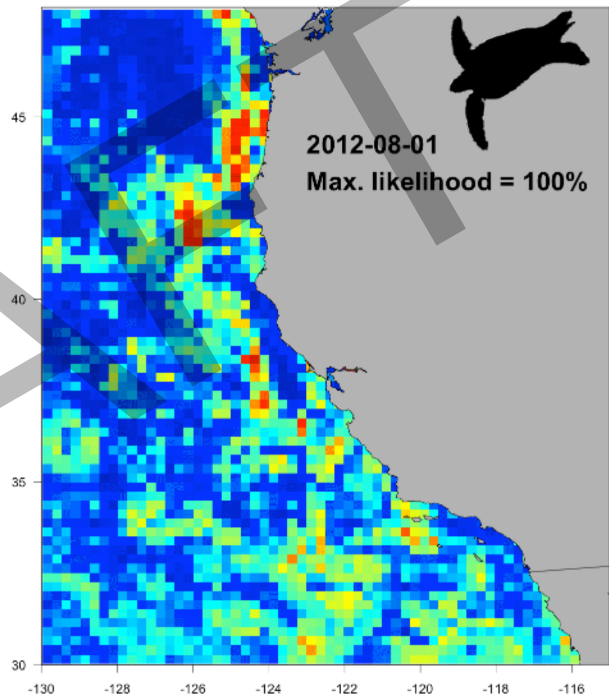
Swordfish Observer



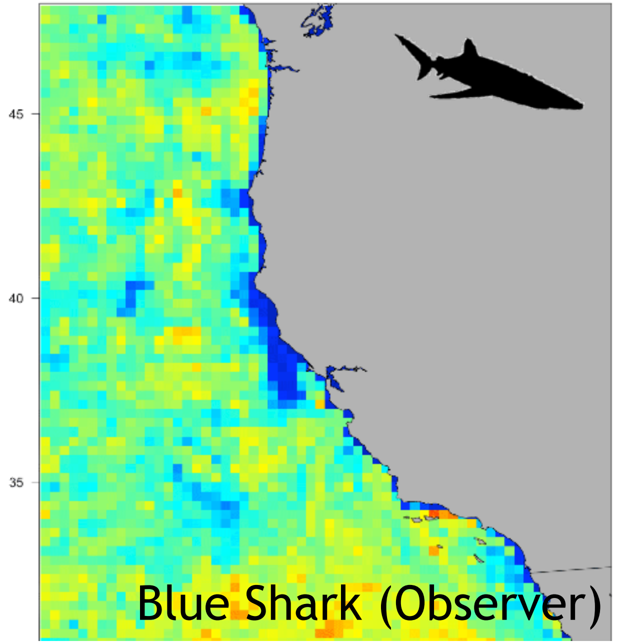
California Sea Lion



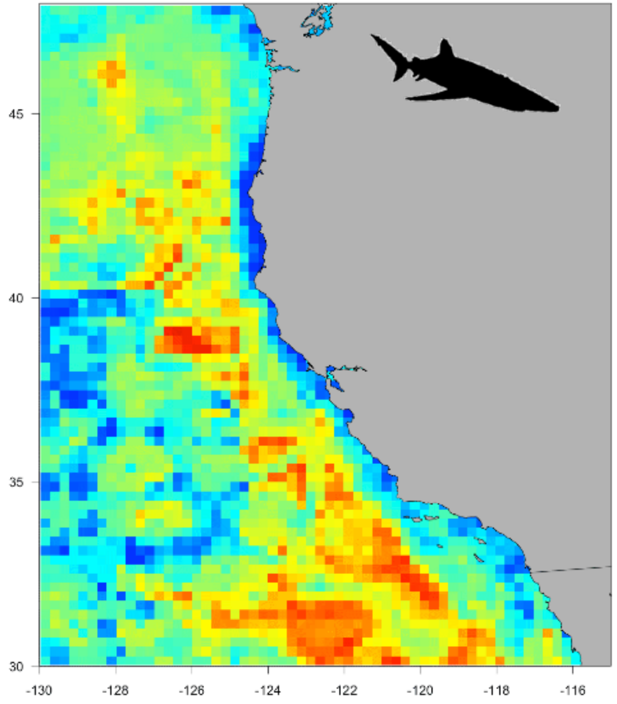
Leatherback Turtle



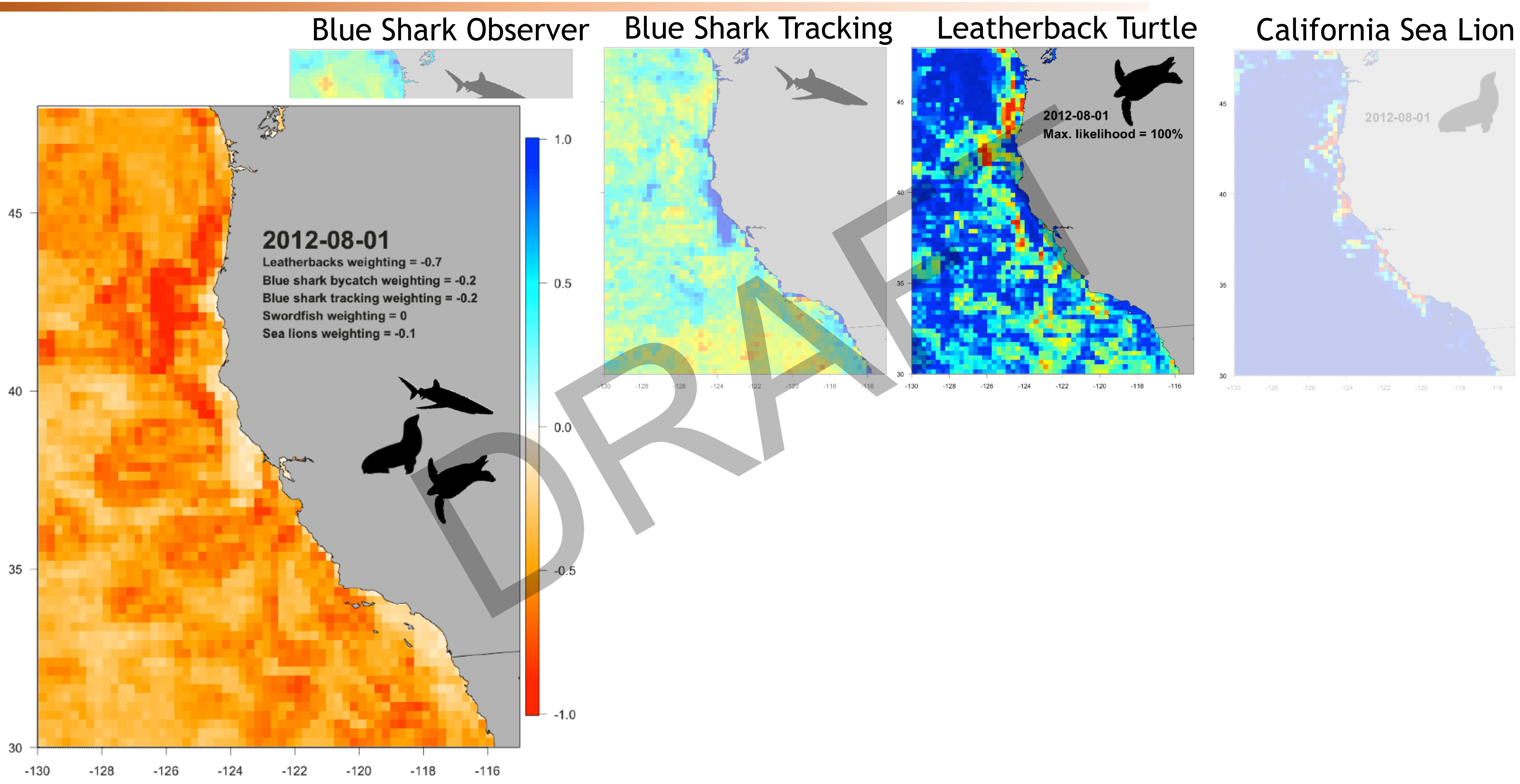
Blue Shark (Tracking)



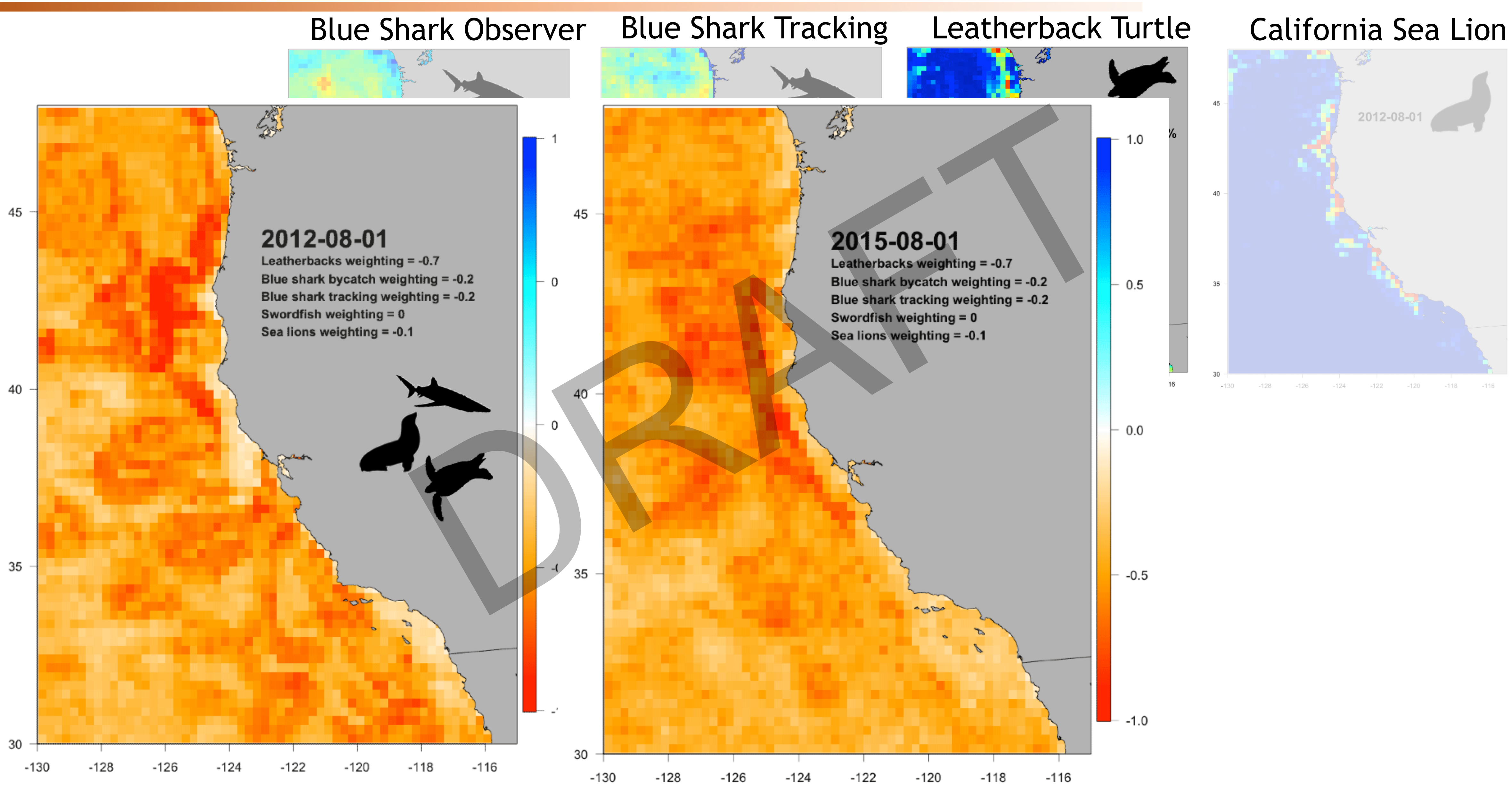
Blue Shark (Observer)



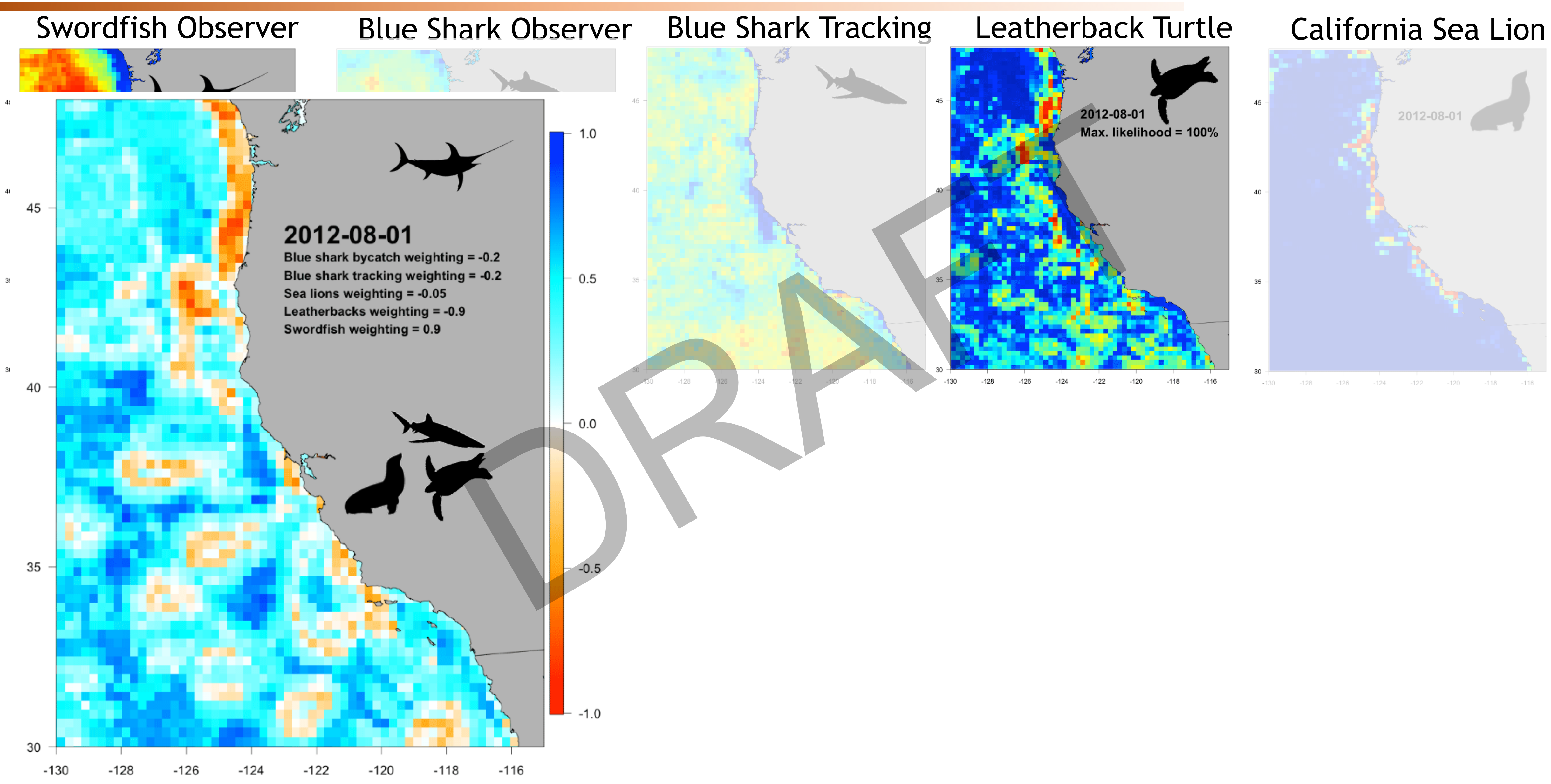
EcoCast predictions - California Drift Gillnet Fishery



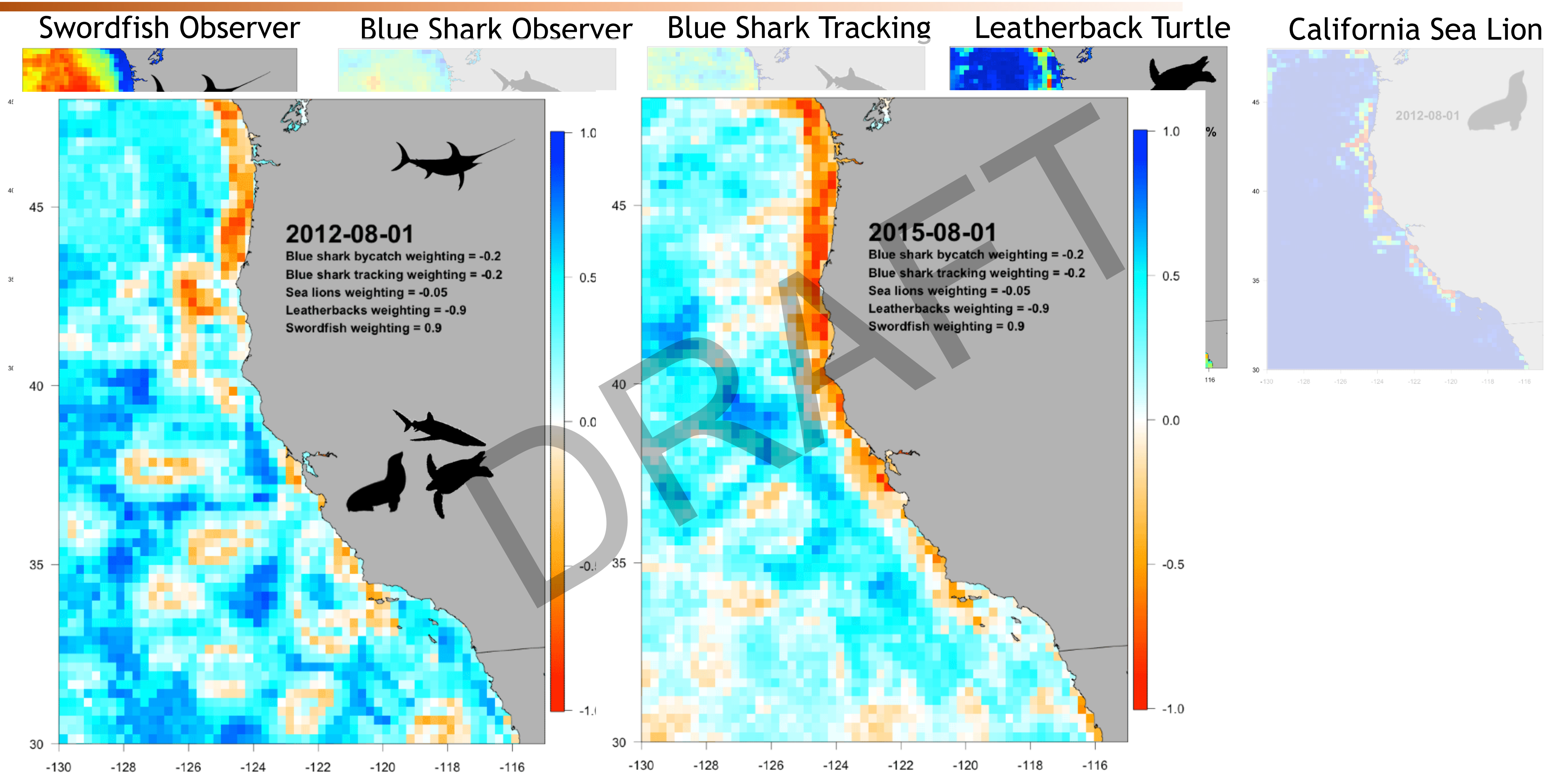
EcoCast predictions - California Drift Gillnet Fishery



EcoCast predictions - California Drift Gillnet Fishery



EcoCast predictions - California Drift Gillnet Fishery

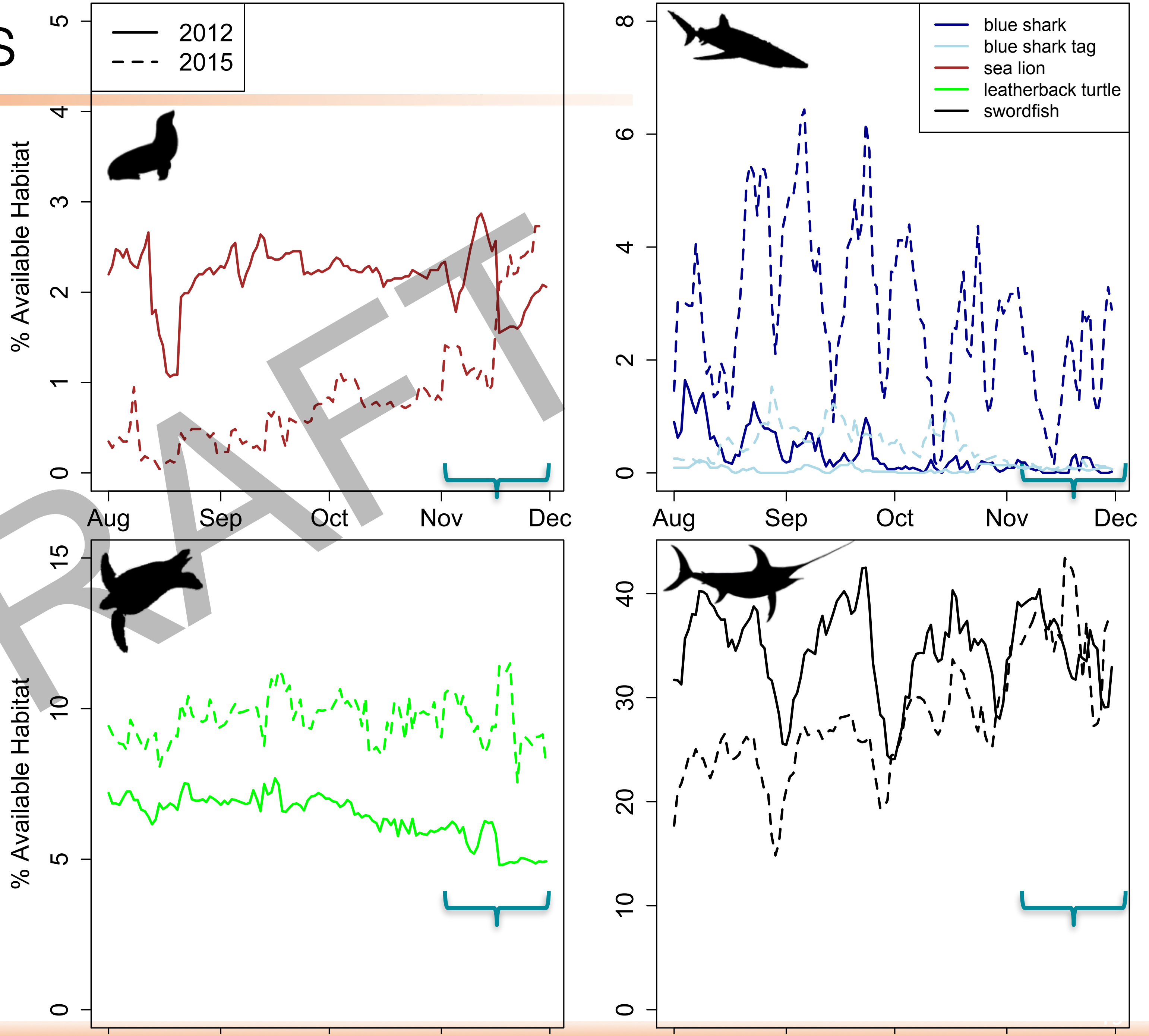


Predicted ENSO effects

1. We can turn predictions into a time series to create indicators.

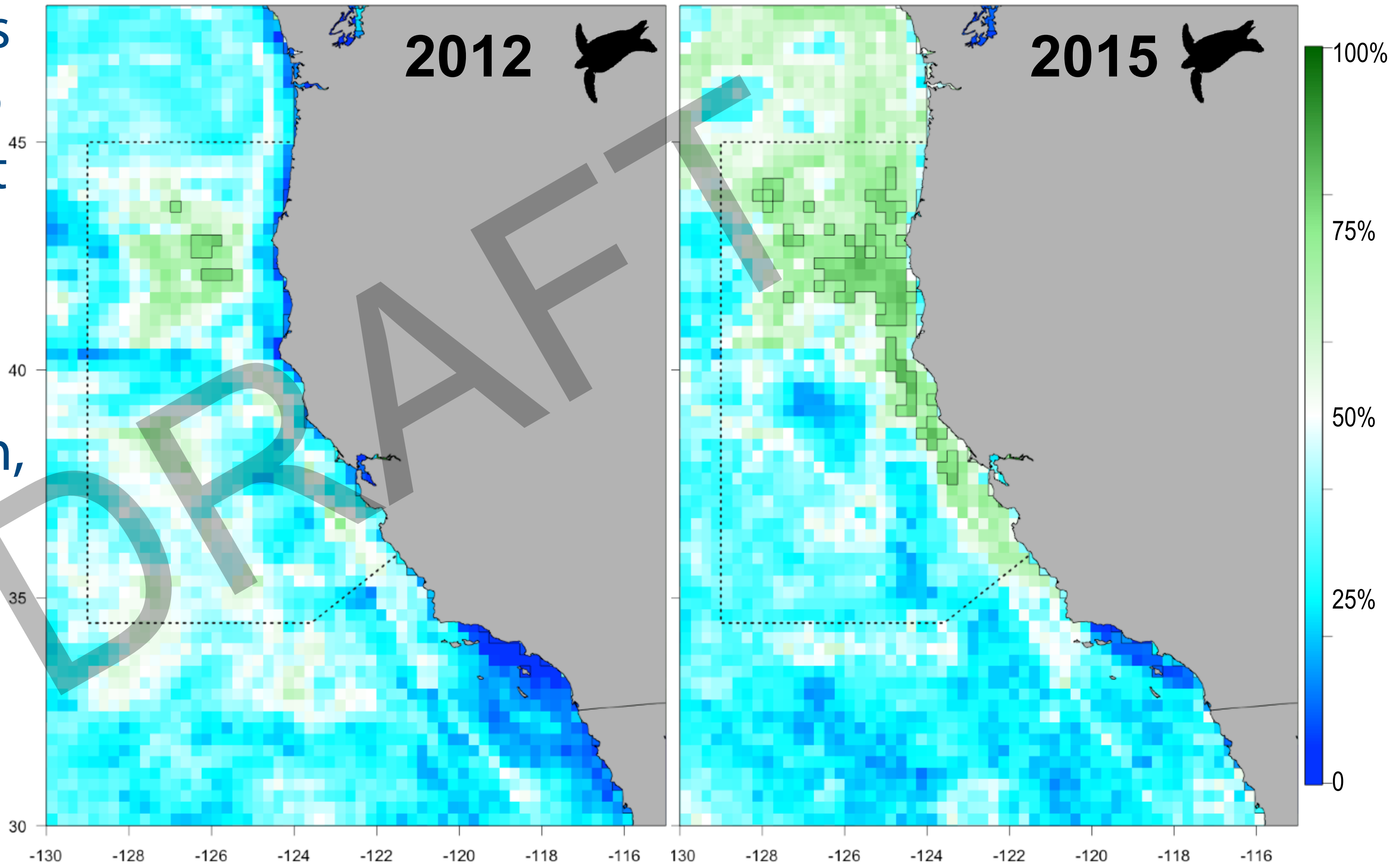
2. Fishing late in the year (Nov-Dec) in 2015 may have been optimal (except for sea lions).

3. Highlights the difficulty in managing across “normal” and “unusual” years.



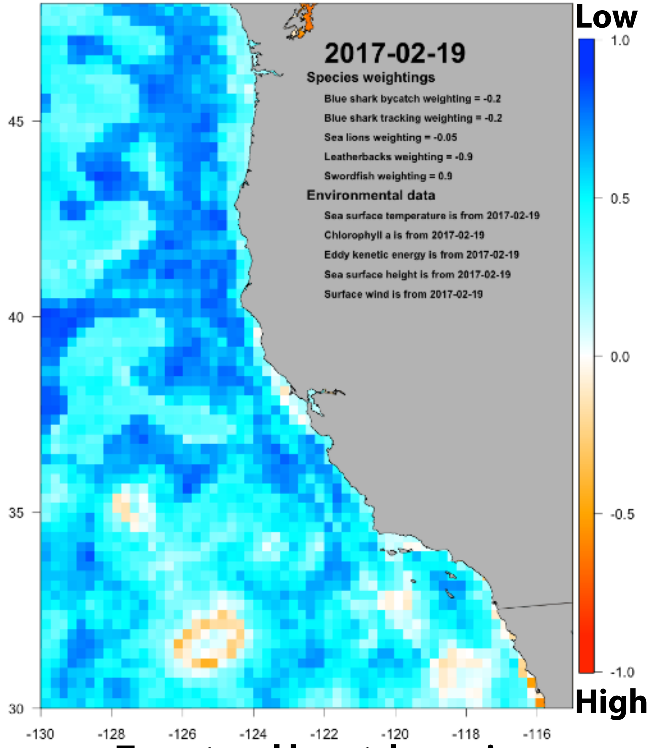
EcoCast predictions - California Drift Gillnet Fishery

- Z = Percentage of days that were predicted to be leatherback habitat
- PLCA captures > 80% of habitat in "normal" year but less in a warm, El Niño year.
- A tool to evaluate efficacy (and timing) of seasonal closures

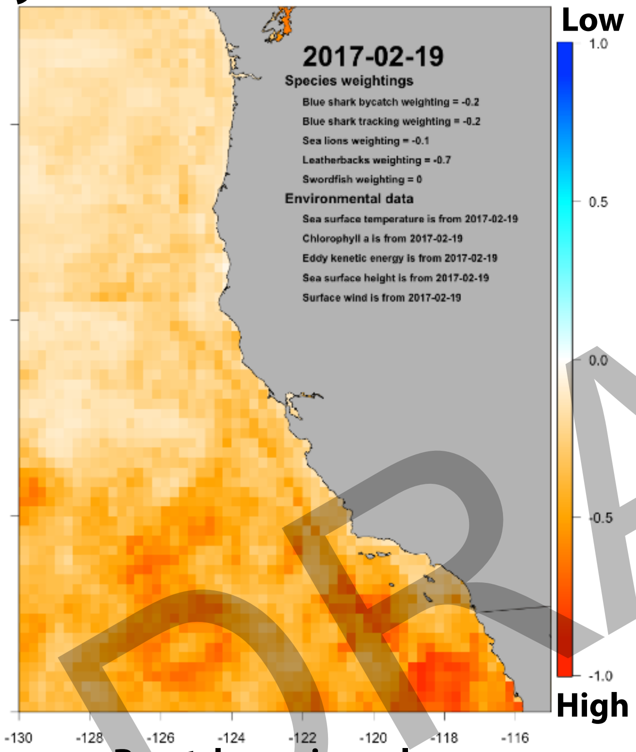


Operationalizing EcoCast: Real-time Website

EcoCast / Bycatch risk

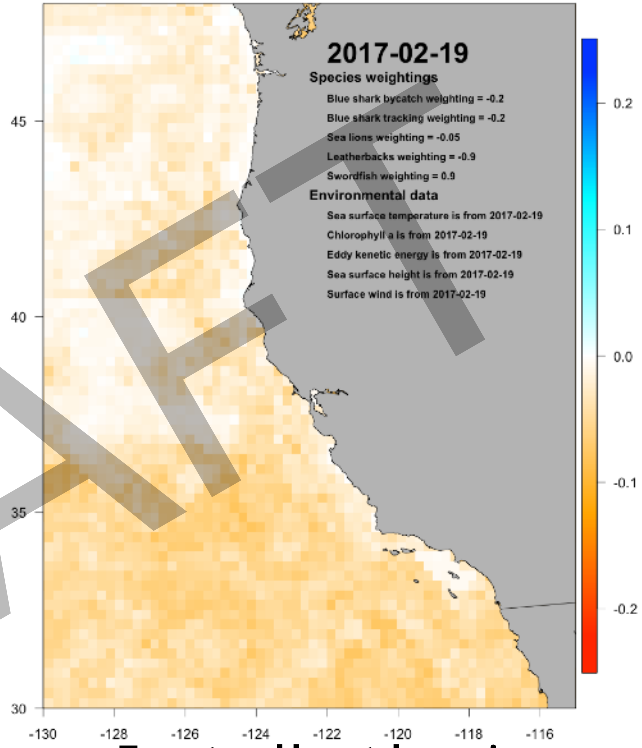


Target and bycatch species

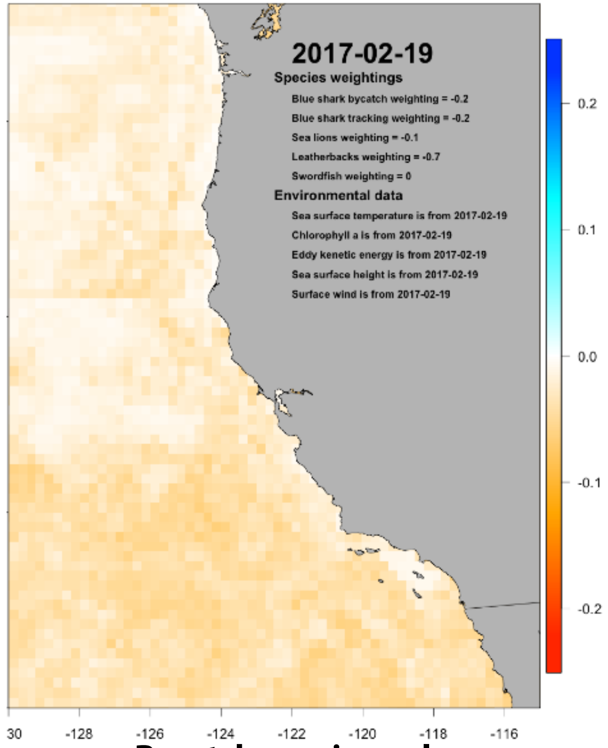


Bycatch species only

Prediction error



Target and bycatch species



Bycatch species only

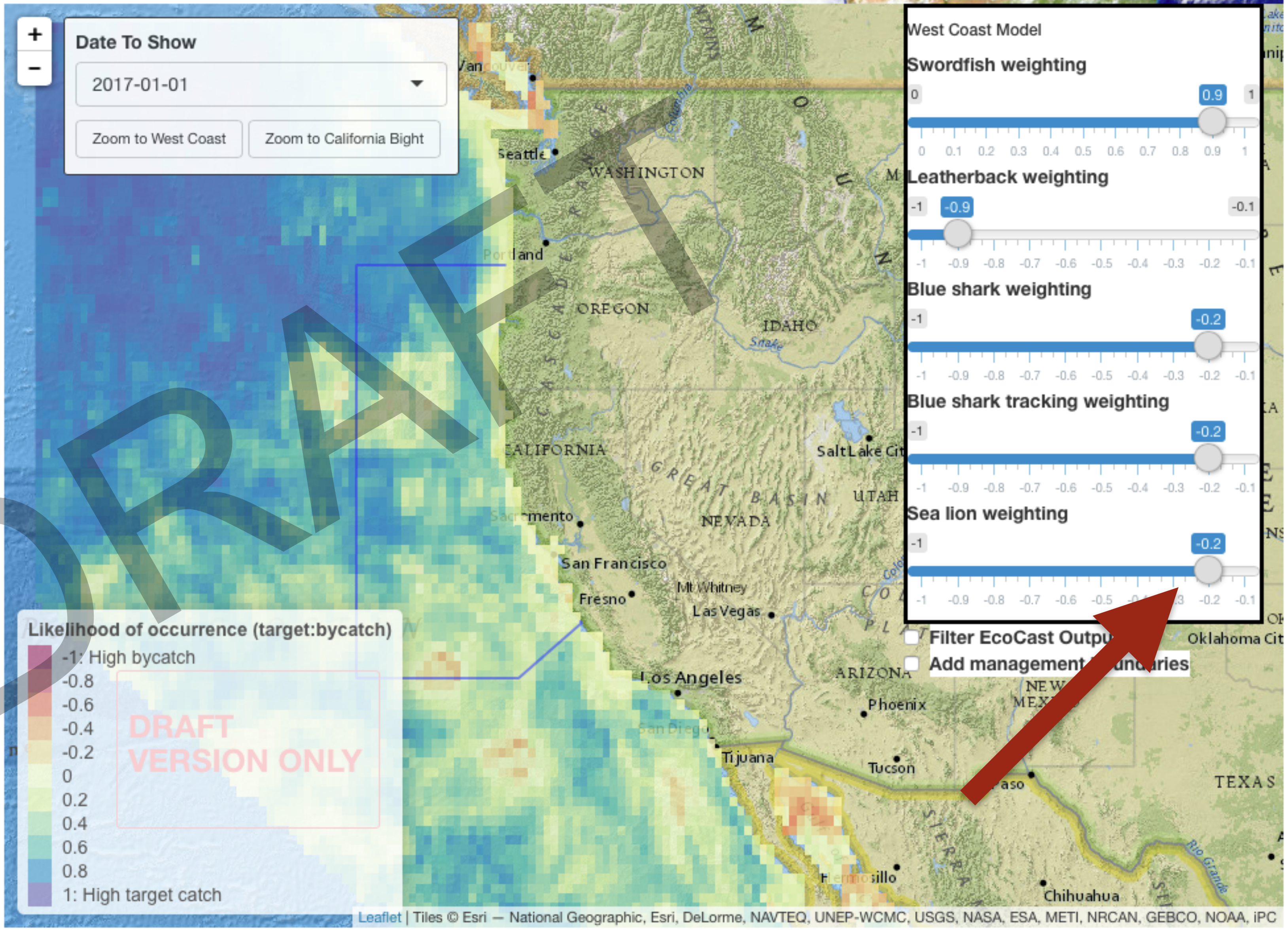
Bycatch risk: the relative likelihood of catching bycatch species versus catching target species at a given location. Areas with **low** bycatch risk are **good** areas to fish, areas with **high** by catch risk are **poor** areas to fish.

Prediction error: a measure of accuracy for the bycatch risk maps. We have most confidence in bycatch risk predictions in areas with lighter color.

Operationalizing EcoCast:

ECOCAST
Monitoring, Modeling, and Forecasting Ecosystem Change

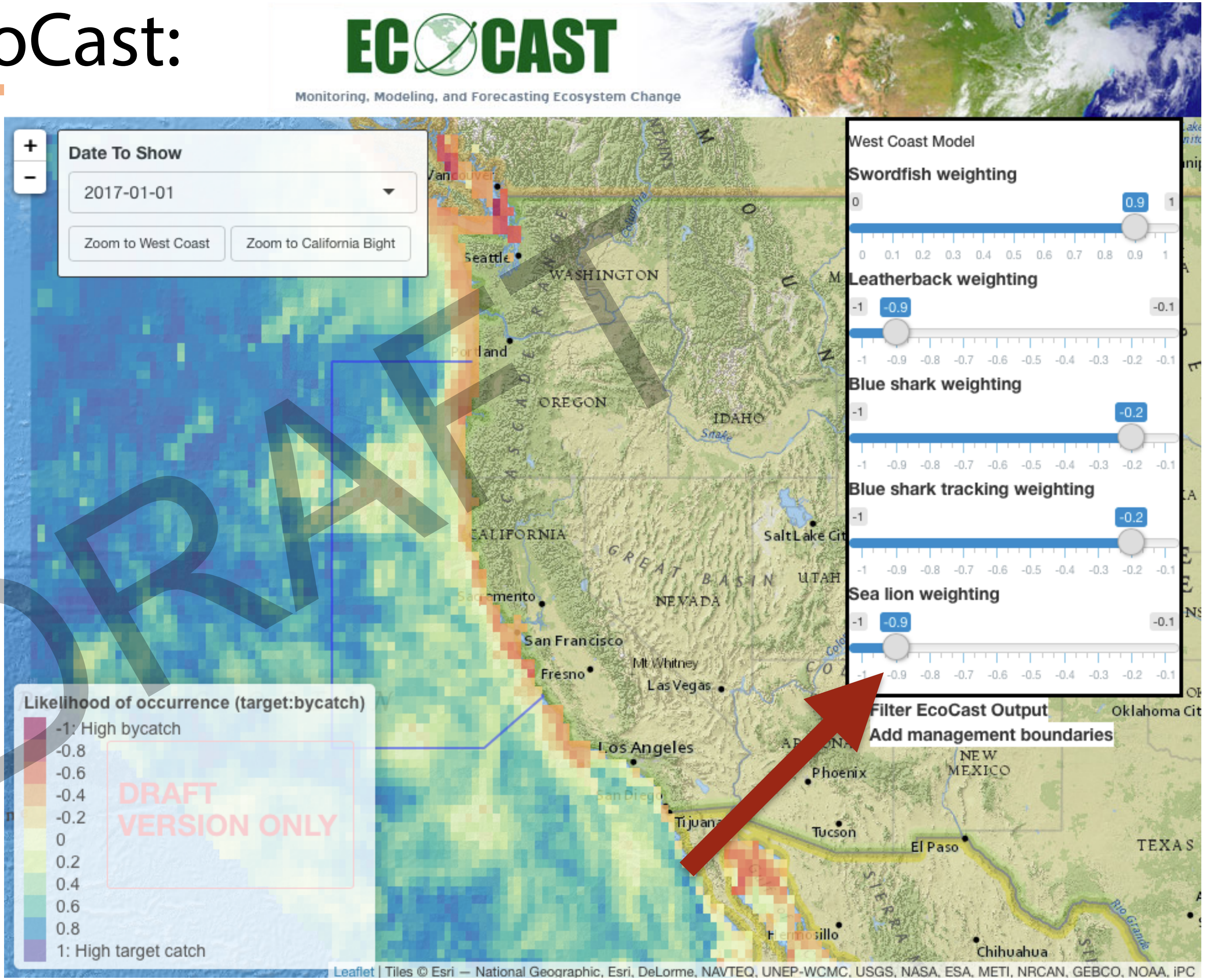
Adjustable bycatch risk weightings



R Shiny app.

Operationalizing EcoCast:

Adjustable bycatch risk weightings

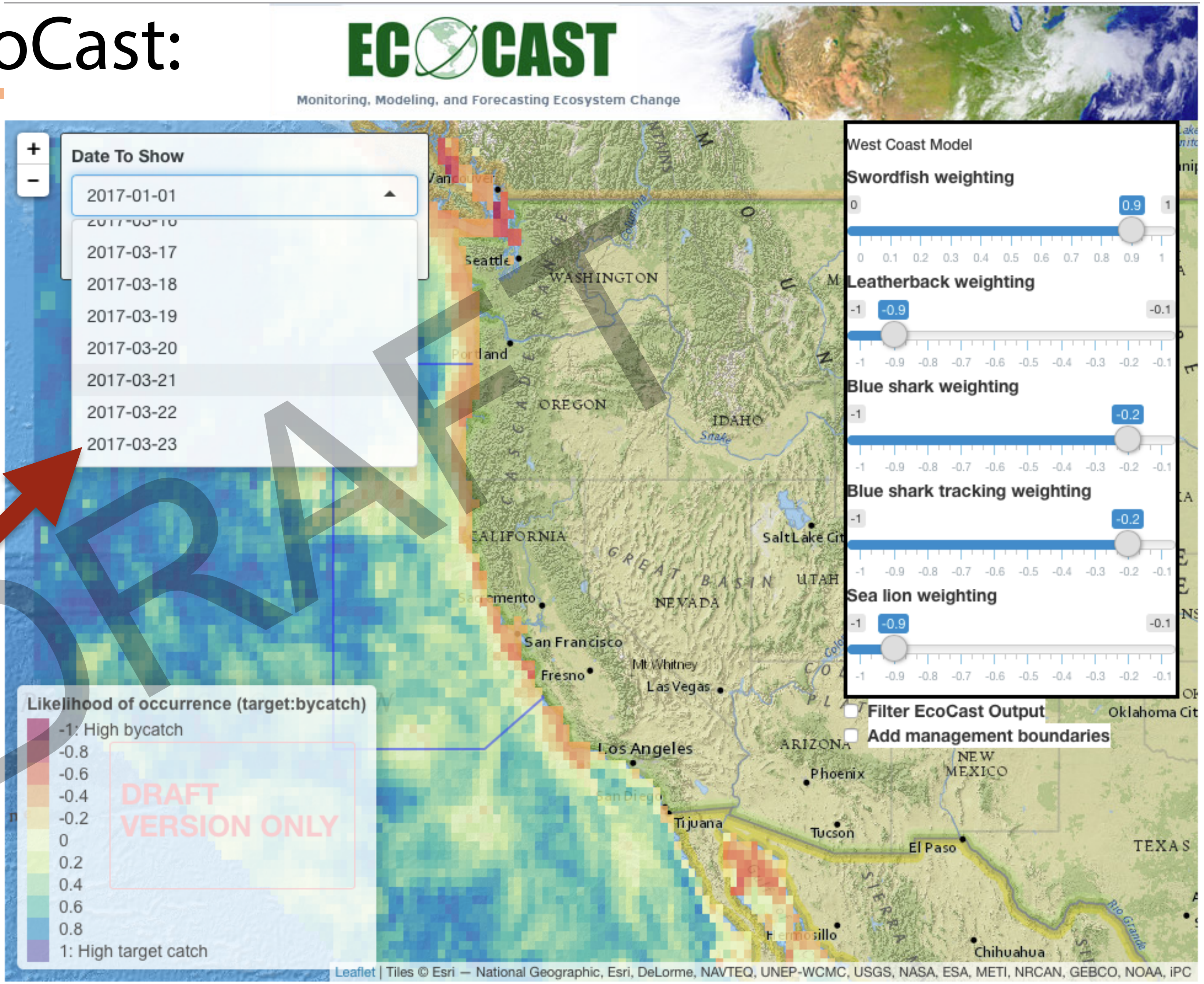


R Shiny app.

Operationalizing EcoCast:

Adjustable bycatch risk weightings

Choose a date



R Shiny app.

FLYWIRE

Electronic Monitoring (EM) System Development for Small Scale Fisheries

Jacob Isaac-Lowry, CEO
859.552.8455
jacob@flywirecameras.com

Introduction

What is FlyWire?

- Technology partner
- Engineering services
- Production manufacturing
- Video capture focus

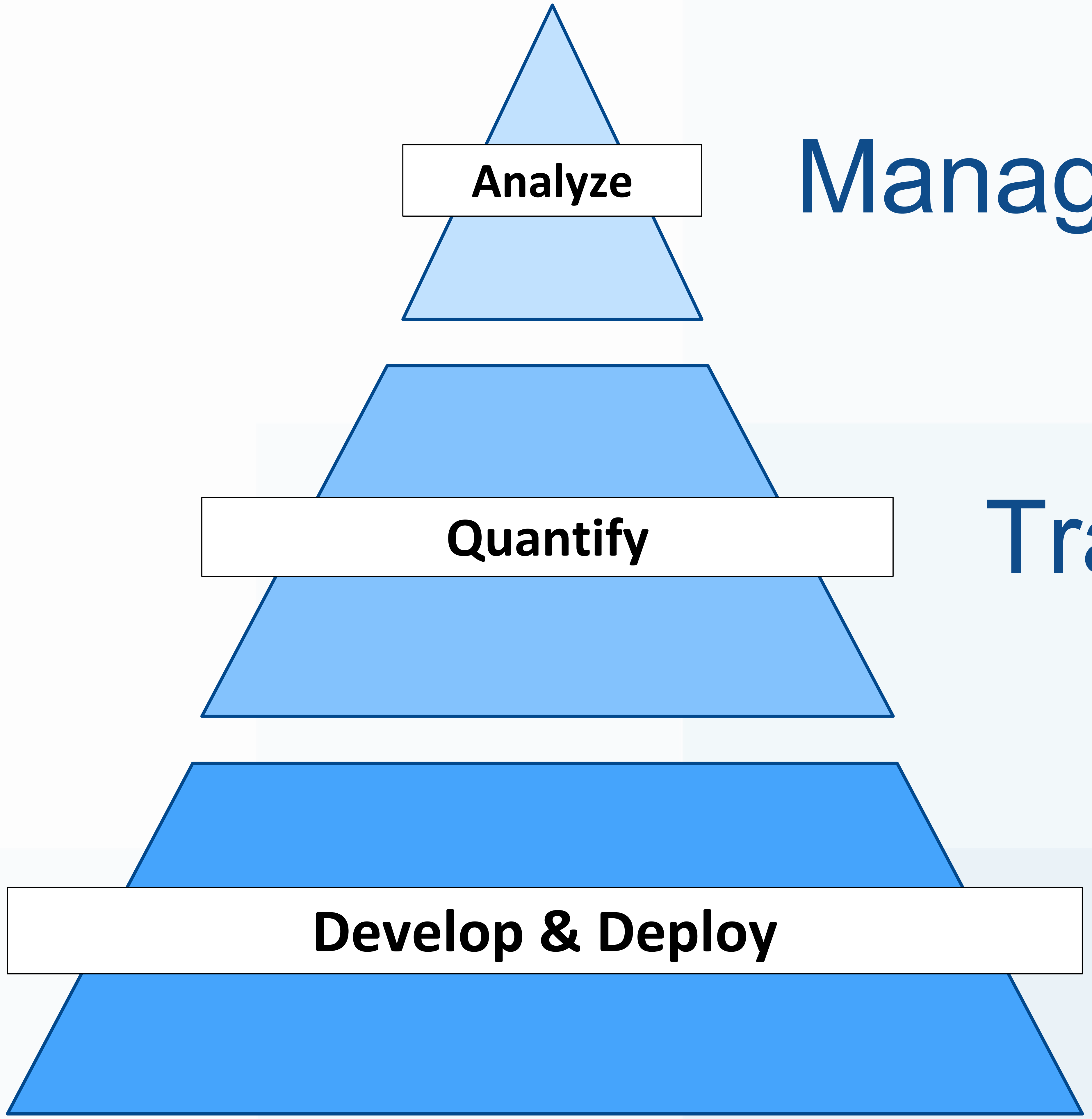
Team Background

- Engineering
- Wildlife biology
- Fisheries science
- A/V technologies

Problem, Product, Solution

- FlyWire EM background
- EM challenges in small scale fisheries

Methods - Development



Management requirements

Translate to technical specifications

Manufacturing, installation, service

Methods - Testing

Study Site

Bahia de los Angeles, MX

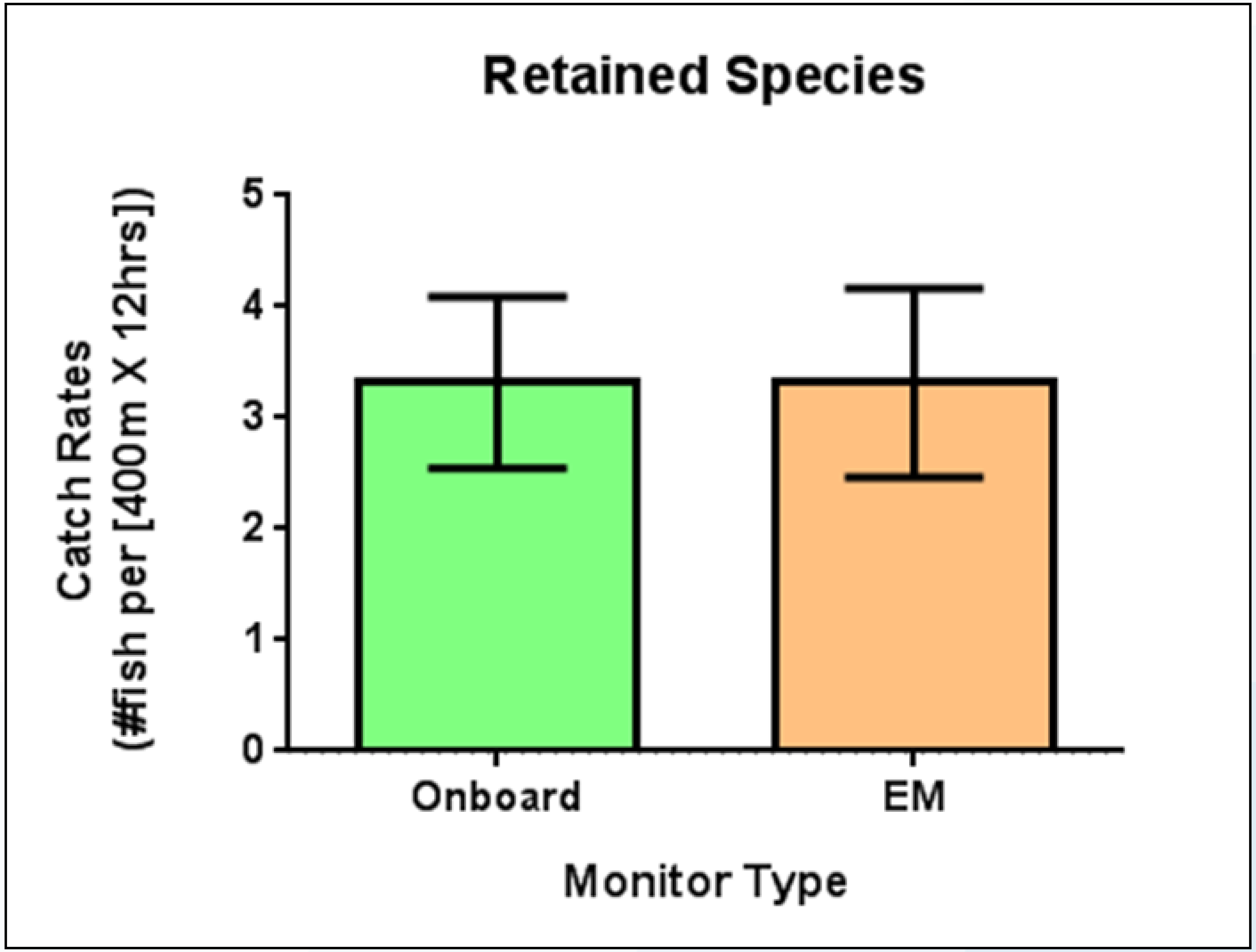
Fishery Type

Vessel: < 6m Ponga
Gear Type: Gill net

Data Scoring

Videos were scored for catch composition

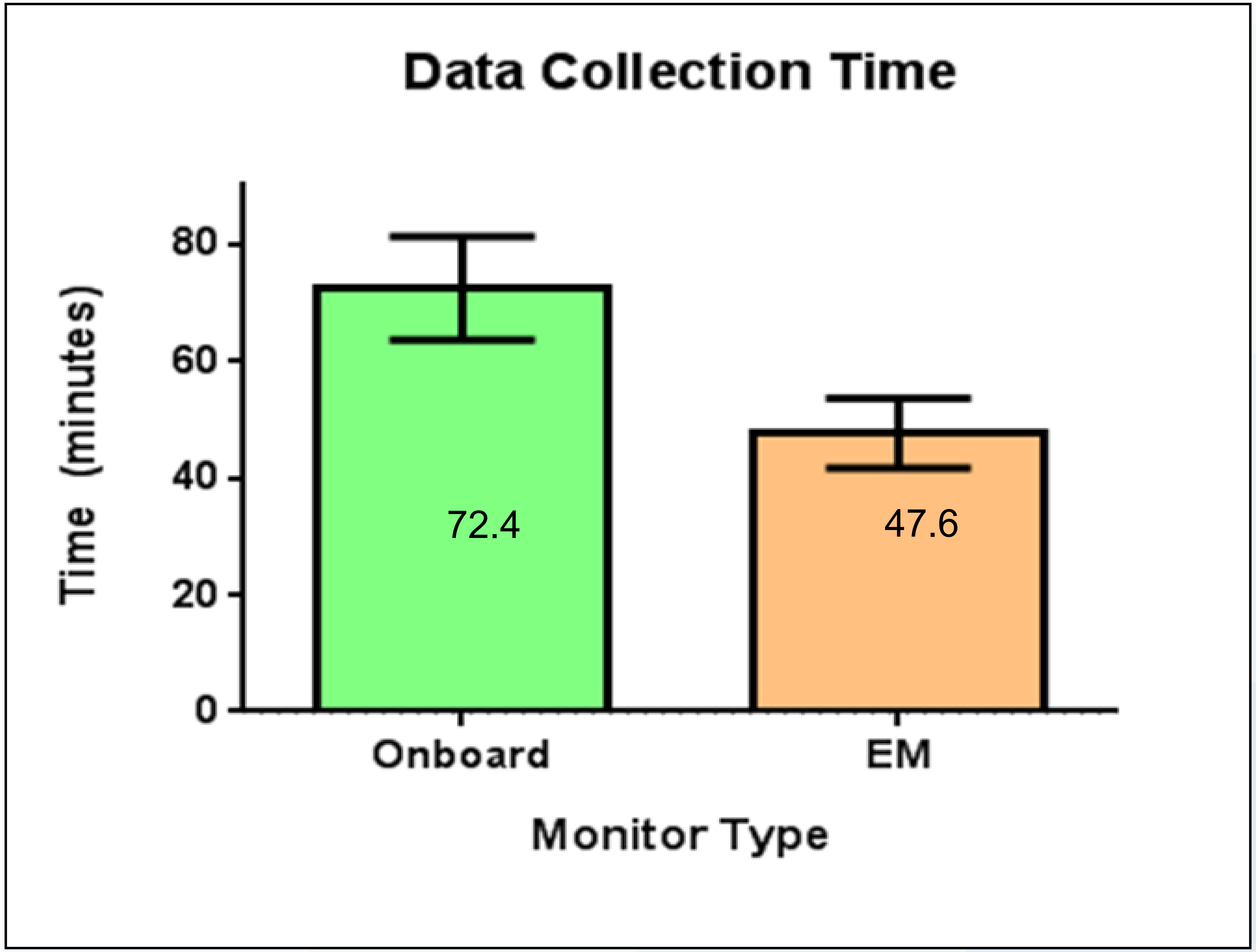
Results – Catch Data



P = > 0.99 (ns)
n = 16 sets

- No significant difference between methods
- Discard results similar

Results – Data Collection Time

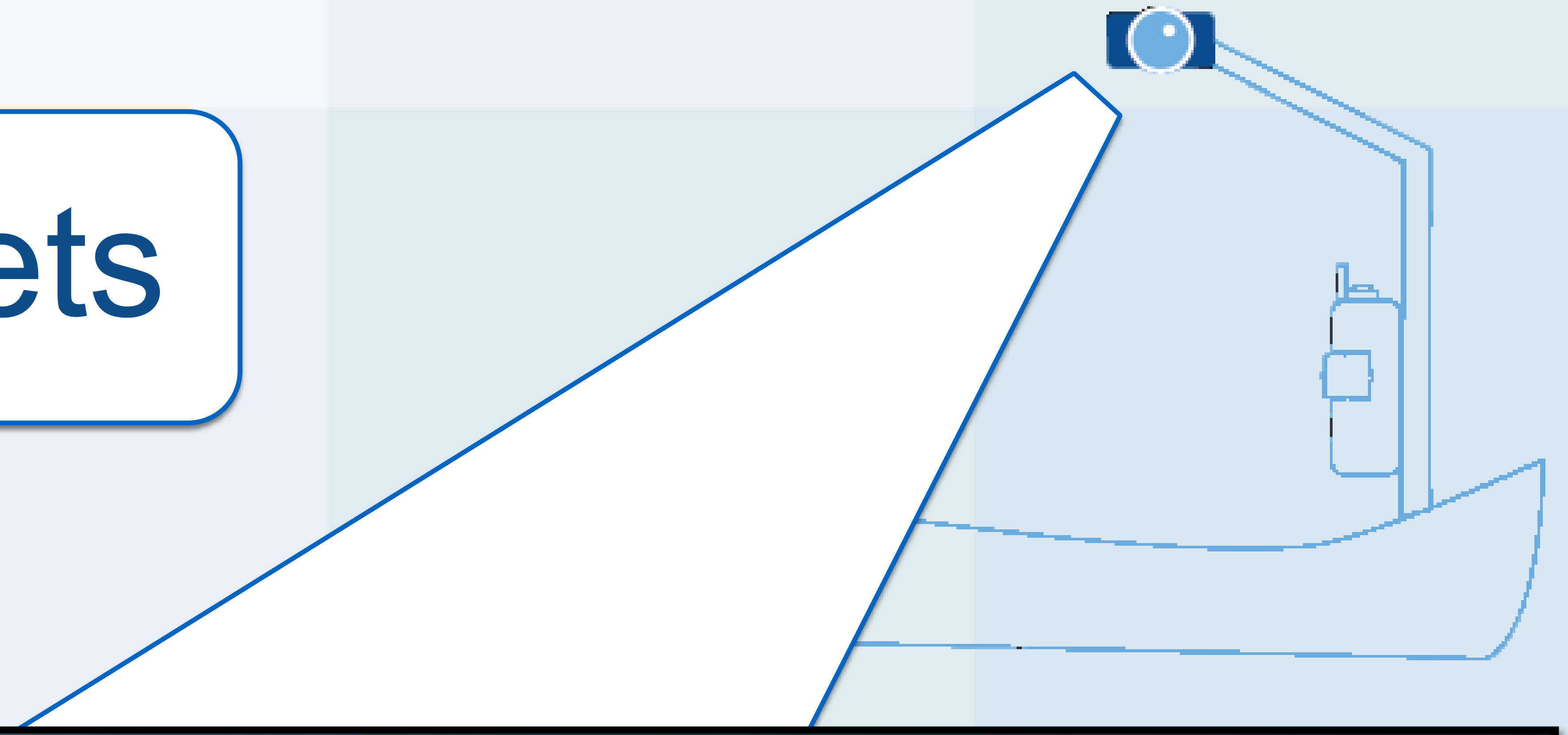


P = > 0.01
n = 16 sets

Data collection faster by EM than by onboard observer

Conclusions - Bahia

Viable solution for unobserved SSF fleets



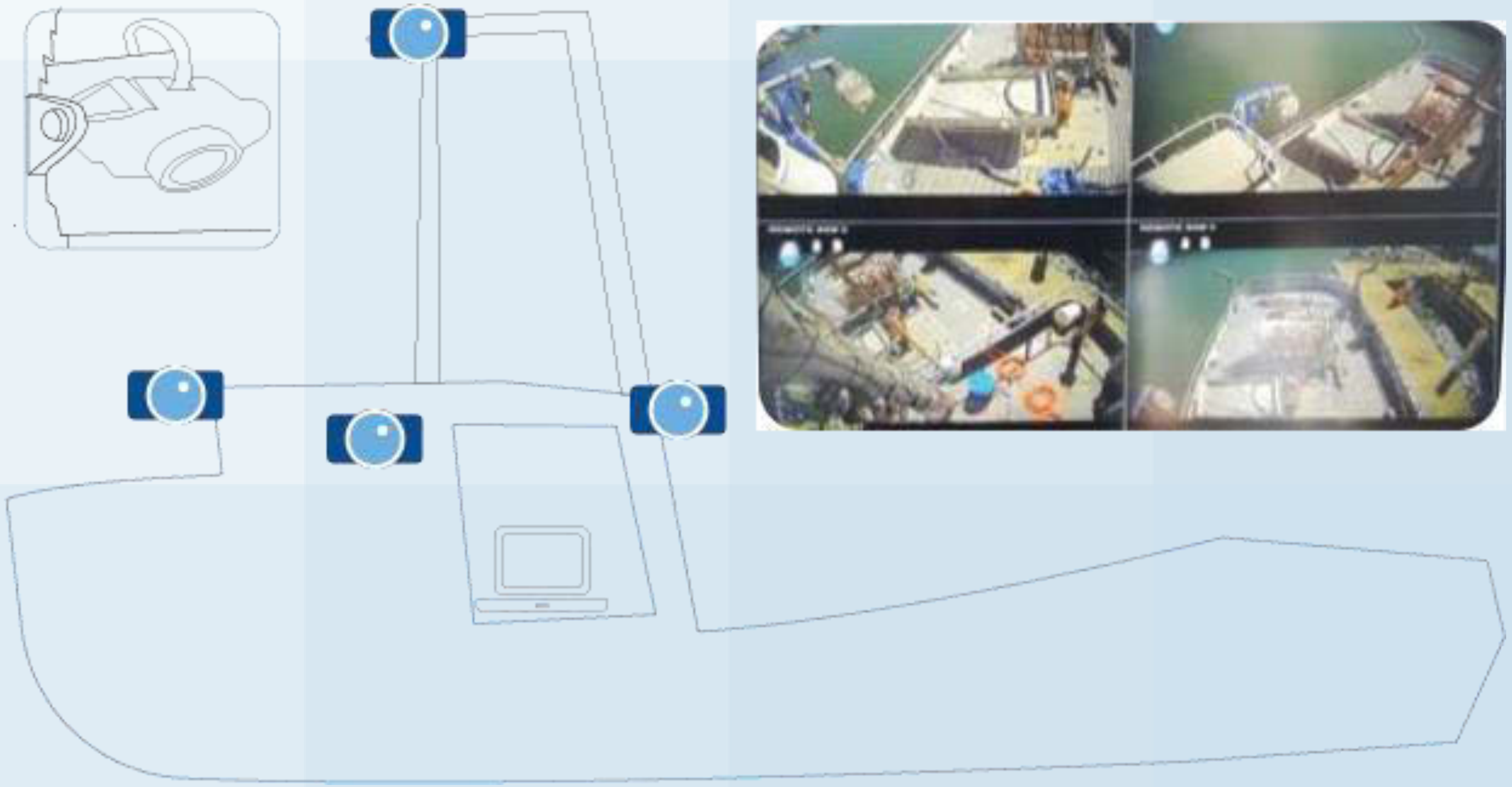
Key Features

- Low cost system
- Easy installation
- Spatial & HD video data
- Passive triggers
- Solar powered
- Secure control panel

Conclusions – Big Picture

Modular systems can be sized to observation needs

- Platform concept
- Low cost
- Portable
- Diverse trigger options
- Multi-channel data sets
- Scalable system



Acknowledgements

Partners

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

OCEAN DISCOVERY INSTITUTE

WWF

Gettysburg COLLEGE

Funding provided by

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

WWF

FLYWIRE

Questions?

Jacob Isaac-Lowry, CEO
859.552.8455
jacob@flywirecameras.com

Developing bycatch reduction technologies for coastal, small scale, gillnet fisheries

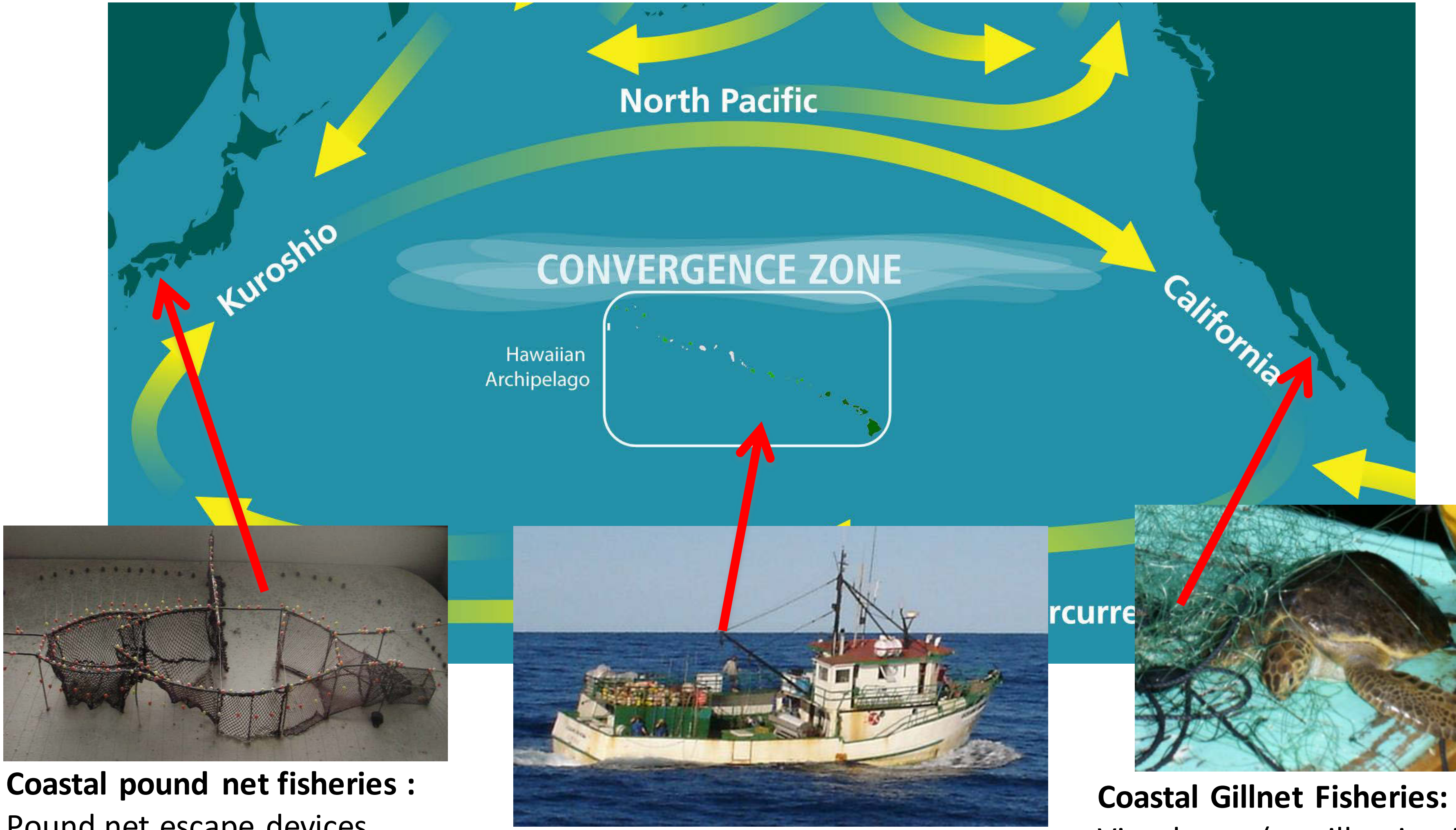
Presenter: John Wang, Ph.D.

NOAA – National Marine Fisheries Service

Pacific Islands Fisheries Science Center

Co-Authors: Yonat Swimmer, S. Fisler, J. Barkan, J. Alfaro-Shigueto, J. Mangel, I. Mustahofa, A. Gautama,

Developing technologies to assess and reduce bycatch in fisheries



Coastal pound net fisheries :
Pound net escape devices

Longline Fisheries:
Circle hooks, offset hooks, appendage hooks

Coastal Gillnet Fisheries:
Visual cues (net illumination)
Auditory cues (ADDs)

Bycatch reduction technology (BRT) projects

I. Sea Turtle BRTs for coastal, small scale gillnets

A. Development of net illumination in Mexico

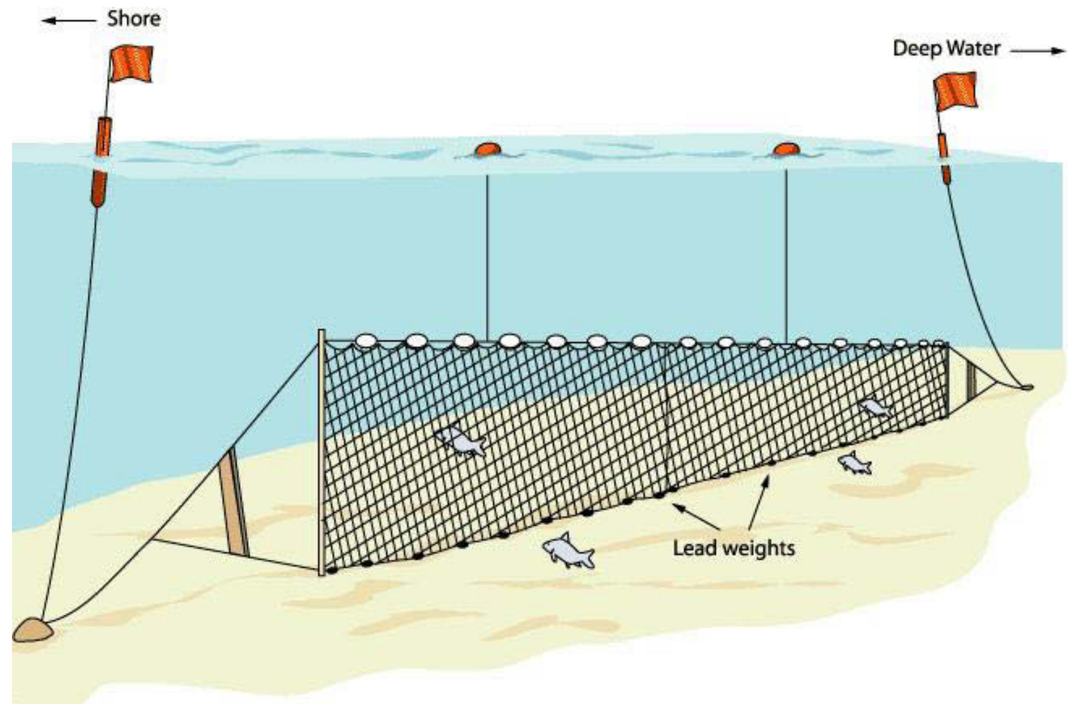
B. Net illumination in Peru
   - multi-taxa potential

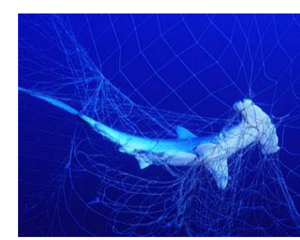
C. Expansion of net illumination in Indonesia – drift gillnet fishery

D. New sensory based BRTs and next steps

I. Coastal, small scale, gillnet fisheries

- Globally ubiquitous
- Often SSF (*artisanal*)
- Poorly regulated
- Poorly monitored
- Low selectivity
- High interaction rates with sea turtles, sea birds, sharks, marine mammals
- *Few bycatch reduction solutions*
- Multi-national issue



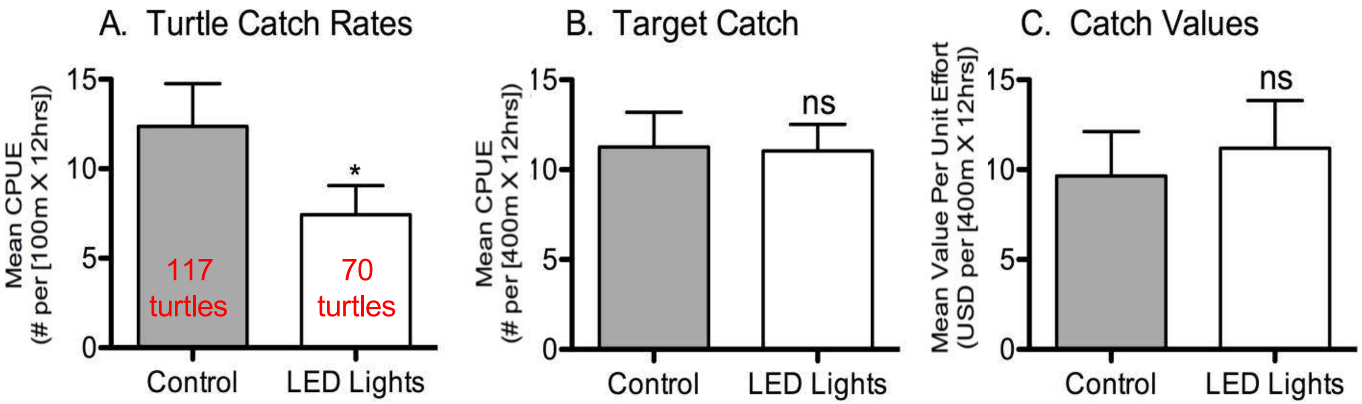


A. Mexico: Development of net illumination:

Developed an experimental system in Baja California, MX.

Proving grounds for bycatch reduction ideas

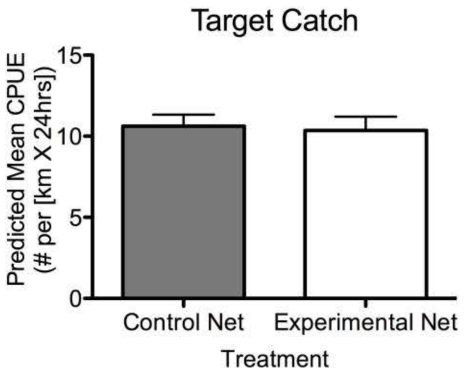
Experimental system
(i.e. Testing grounds)

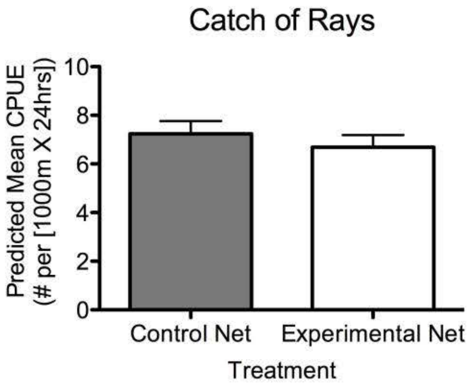


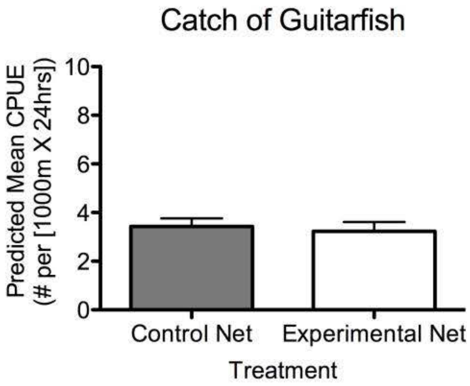
Wang et al 2010

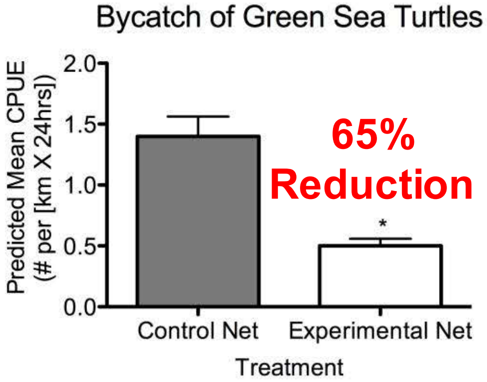
B. Peru: Effects of net illumination in a small scale gillnet fishery

- Results from 114 paired trials – control net vs green illumination
- Showed no change in total target catch rates and primary catch (Guitarfish and Rays)
- Illuminated nets had significant decreases in interaction rates with bycatch species





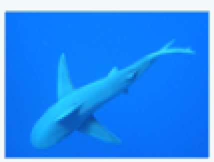




Ortiz et al, 2016 MEPS

Peru: **Net illumination as a multi-taxa BRT:**

- Reductions in sea bird, sharks, and marine mammal bycatch
- Increase selectivity of gillnets

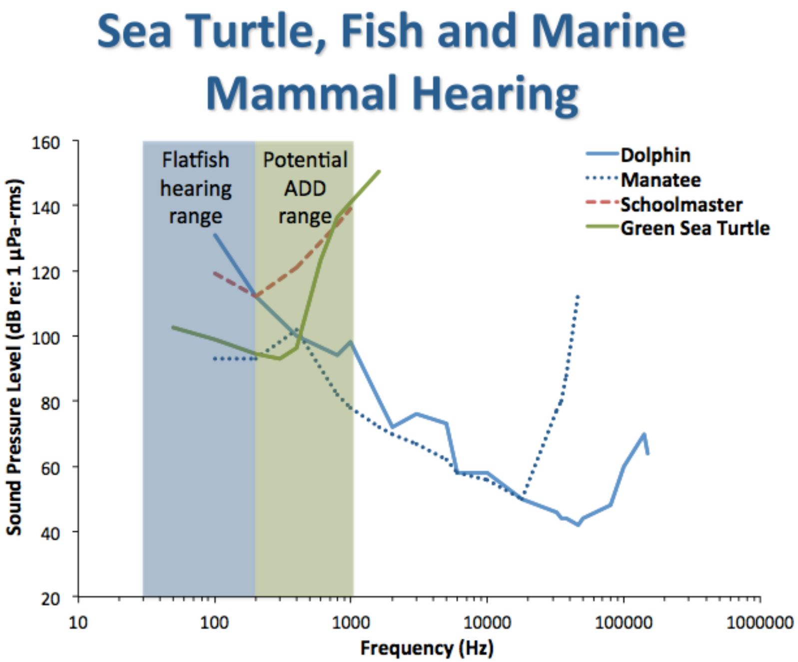
Bycatch	Visual Cue/Illumination	Change in bycatch rates	Target Catch Rate	Target Catch Value
Sea birds Peru 	Green LED Every 10m	85% reduction (*in manuscript*)	NO EFFECT	NO EFFECT
Shark spp Mexico 	UV LED Every 10m	46% reduction (in manuscript)	NO EFFECT	NO EFFECT
Marine mammals Peru 	Green LED Every 10m	experiments ongoing (promising trends)		

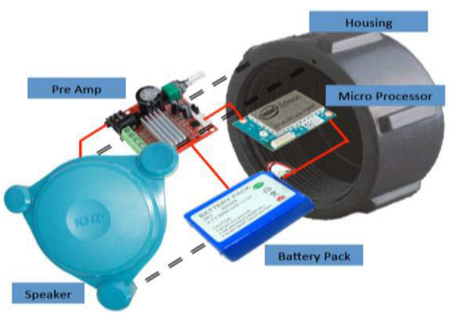
C. Expansion of net illumination trials

1. Drift gillnet fishery off Borneo, Indonesia
2. Small Scale fisheries in Ghana
3. Coastal fisheries in the Mediterranean (Adriatic Sea)
4. Gillnet fisheries in Pakistan
5. Philippines coastal gillnet fishery
6. NC gillnet fishery in Pamilico Sound

D. Testing new BRTs: acoustics deterrents tuned for sea turtles

Baja California, Mx – Developing an acoustic based BRT
In collaboration with Wendy Dow Piniak,
Ocean Discovery Institute, CONANP

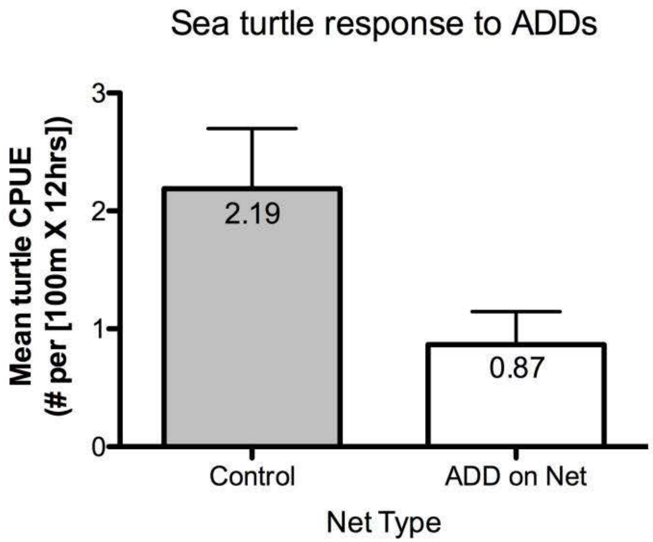




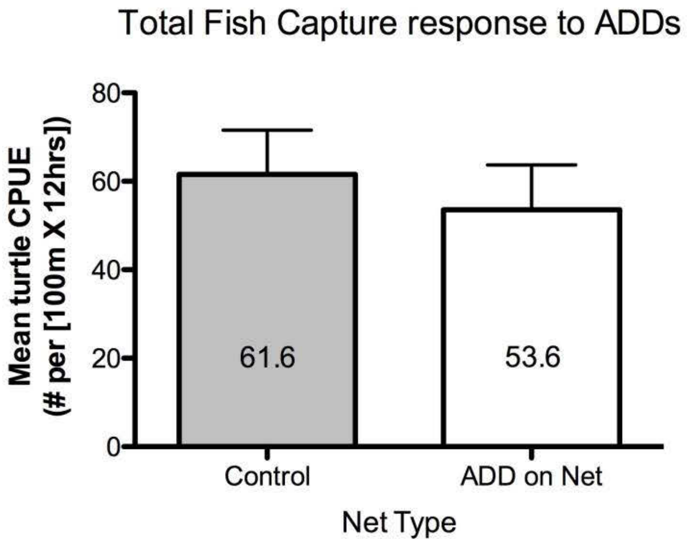
200-500Hz, Source Level: 139 dB re: 1 µPa @ 1m

D. Testing new BRTs: acoustics deterrents tuned for sea turtles

Results from 2015 – 2017 field testing in Baja California



N= 23 paired nets, p<0.02
Wilcoxon Signed Ranks test
60.3% reduction



N=26 paired nets, NS
Wilcoxon Signed Ranks Test
12.9% reduction

Acknowledgements

Co-PIs:
Yonat Swimmer,
S. Fisler, J. Barkan, C. Godinez-Reyes, M. Osmond J. Alfaro-Shigueto, J. Mangel,
I. Mustahofa, A. Gautama, W. Dow-Piniak, T. Todd Jones,, J. Isaac–Lowry.

Funders and Partners:
NOAA-WCRO, NOAA-PIRO, NOAA-BREP,
NOAA-S&T International, NOAA-SWFSC, NOAA FIsheries-Office of International Affairs,
NOAA–Office of Education, Ocean Discovery Institute Supporters,
WWF-Smartgear, WWF-Marine Innovation Fund
WWF-Indonesia, Bogor University, ProDelphinus

Fishers:
Fishers and community of Punta Abreojos and Bahía de los Angeles
Grupo Tortugero de las Californias, Baja California
Fishers and communities of Constante, San Jose, Bayovar, Peru
Fishers and community of Paloh, West Kalimantan

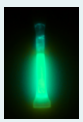
Special Thanks to: C. Fahy,, I. Kelly, E. English, A. Guiterrez,
K. Channon, L. Benaka, B. Higgins, D. Lawson, J. Seminoff, P. Dutton,
K. Bigelow, C. Boggs, Pro Delphinus, WWF-Indonesia, Grupo Tortugero.

CONANP, IMARPE, IMMAF (KKP)

ODI Staff and Students of Hoover High School (San Diego, CA)
A. Figuero, KC Dam, B. Lederer, and many ODI staff.

Net illumination as a visual based BRT:

Reduces sea turtle interactions with gillnets
Maintains target catch rates and catch value

Location	Visual Cue/Illumination	Turtle Catch Rates	Target Catch Rate	Target Catch Value	Citation
Mexico 	Green Chemi-lights Every 5 m (night)	59% decrease	NO change	NO change	Wang et al, 2010
Mexico 	Green LED Every 10 m (night)	40% decrease	NO change	NO change	Wang et al, 2010
Mexico 	UV LED Every 5 m (night)	40% decrease	NO change	NO change	Wang et al, 2013
Mexico 	Orange LED Every 5 m (night)	50% decrease	NO change	NO change	Wang et al, (In Manuscript)

Can the United States Have Its Fish and Eat It Too?

Mark Helvey, Caroline Pomeroy, Naresh C. Pradhan
Dale Squires, and Stephen Stohs

POCTRT Meeting
June 15, 2017

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
NOAA

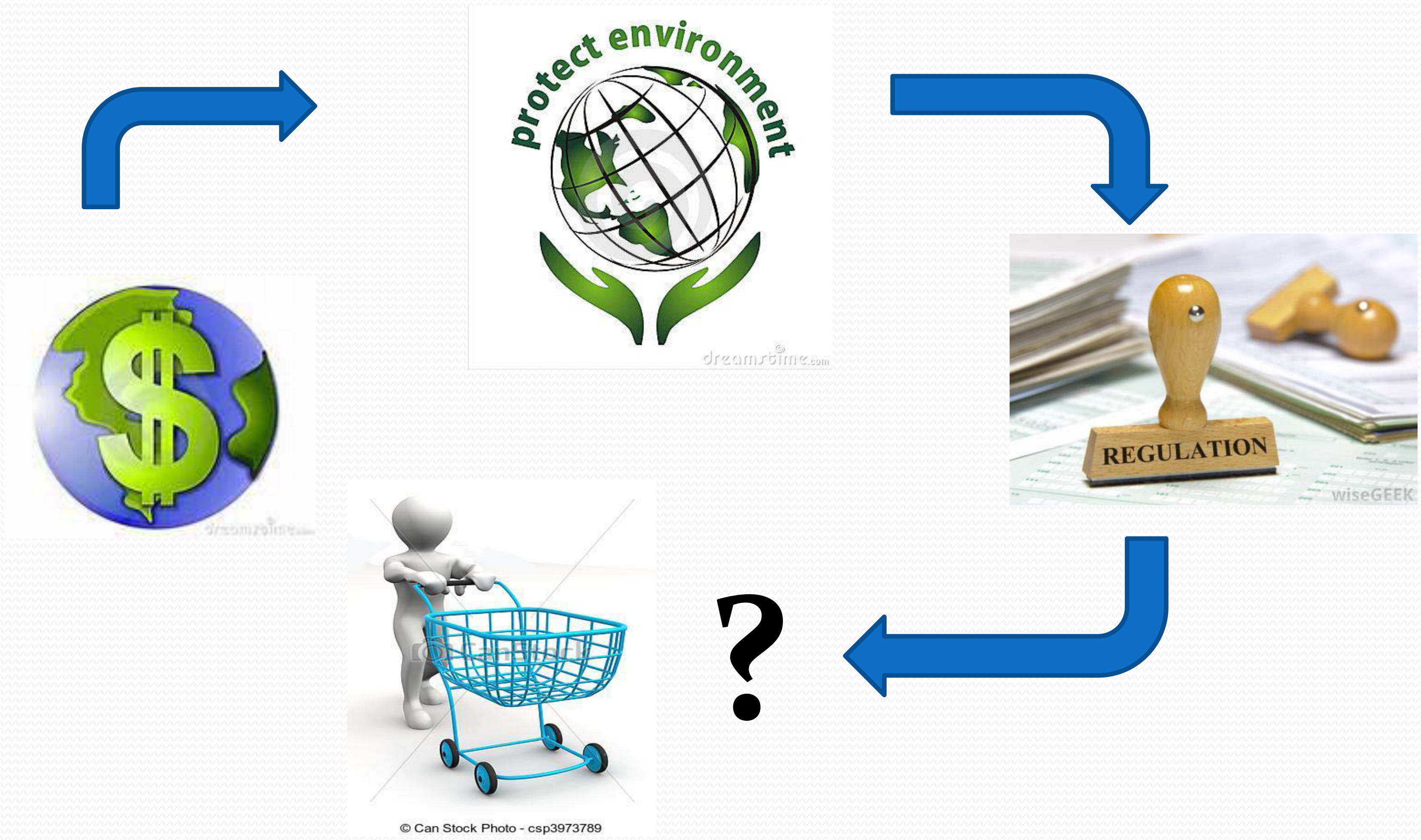
Sustainable Seafood Consultants

Sea Grant California

Overview

- Consumption-environmental protection paradox
- U.S. seafood consumption
- Case studies of “leakage” from U.S. fisheries
- Suggested solutions

Consumption – Environmental Protection Paradox



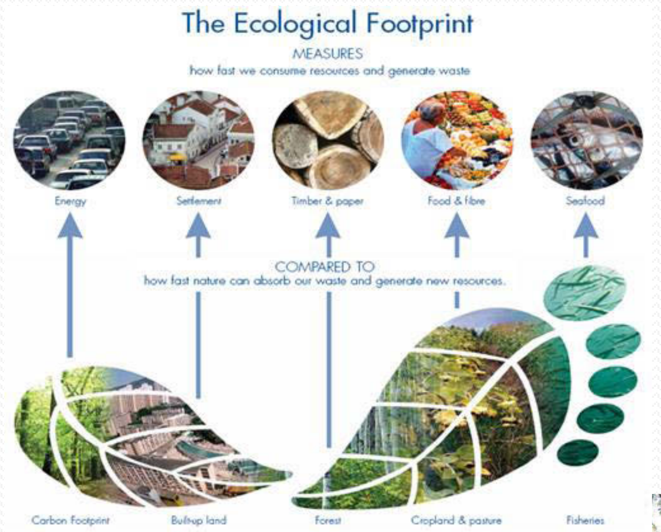
Consumption – Environmental Protection Paradox (cont.)

- Consumption = Production + Imports – Exports
- Consumption = Production + Imports – Exports

- "Feel good syndrome"
- Rothman (1998) suggested that when international trade is considered, the behavior of the end-consumer rather than the producer is the principal driver of associated environmental impacts
- Measure environmental impacts by consumption-based approaches and not production-based approaches

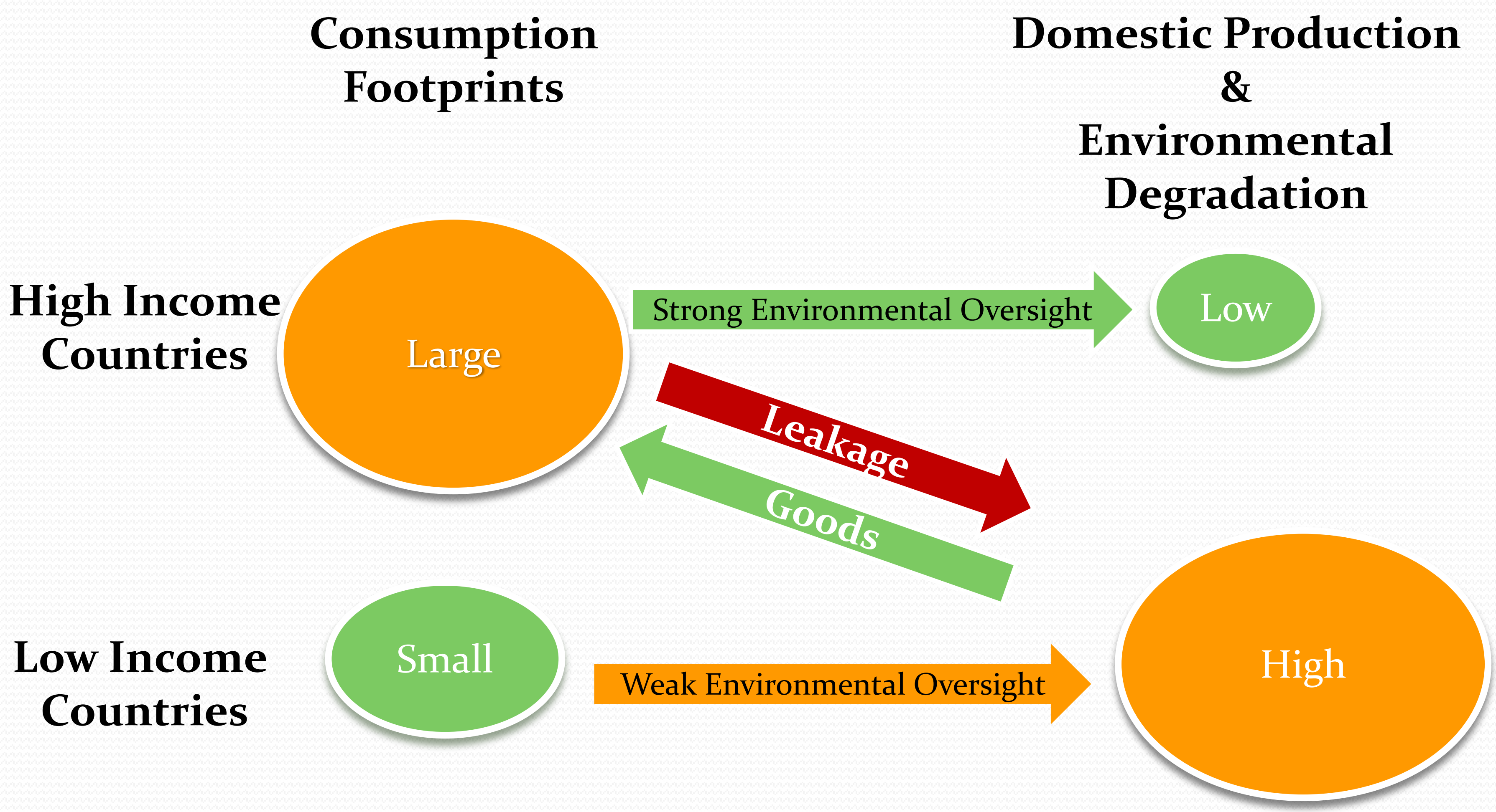
Consumption-Based Approaches for Measuring Impacts

- Footprint Indicators
  - Carbon
  - Ecological
  - Land
  - Material
  - Biodiversity
  - Water
- Life cycle Analysis



Global Resource Consumption

Source	Objective	Method	Conclusion
Dietz et al. (2007)	Attribute environmental stresses to consumer country	Ecological footprint	U.S. has largest footprint
Bradshaw et al. (2010)	Assess country relative environmental impact across 7 variables	Ecological footprint	U.S. (and Brazil, China, Indonesia, Japan, Mexico, India, Russia, Australia, Peru) have highest absolute environmental impact
Lenzen et al. (2012)	Net trade balances of 187 countries for implicated import commodities	Biodiversity footprint	U.S., EU, Japan demand for traded commodities posing greatest threats to biodiversity
Selles (2013)	Nations' contributions to global natural resource consumption and ecological degradation	Ecological footprint	China, U.S., India, Brazil, Russia, Indonesia, Mexico, Australia, Japan and Germany have highest overall impact
Wiedmann et al. (2013)	Material flows of global production/consumption networks of 186 countries	Material footprint	U.S. is largest importer of primary resources embodied in trade in absolute values



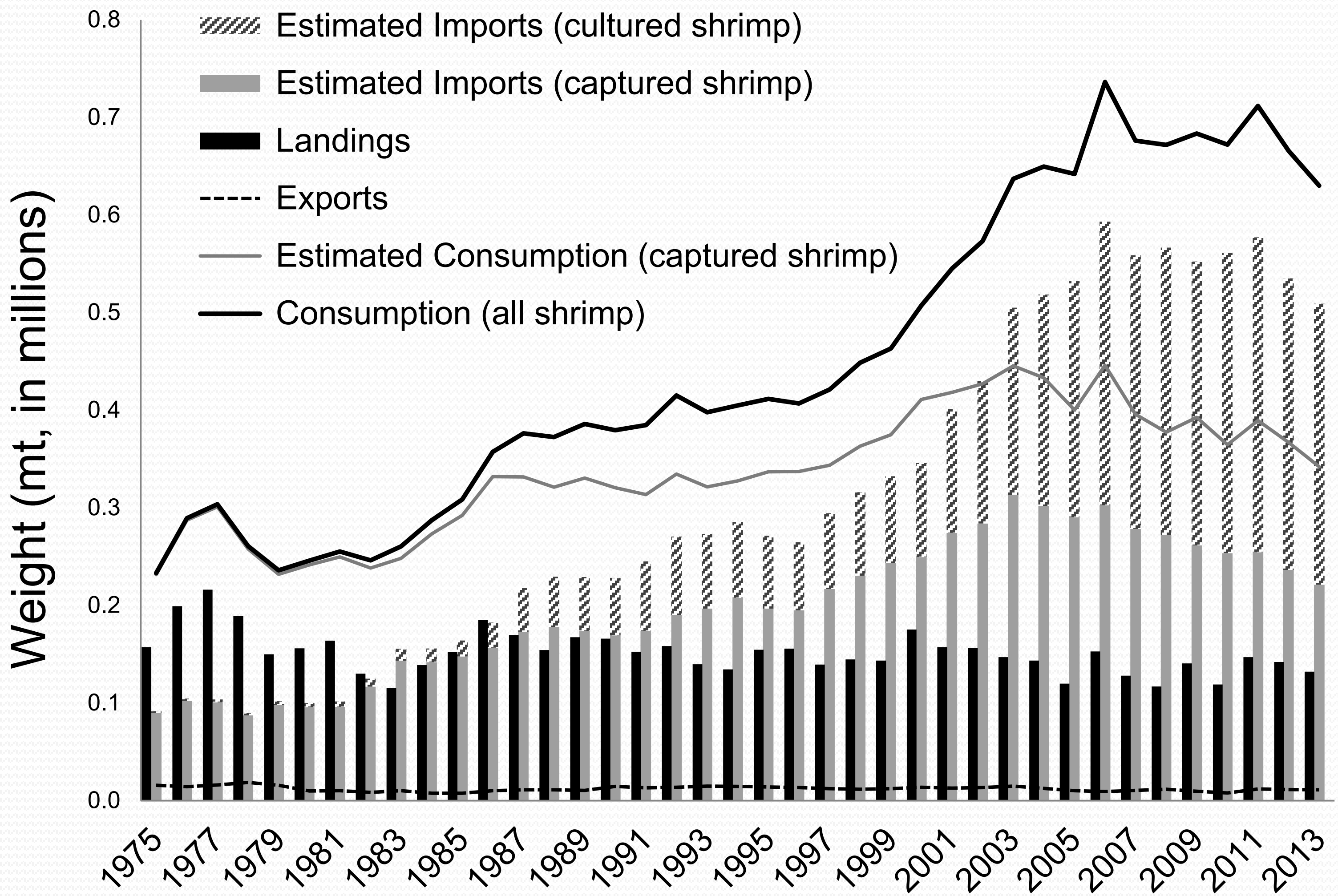
Consumption Footprints
Domestic Production & Environmental Degradation
High Income Countries
Large
Strong Environmental Oversight
Low
Leakage
Goods
Low Income Countries
Small
Weak Environmental Oversight
High

- Consumption-environmental protection paradox
- **U.S. seafood consumption**
- Case studies of “leakage” from U.S. fisheries
- Suggested solutions

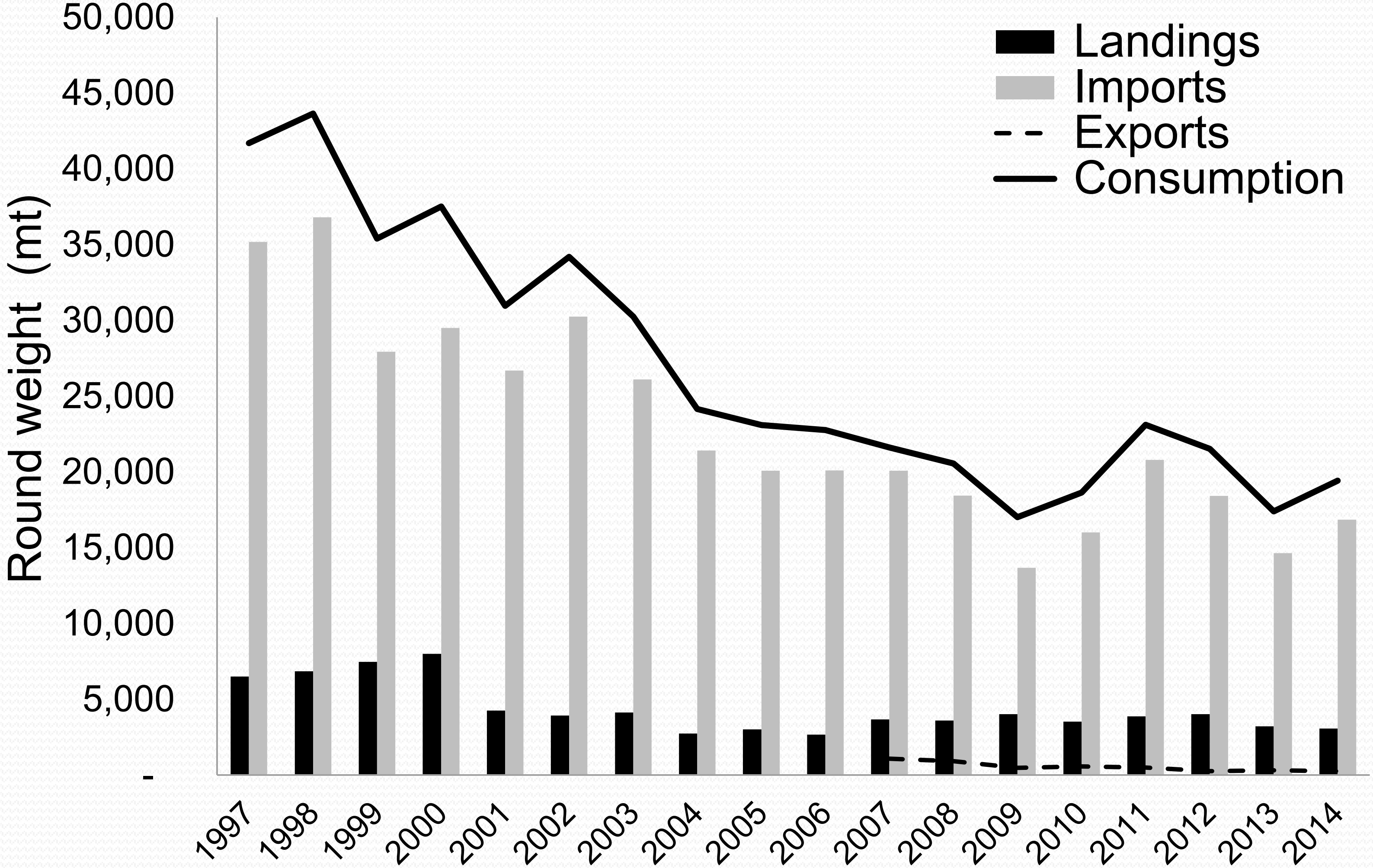
Annual average landings, trade, and consumption of edible fishery products in the U.S. (round weight, million mt)

Period	Landings	Imports	Exports	Consumption	Imports/ Consumption
1990-95	3.4	2.6	1.8	4.2	61%
1995-00	3.3	3.0	1.9	4.4	68%
2000-05	3.3	4.0	2.5	4.8	83%
2005-10	3.3	4.8	2.6	5.5	87%
2010-14	3.4	4.9	2.9	5.4	90%

U.S. Consumption, Landings, and Trade: Shrimp



U.S. Consumption, Landings, and Trade: Swordfish



- Consumption-environmental protection paradox
- U.S. seafood consumption
- **Case studies of “leakage” from U.S. fisheries**
- Suggested solutions

Case Studies of Leakage in U.S. Fisheries

- Sarmiento (2006)
  - Swordfish imports, primarily from Ecuador and Panama, increased appreciably
- Rausser et al. (2009)
  - 1,602 mt of imported swordfish associated with 2,882 additional (net) sea turtle interactions from foreign fisheries combined
- Chan and Pan (2016)
  - 1,841 fewer turtle interactions globally by displacing imports from higher sea turtle bycatch fisheries

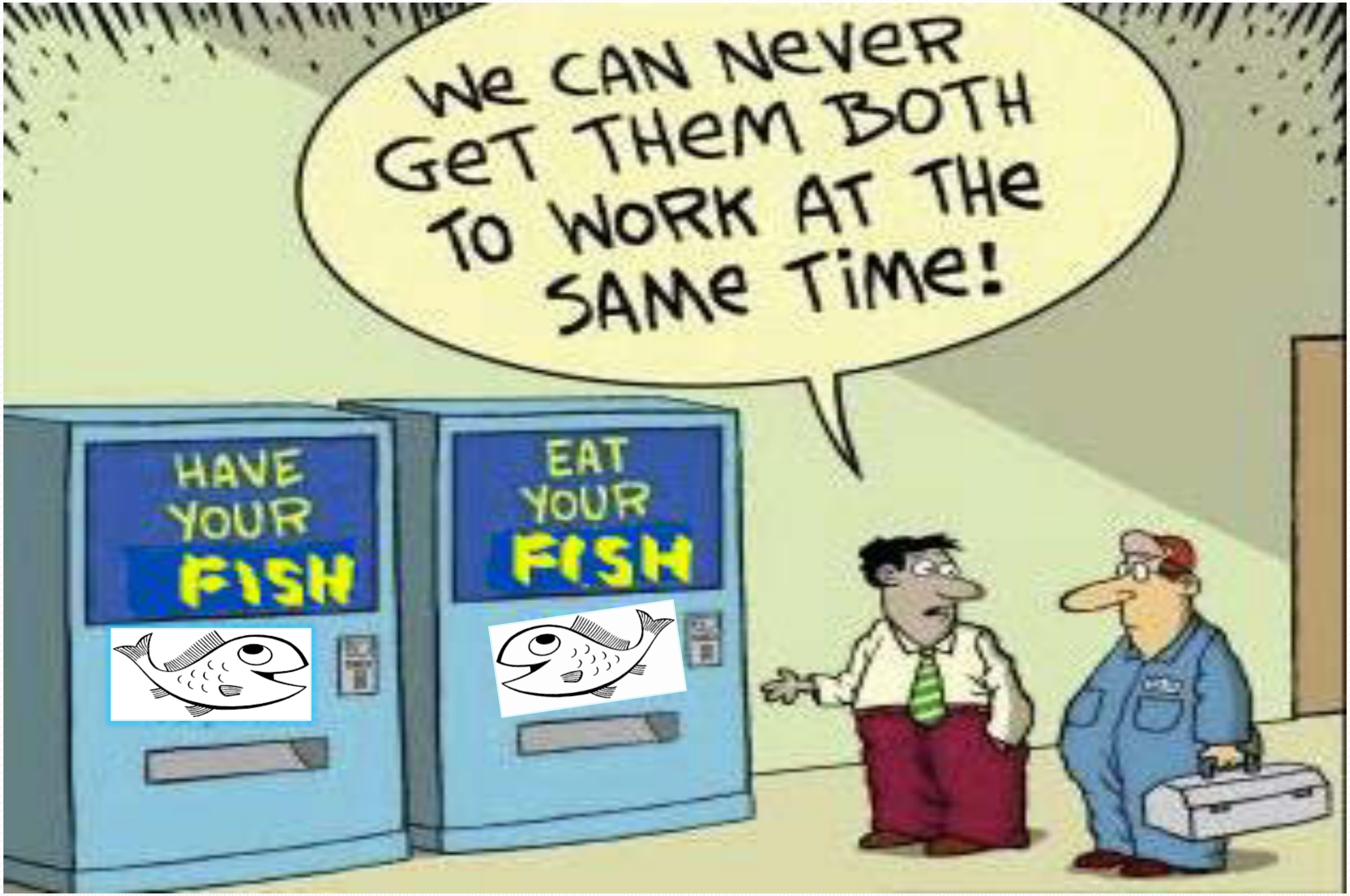
Case Studies of Leakage in U.S. Fisheries (cont.)

- Squires et al. (2016)
  - U.S. production leakage of $27.5 million due to curtailed West Coast drift gillnet fishery
  - Bycatch of 1,457 endangered leatherback sea turtles compared to 45 turtles, had U.S. fishing grounds remained open
- Cunningham et al. (2016)
  - Evidence of production leakage between the NEFMC and MAFMC from Groundfish Sector catch share program

- Consumption-environmental protection paradox
- U.S. seafood consumption
- Case studies of "leakage" from U.S. fisheries
- **Suggested solutions**

Solutions to Policy-Induced Leakages

- Increase awareness of U.S. fishery management's high sustainability standards
- Develop U.S. domestic aquaculture
- Support sustainable fishing practices in other nations
- Seek multilateral cooperation on conservation policy
- Recognize management decision externalities
- Treat fisheries as part of the U.S. food production system


We CAN Never Get THem BOTH To WORK AT The SAMe Time!
HAVE YOUR FISH
EAT YOUR FISH

Eating seafood means harvesting it somewhere!

Thank you!

Author contacts:
markhelvey2@gmail.com (M. Helvey)
cpomeroy@ucsd.edu (C. Pomeroy)
npradhan@nefmc.org (N.C. Pradhan)
dale.squires@noaa.gov (D. Squires)
stephen.stohs@noaa.gov (S. Stohs)

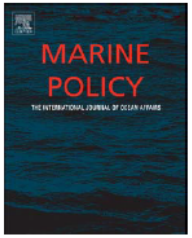
Further Reading: ***Marine Policy (2017): 75:62-67***

Marine Policy 75 (2017) 62–67

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol



Can the United States have its fish and eat it too?

Mark Helvey[a,b,*,1], Caroline Pomeroy[c], Naresh C. Pradhan[d], Dale Squires[e], Stephen Stohs[e]

[a] *NOAA National Marine Fisheries Service, West Coast Region, Long Beach, CA, USA*
[b] *Sustainable Seafood Consultants, 16 Saucito, Foothill Ranch, CA 92610, USA*
[c] *California Sea Grant Extension Program, University of California, Long Marine Lab, 100 Shaffer Rd, Santa Cruz, CA 95060, USA*
[d] *New England Fishery Management Council, 50 Water Street, Mill 2, Newburyport, MA 01950, USA*
[e] *NOAA National Marine Fisheries Service, Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla, CA 92037, USA*

ARTICLE INFO

Keywords:
Imported seafood
International trade
Leakage
Marine conservation policy
Seafood security

ABSTRACT

As domestic affluence increases, nations advocate for conservation policies to protect domestic biodiversity that often curtail natural resource production activities such as fishing. If concomitant consumption patterns remain unchanged, environmentally conscious nations with high consumption rates such as the U.S. may only be distancing themselves from the negative environmental impacts associated with consuming resources and commodities produced elsewhere. This unintended displacement of ecosystem impacts, or leakage, associated with conservation policies has not been studied extensively in marine fisheries. This paper examines this topic, drawing on case studies to illustrate the ways in which unilateral marine conservation actions can shift ecosystem impacts elsewhere, as has been documented in land use interventions. The authors argue that the U.S. should recognize these distant ecological consequences and move toward greater self-sufficiency to protect its seafood security and minimize leakage as well as undertake efforts to reduce ecosystem impacts of foreign fisheries on which it relies. Six solutions are suggested for broadening the marine conservation and seafood consumption discussion to address leakage induced by U.S. policy.

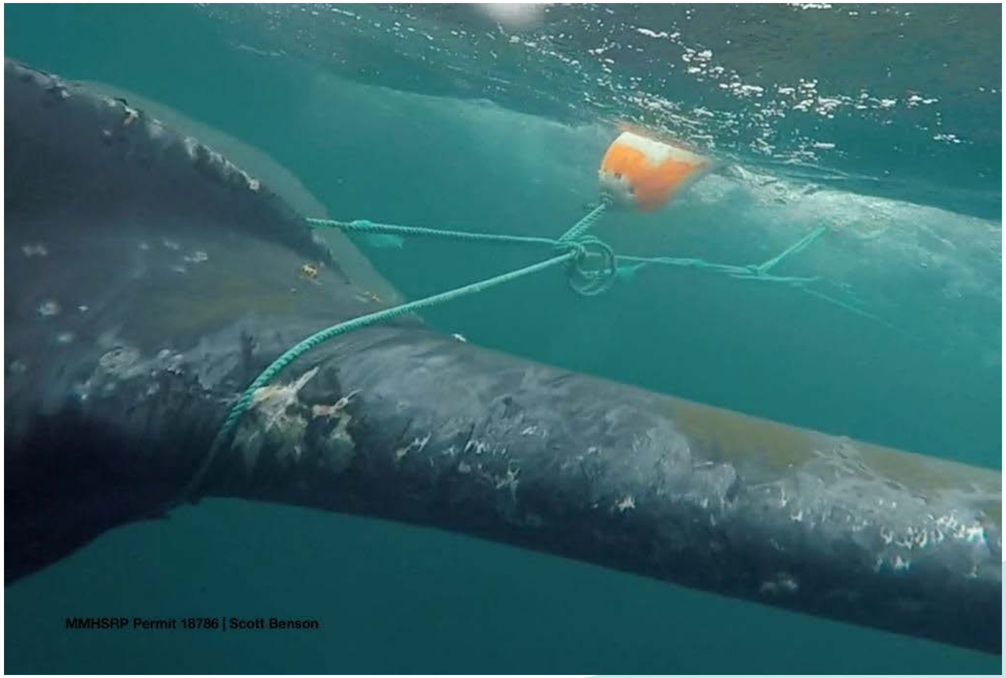
Broaden the Conversation – Blinders Off

Updates on whale entanglement reports in recent years

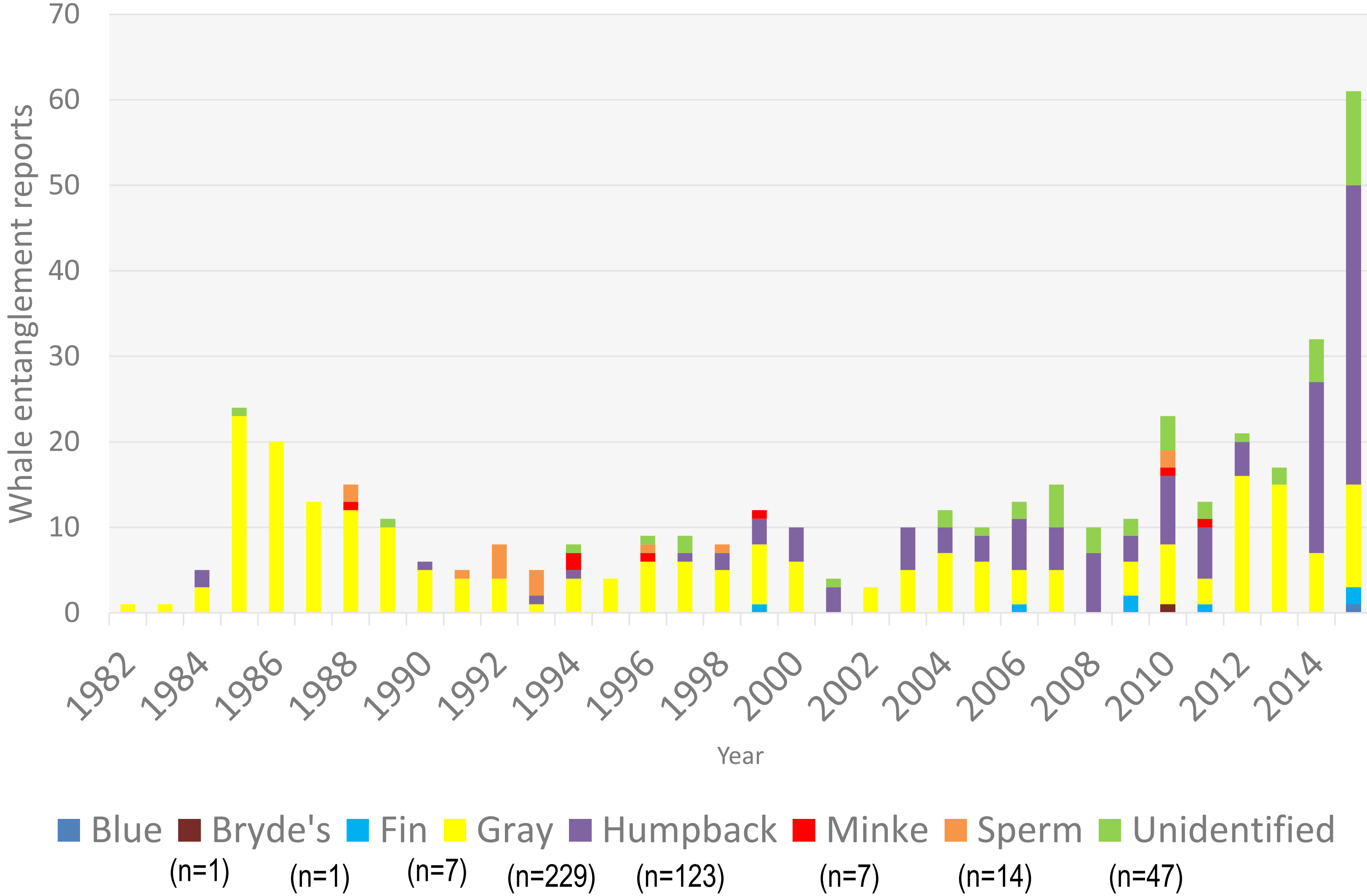
Dan Lawson and Lauren Saez

NOAA FISHERIES

West Coast Region

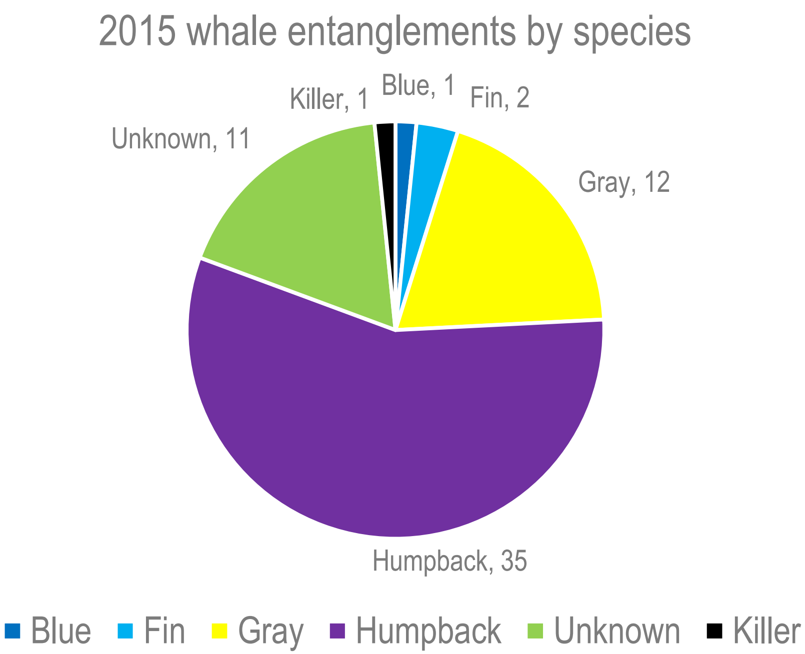


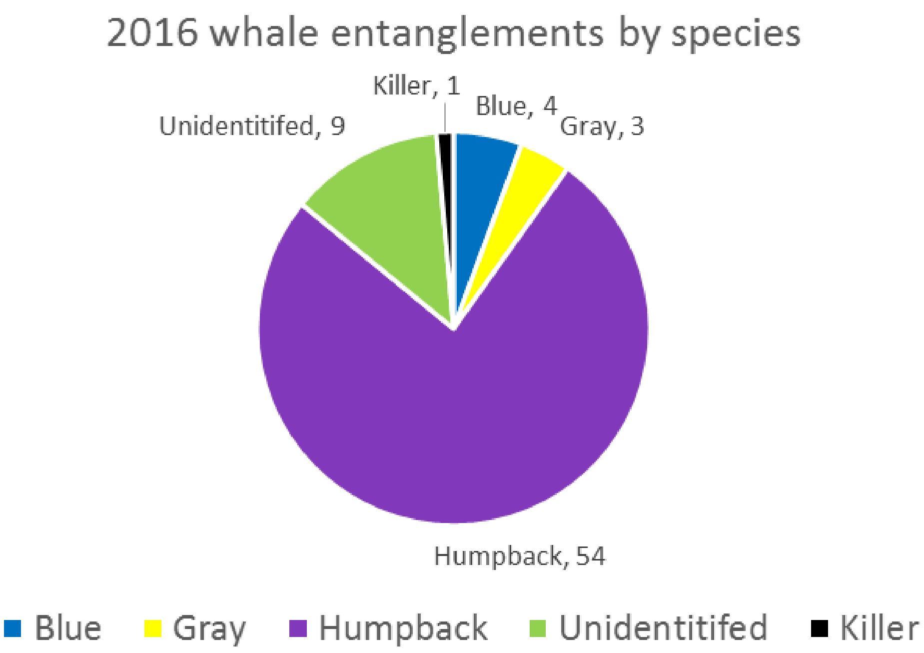
All whale entanglement reports per year per species 1982-2015 (n=429)

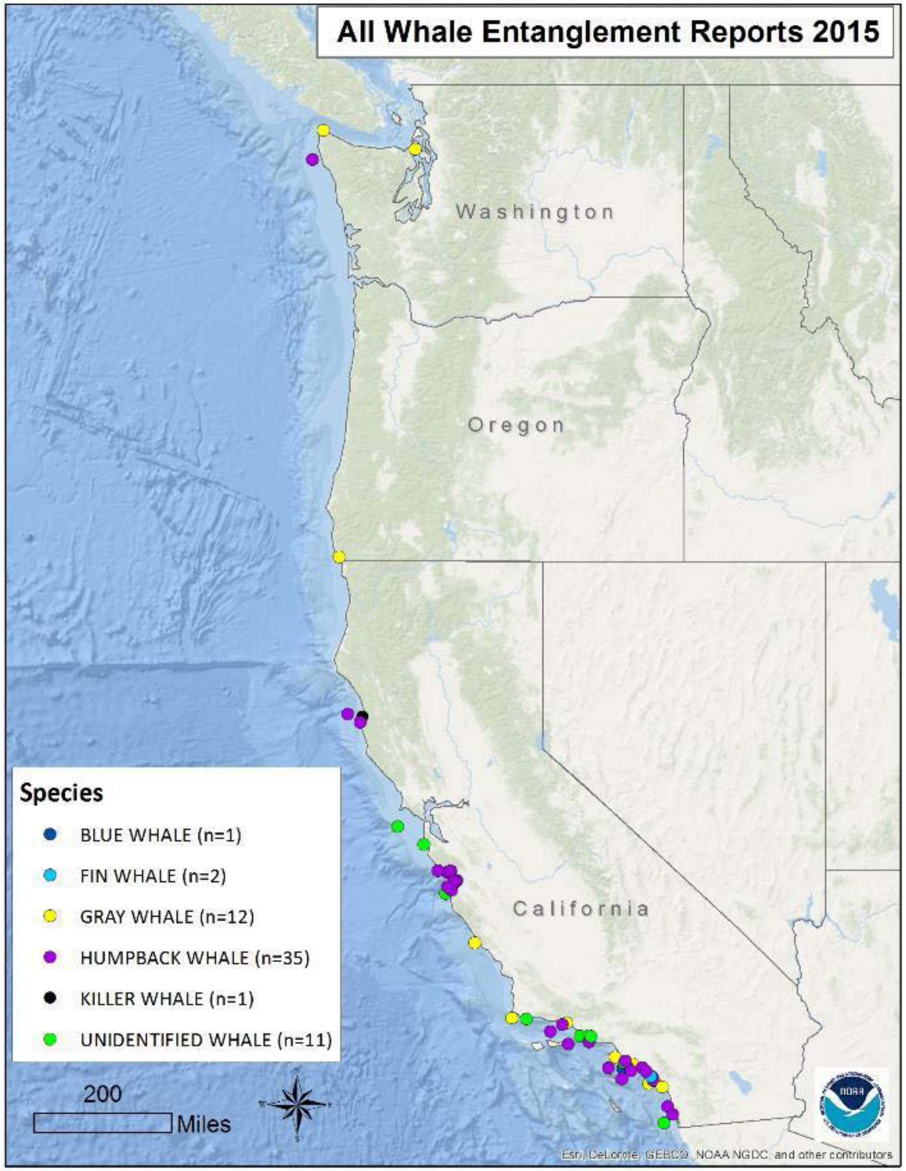


NOAA FISHERIES

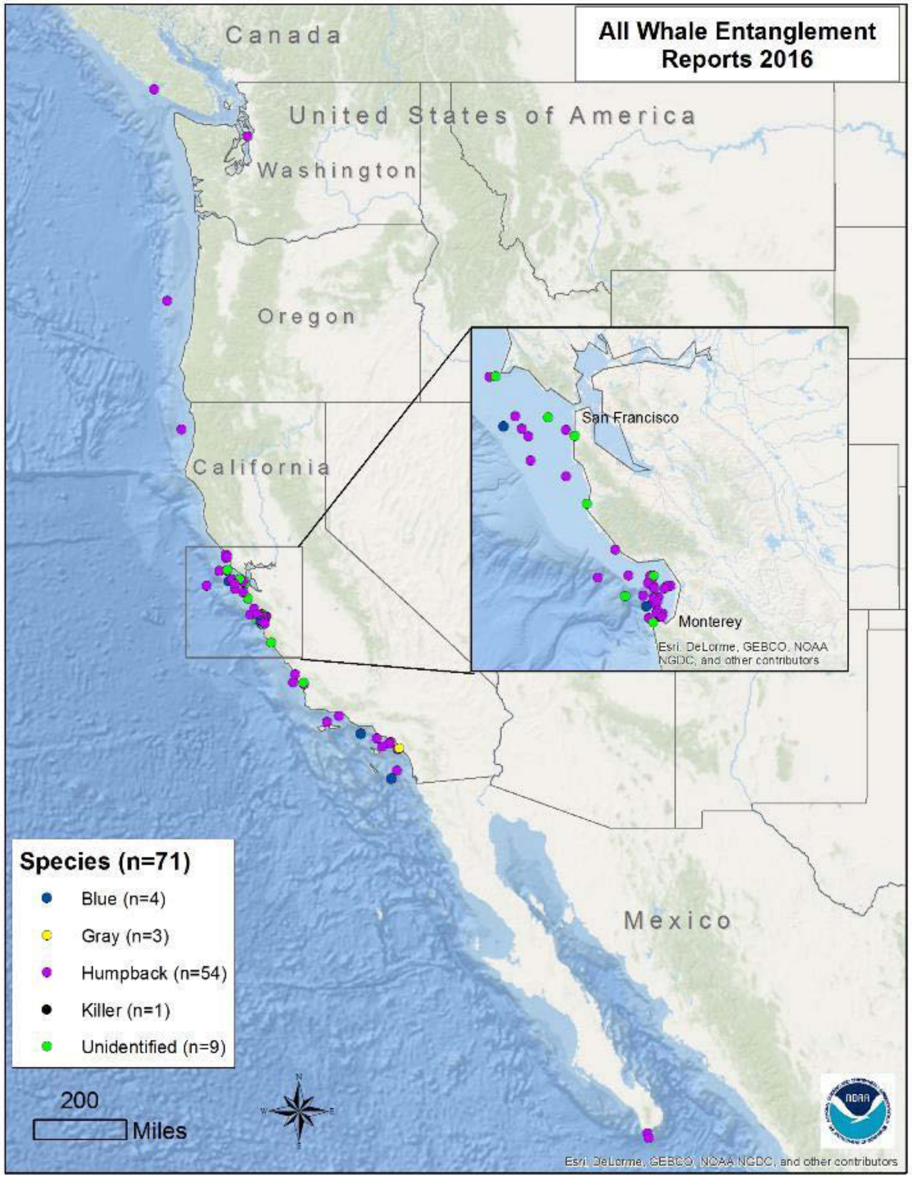
What whales are being reported as entangled?







All Whale Entanglement Reports 2015
Washington
Oregon
California
Species
BLUE WHALE (n=1)
FIN WHALE (n=2)
GRAY WHALE (n=12)
HUMPBACK WHALE (n=35)
KILLER WHALE (n=1)
UNIDENTIFIED WHALE (n=11)
200
Miles
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors



All Whale Entanglement Reports 2016
Canada
United States of America
Washington
Oregon
California
Mexico
San Francisco
Monterey
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
Species (n=71)
Blue (n=4)
Gray (n=3)
Humpback (n=54)
Killer (n=1)
Unidentified (n=9)
200
Miles
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

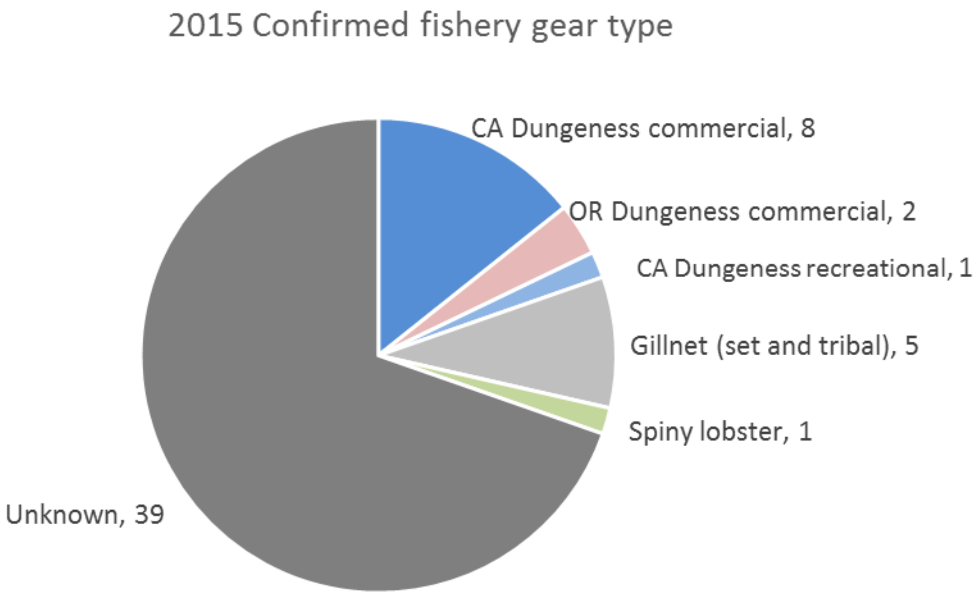
Comparing 1982-2013, 2014, 2015 and 2016:

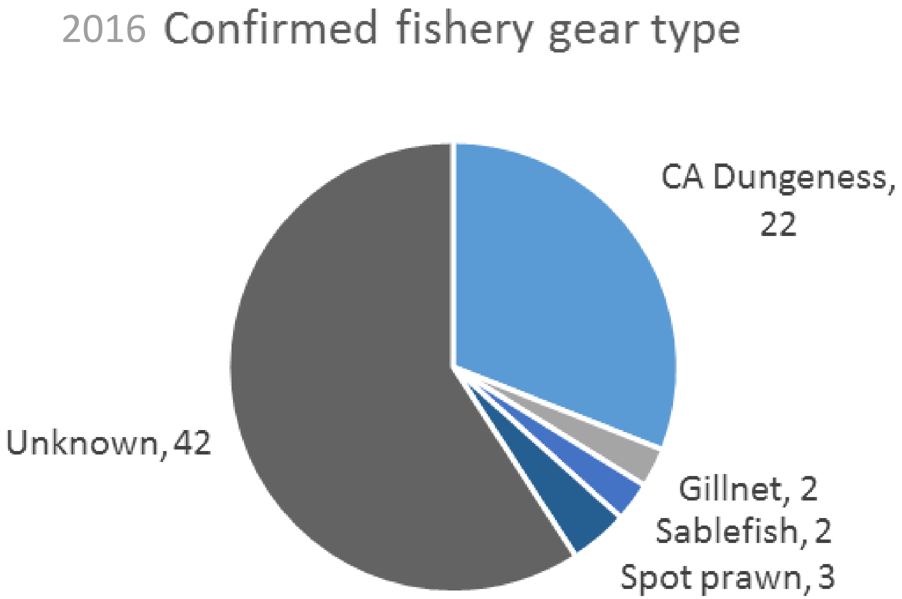
Whale entanglement reports by month

	Humpback			
Month	**82-13**	**2014**	**2015**	**2016**
January	1	0	2	1
February	1	0	2	2
March	1	0	1	1
April	1	1	0	6
May	11	3	4	8
June	4	3	5	10
July	7	1	5	1
August	20	2	2	12
September	4	7	6	3
October	8	2	6	6
November	5	1	2	1
December	3	0	0	3

	Gray			
Month	**82-13**	**2014**	**2015**	**2016**
January	26	1	0	0
February	20	0	2	1
March	53	0	4	0
April	50	1	0	2
May	22	2	1	0
June	7	0	0	0
July	9	1	1	0
August	9	0	1	0
September	3	2	2	0
October	4	0	0	0
November	2	0	0	0
December	4	0	1	0

Sources of entanglements 2015 and 2016





What we know

- NMFS West Coast Region is receiving an **increasing number of whale entanglement reports (especially humpbacks)**
  - Potentially contributing factors: increased outreach/awareness, changing distributions of whales and fishing effort (Environmental? Economic?)
- **Blue whales** are being reported as entangled! No reported prior to 2015
- Recent (2015-16) increase in entanglements reported in **central California (whale hotspot? local awareness?)**
- Whales can carry gear for long distances

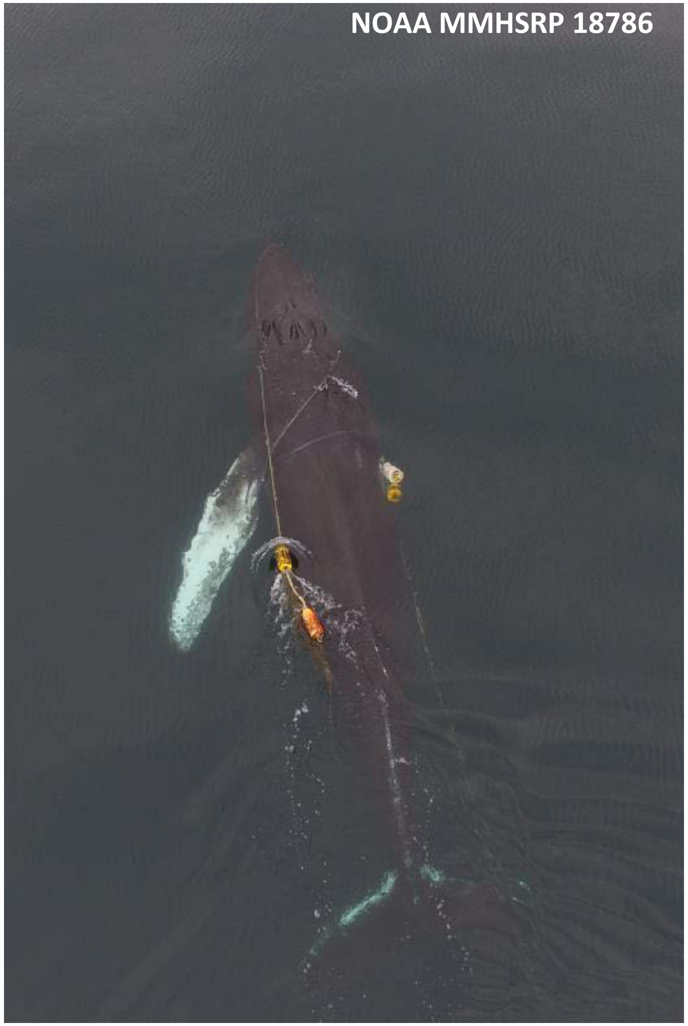
What we know (continued)

- More detailed documentation/better reporting and increasing response in recent year has **increased ability to identify gear (along with trap tags)**, but still limited
- **Trap/pot fisheries** are being identified as the majority entangling gear (of identified gear types); **commercial Dungeness crab gear** has the highest confirmed entanglement reports
- Dungeness crab is the largest trap fishery off the west coast with the highest number of participants and number of traps/lines:
  - may not be anything special about crab gear as much as relative extent of overlap in terms of extent of gear in water
- Whales are getting entangled every way possible, in all types/colors of line – not likely to be one easy fix to solve all problems

What we don’t know (data gaps)

Entanglement Data

- Identifying entanglement origins
  - Fishery
  - Locations
  - Timing (where to focus management and research efforts)
- Understanding of gear configurations of gear involved in entanglements
- Knowing the total # of entanglements that occur
- Understanding how whale behavior and gear configuration could make an interaction become an entanglement
- Understanding outcomes of entanglements (long term survival, serious injuries, impacts of reproduction)



What we don't know (data gaps)

Whale data

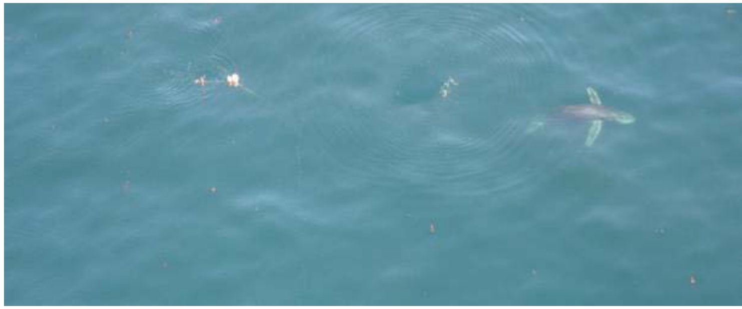
- Precise understanding of seasonal/annual variability in whale presence and abundance along the west coast, including factors that influence that variability

Fishery Data

- Precisely where and when (spatial and temporal) crab gear is distributed across the west coast, along with factors that influence variability
- Knowledge of how crab gear is configured across the west coast
- General knowledge of recreational crab fishery

Solutions

- Effectiveness of ideas to reduce risk are not necessarily clear
- Evaluation of innovations in terms of reducing entanglements may be difficult
- Require time and coordination across west coast



NOAA MMHSRP 18786

What are we doing?

- **Extensive outreach** on the entanglement issue across the west coast; response training
- **Supporting initiatives** such as the California Dungeness crab Whale Entanglement Working Group (started in 2015)
    - Develop recommendations for industry and management (e.g. Best Practices Guide)
    - Promote gear research, enhanced data collection and analysis
- **Review/analysis of whale entanglement documentation**
- Working to **provide/facilitate scientific expertise and developing tools** that can be used by industry, States, others, to help understand and address this issue (e.g. whale models)
- **Funding** (BREP)

Pacific Offshore Cetacean Take Reduction Team

June 2017

Jim Carretta
NOAA Fisheries
Southwest Fisheries Science Center

This presentation is intended to support deliberations of the Federally-appointed Pacific Offshore Cetacean Take Reduction Team. Information presented here is not considered "final" unless specifically noted as such.

Human-caused *mortality* and *serious injury* (MSI) is the sum of 2 sources:

1) **Opportunistic at-sea sightings / strandings of cases**

2) **Observer program cases with associated estimates of bycatch**

Opportunistic MSI represent minimum counts.

Observer program cases (DGN) result in estimates that account for unobserved fishing effort (model-based estimates, see ‘apples and oranges’ slide).

(S) denotes 'strategic' stocks. MSI = mortality + serious injury (human-caused).

Species	Pop. Size	PBR	Annual mean MSI (all sources 2011-2015)	Annual mean MSI (DGN 2011-2015)
Sperm Whale (S)	2,106	2.7	0.9	0.36
Short-finned pilot whale	836	4.5	1.2	1.2
Mesoplodon spp. (S)	694	3.9	0	0
Pygmy sperm whale	4,111	19	0	0
Baird's beaked whale	847	4.7	0	0
Humpback whale (S)	1,729	11	6.5 (+)	0.02
Cuvier's beaked whale (S)	6,590	45	0.02	0.02

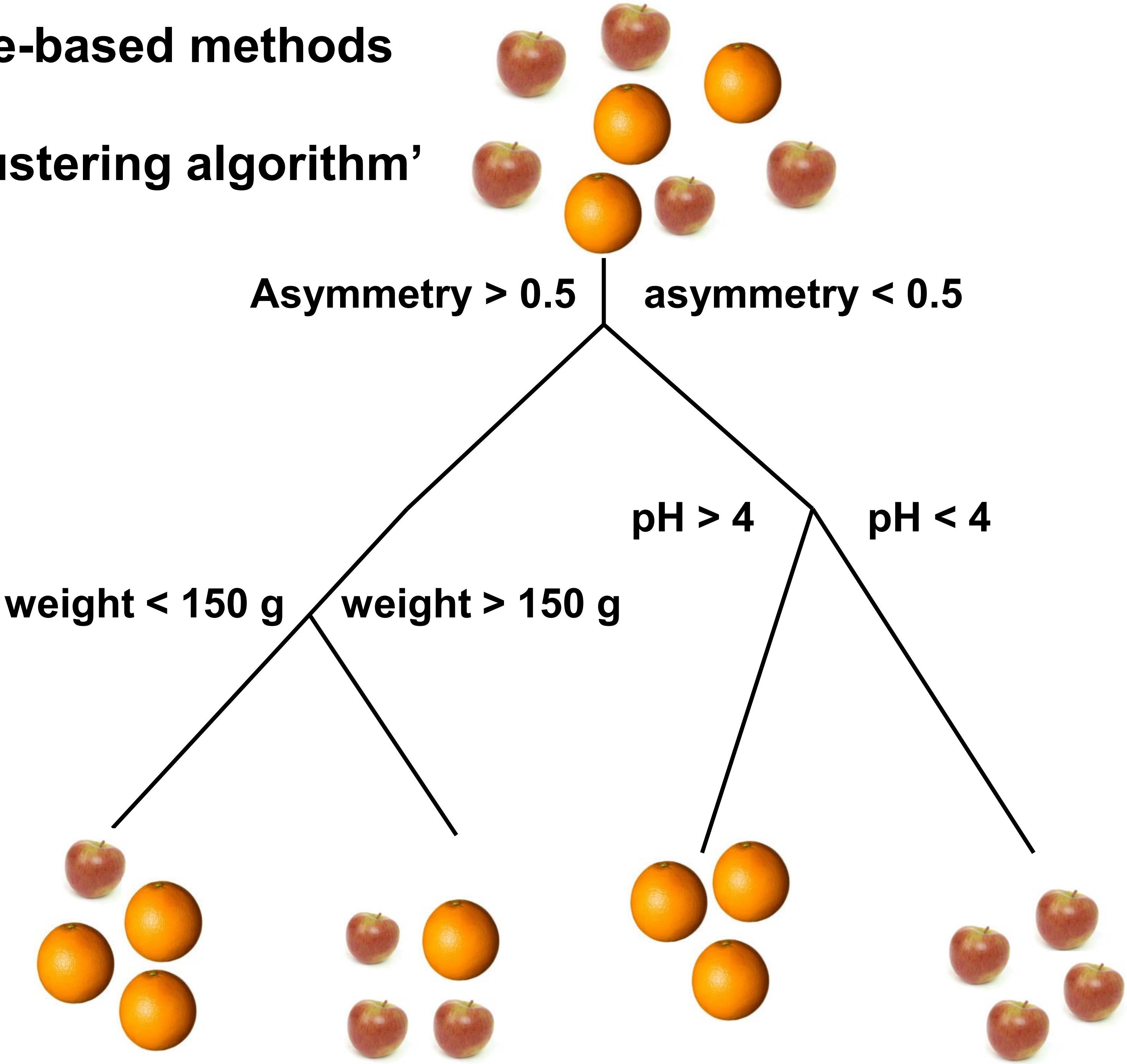
Species	Pop. Size	PBR	DGN Mean Annual MSI	% of PBR
Sperm Whale (S)	2,106	2.7	0.36	13%
Short-finned pilot whale	836	4.5	1.2	27%
Humpback whale (S)	1,729	11	0.02	<<1%
Cuvier's beaked whale (S)	6,590	45	0.02	<<1%
Mesoplodon spp. (S)	694	3.9	0	0%
Pygmy sperm whale	4,111	19	0	0%
Baird's beaked whale	847	4.7	0	0%

- Updated DGN bycatch 1990-2016 currently in progress (do not cite).

- Bycatch = observed + estimated from unobserved fishing

Tree-based methods

‘Clustering algorithm’



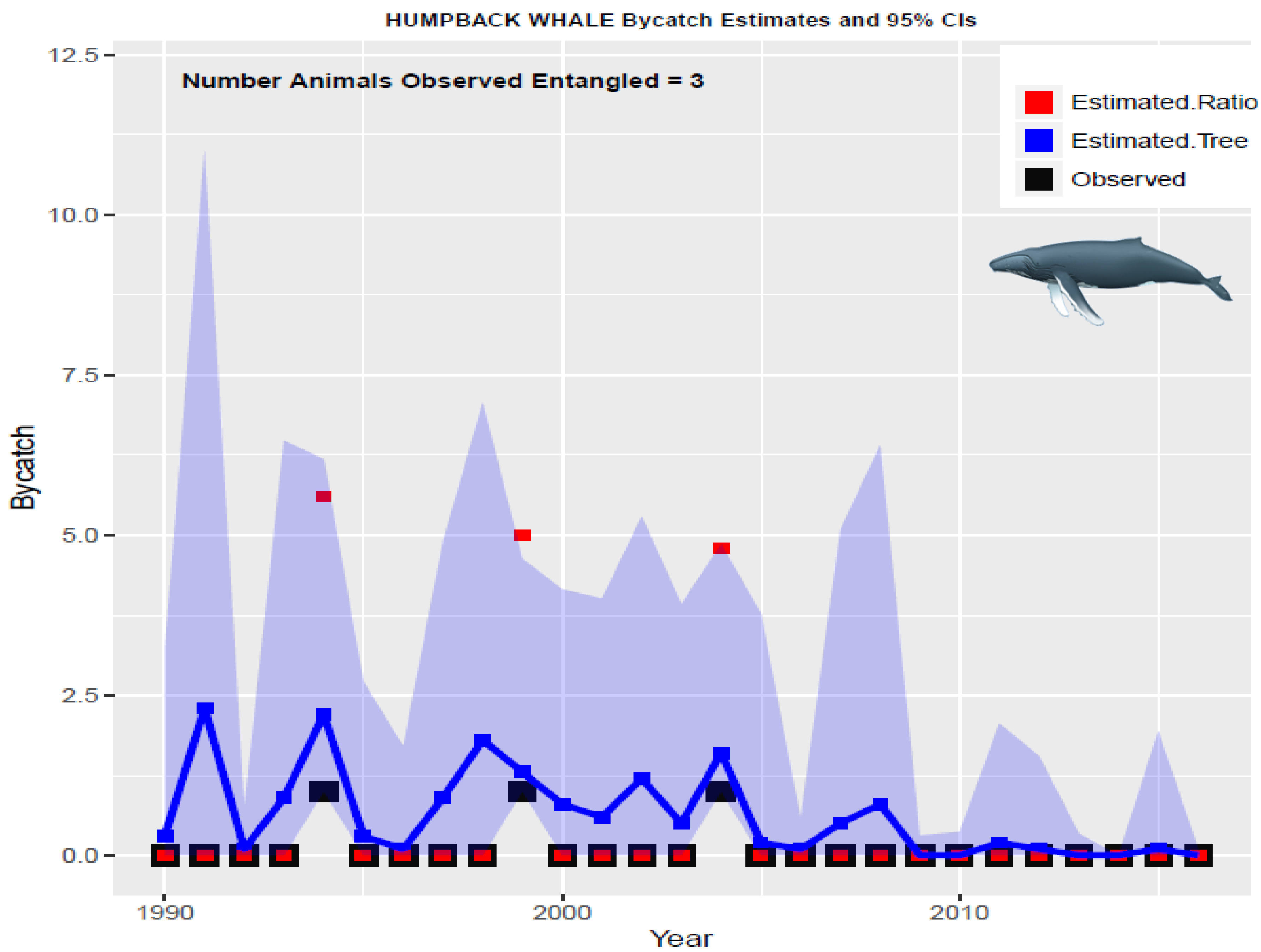
TRT performance metrics: MSI vs PBR

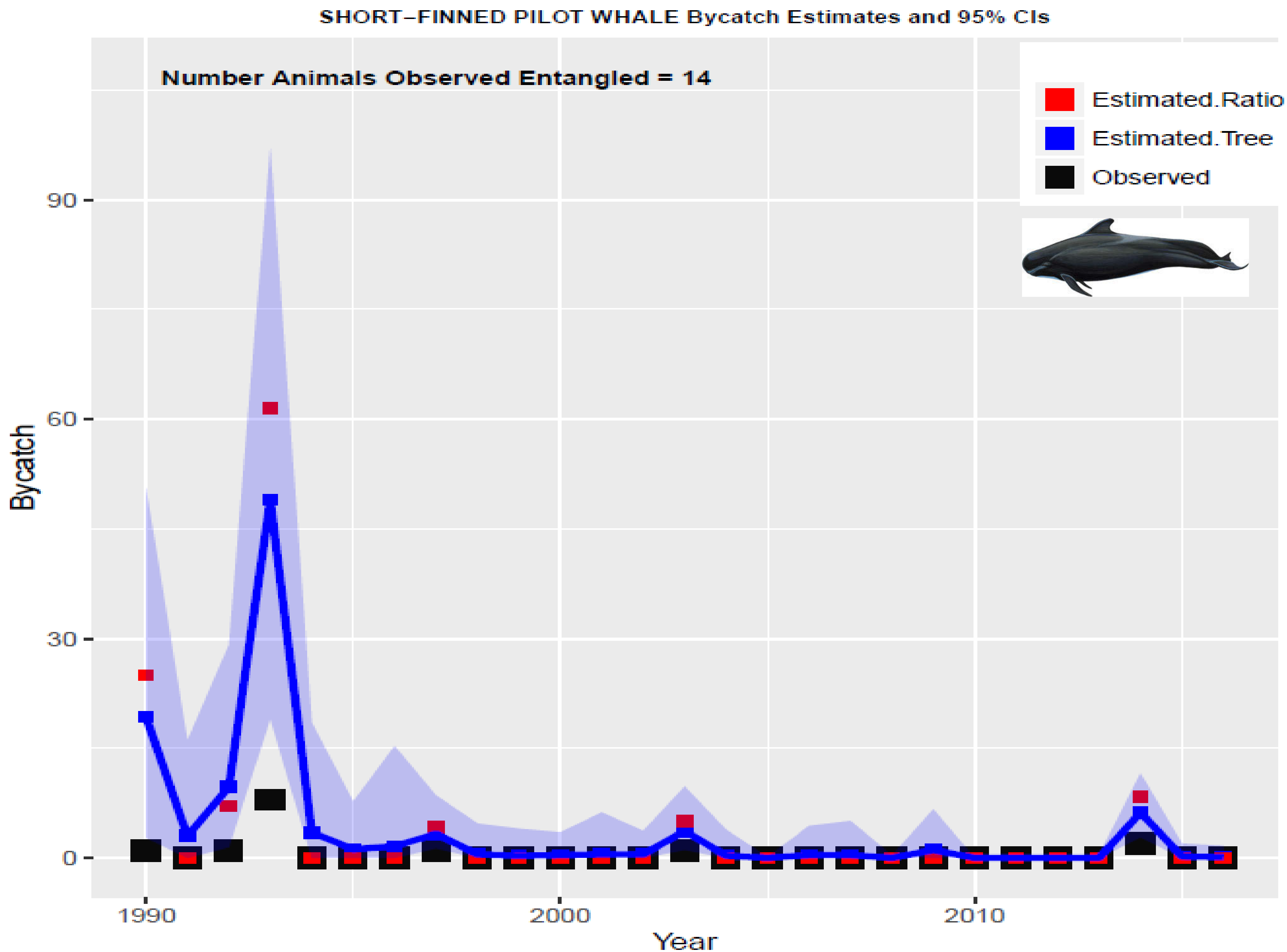
- MSI is below PBR for all stocks.
- MSI below 10% of PBR (=ZMRG) for humpbacks and all beaked whales.
- Above 10% of PBR for sperm whales and short-finned pilot whales. Absolute bycatch has declined however.
- Below 10% of PBR for northern right whale dolphins. This is not a TRT species, but we have exceeded 10% of PBR in the past.

Preliminary bycatch estimates, 1990 – 2016.

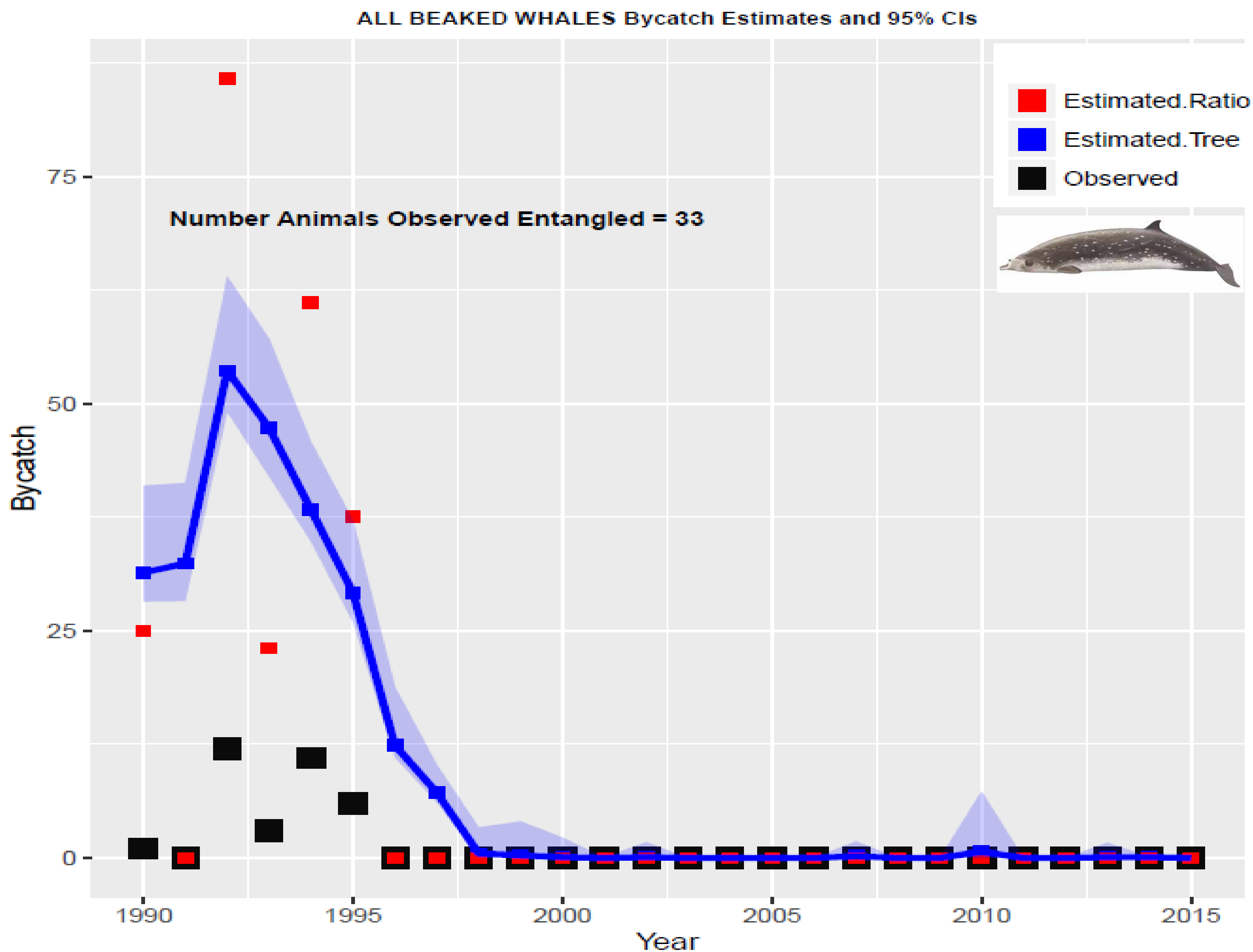
- Draft estimates are for POCTRT informational purposes. Please do not cite.
- New estimates hardly differ from the published estimates in Carretta et al. 2017 for the time period 1990-2015.
- The reason is that we have added only a handful of observations to generate new species bycatch models.
- And there has not been a significant increase in fishing effort.

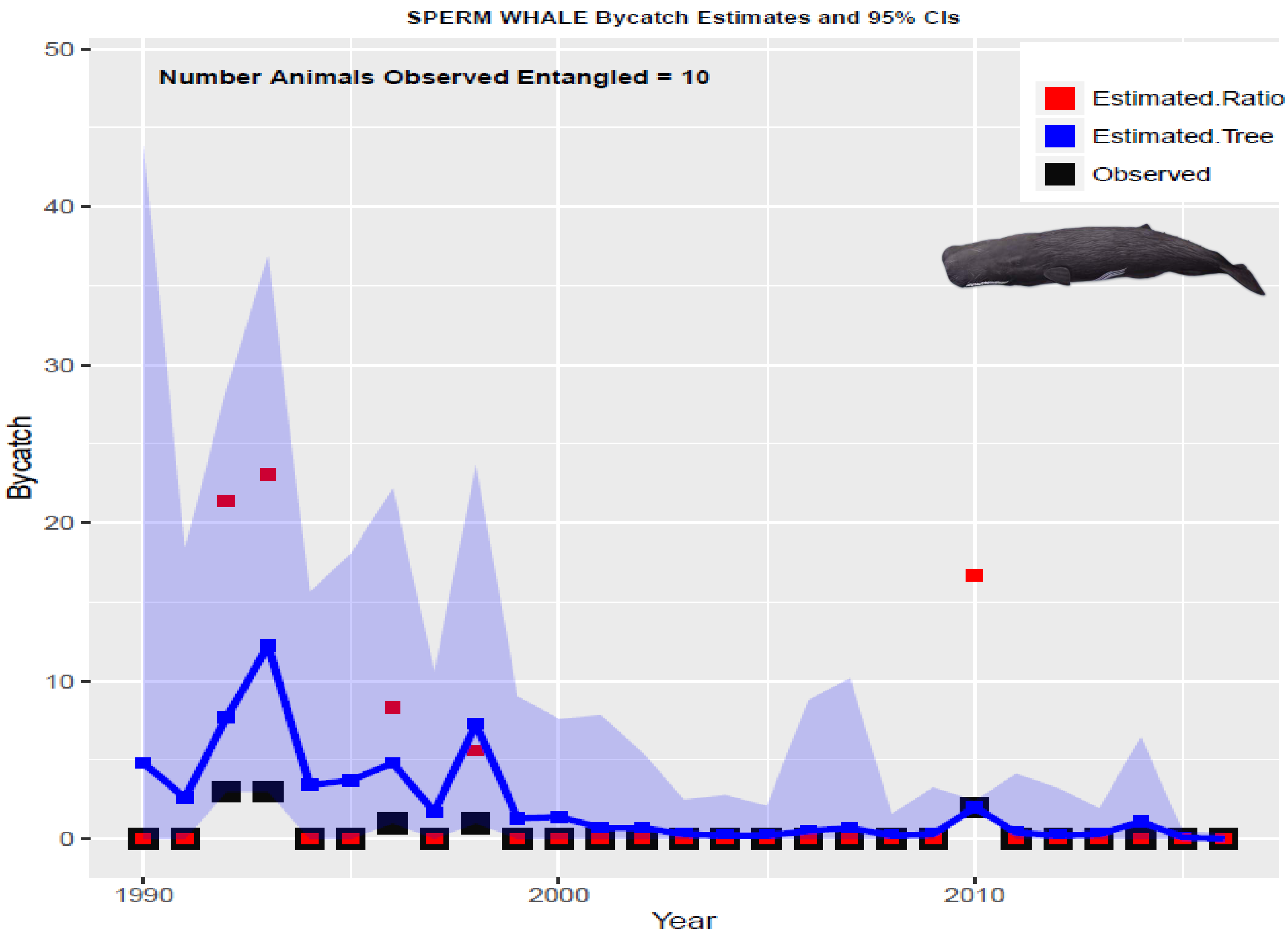
Carretta, J.V., J.E. Moore, and K.A. Forney. 2017. Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p. doi:10.7289/V5/TM-SWFSC-568.


HUMPBACK WHALE Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 3
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
12.5
10.0
7.5
5.0
2.5
0.0
1990
2000
2010
Year

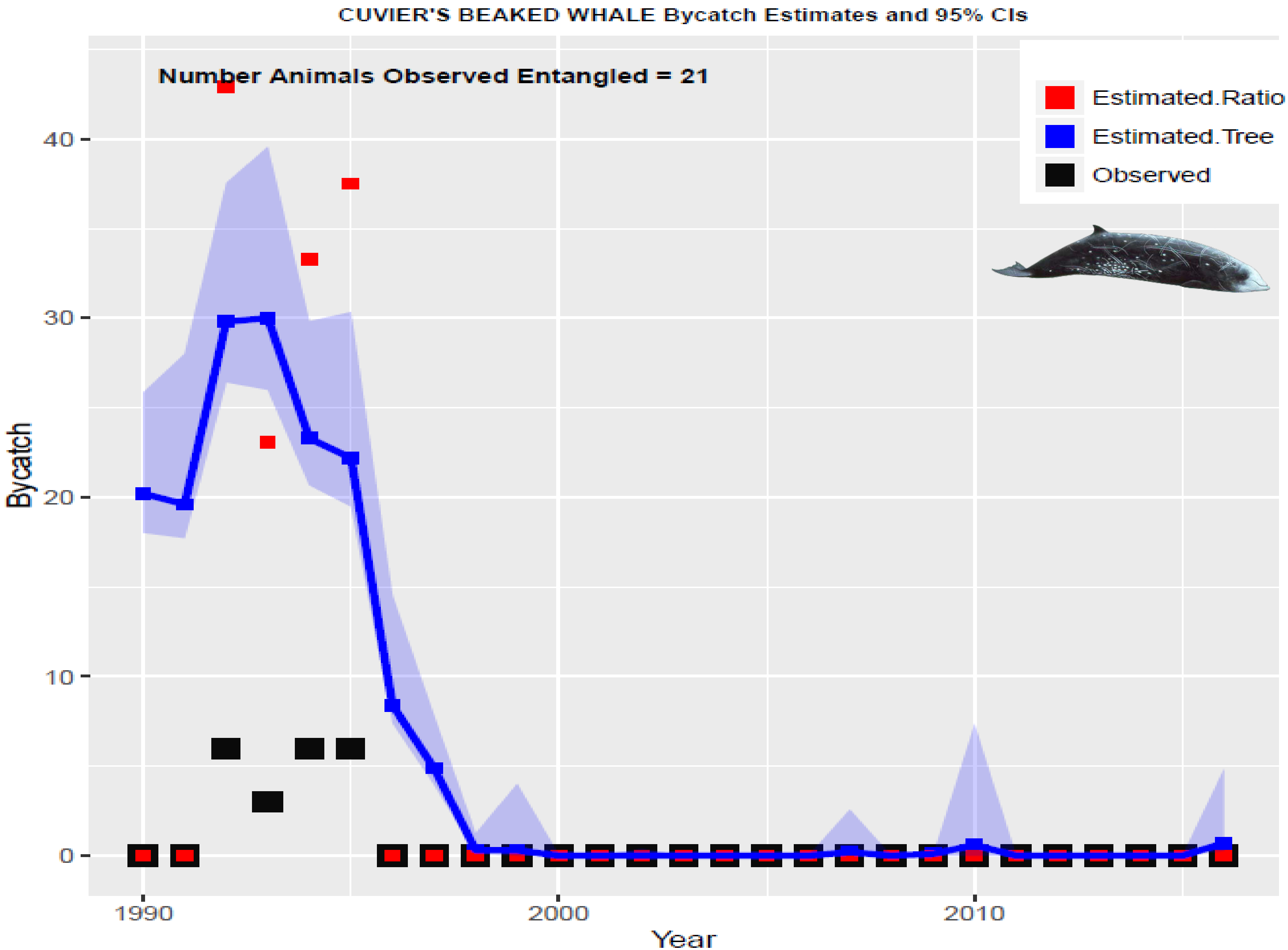


SHORT–FINNED PILOT WHALE Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 14
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
90
60
30
0
1990
2000
2010
Year


ALL BEAKED WHALES Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 33
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
0
25
50
75
Year
1990
1995
2000
2005
2010
2015

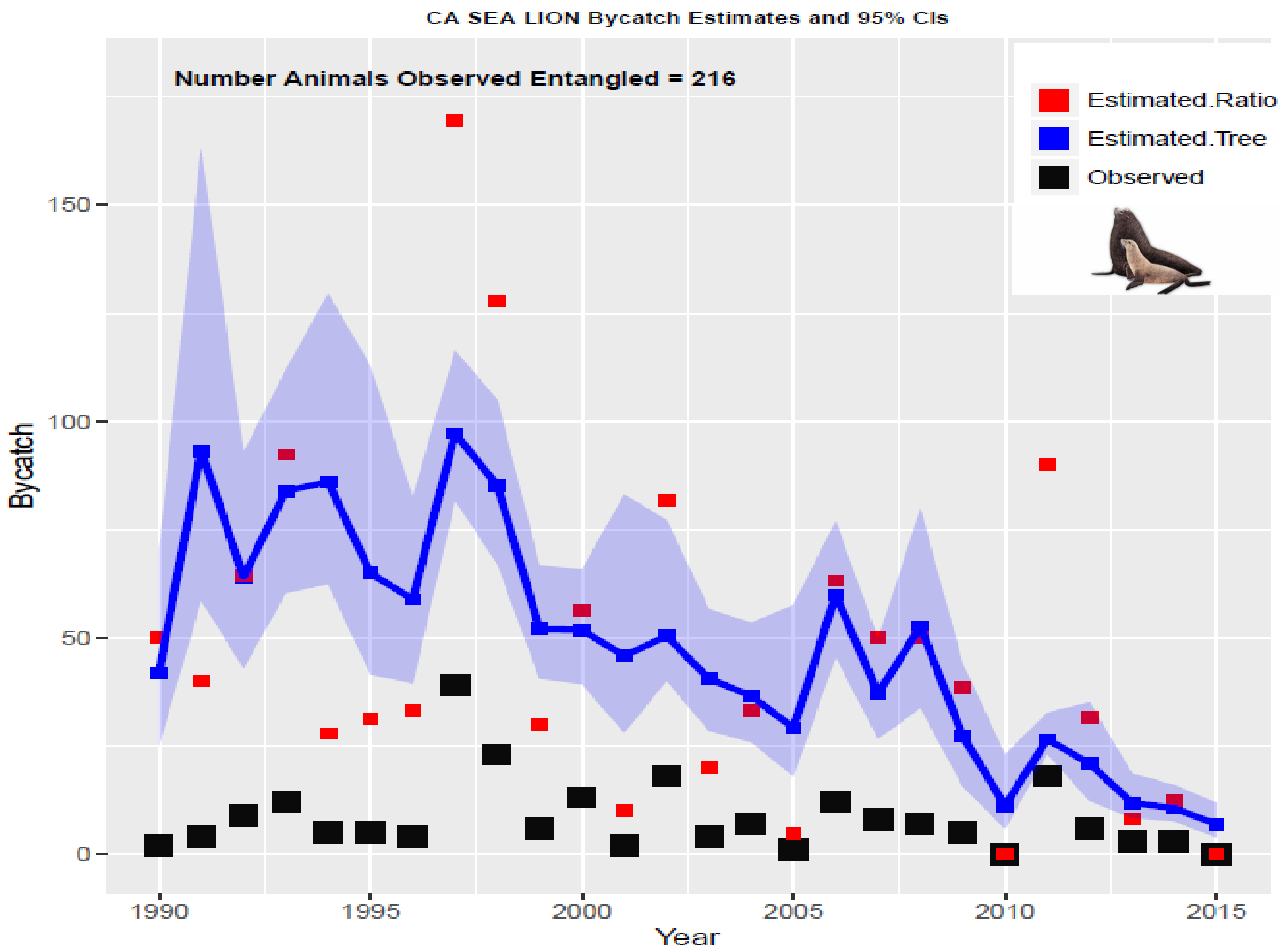


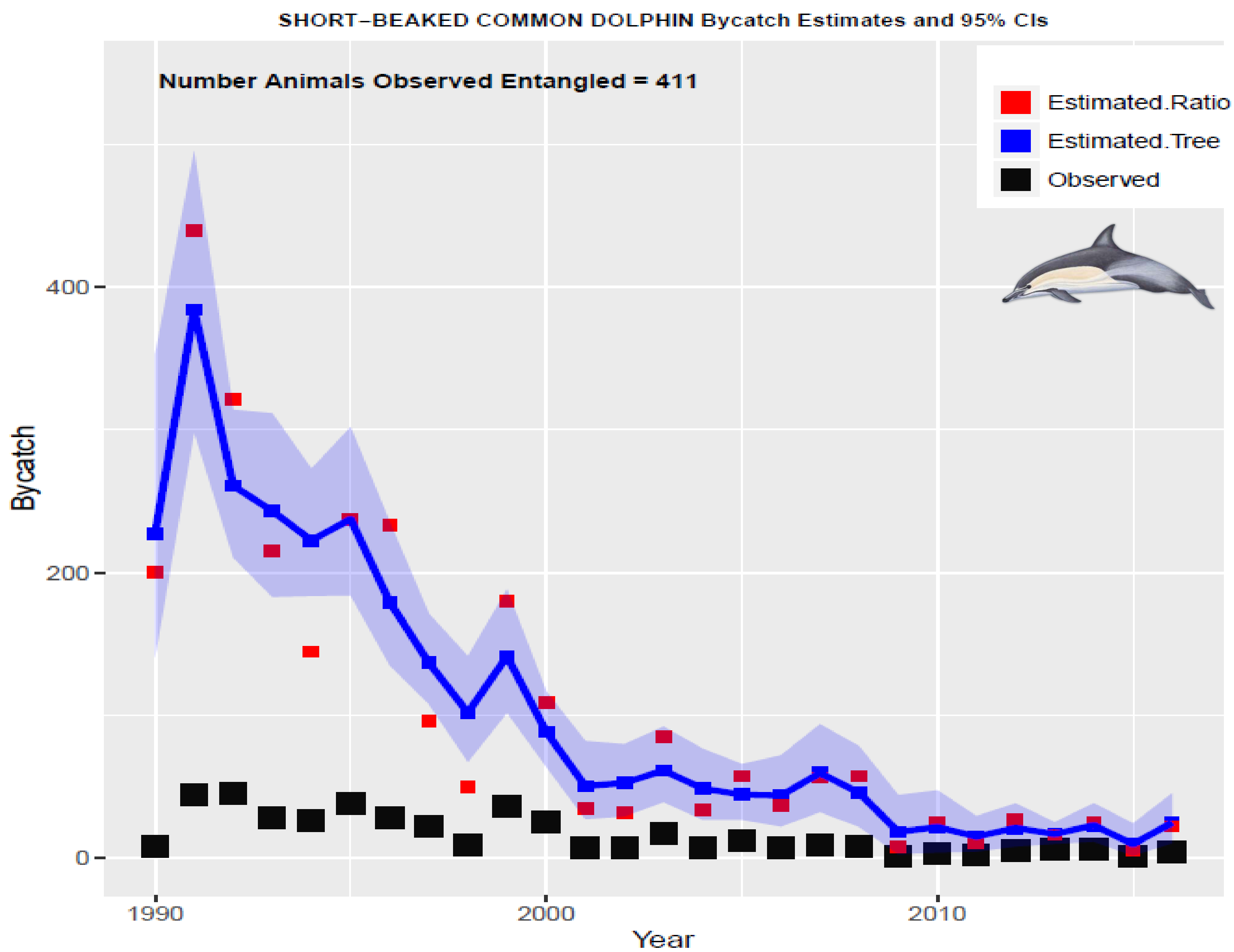
SPERM WHALE Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 10
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
Year
0
10
20
30
40
50
1990
2000
2010



CUVIER'S BEAKED WHALE Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 21
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
40
30
20
10
0
1990
2000
2010
Year

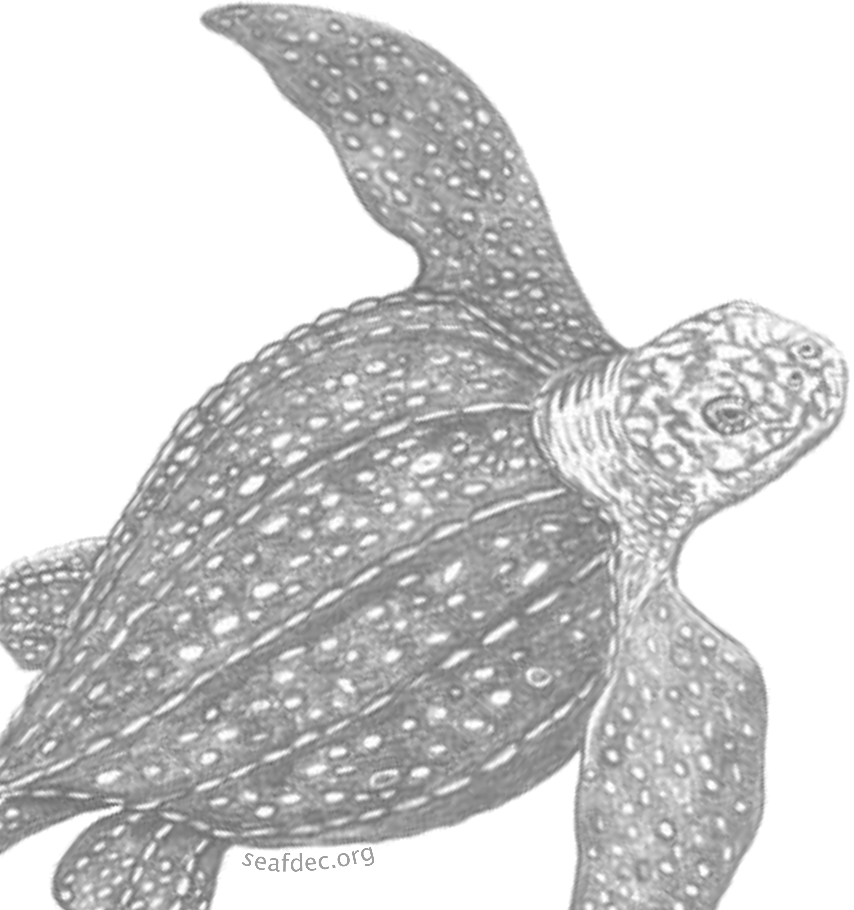
- Other non-TRT species FYI


CA SEA LION Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 216
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
0
50
100
150
Year
1990
1995
2000
2005
2010
2015


SHORT–BEAKED COMMON DOLPHIN Bycatch Estimates and 95% CIs
Number Animals Observed Entangled = 411
Estimated.Ratio
Estimated.Tree
Observed
Bycatch
400
200
0
1990
2000
2010
Year

- This presentation is intended to support deliberations of the Federally-appointed Pacific Offshore Cetacean Take Reduction Team. Information presented here is not considered "final" unless specifically noted as such.

Ecological and social outcomes of spatial management for leatherback conservation

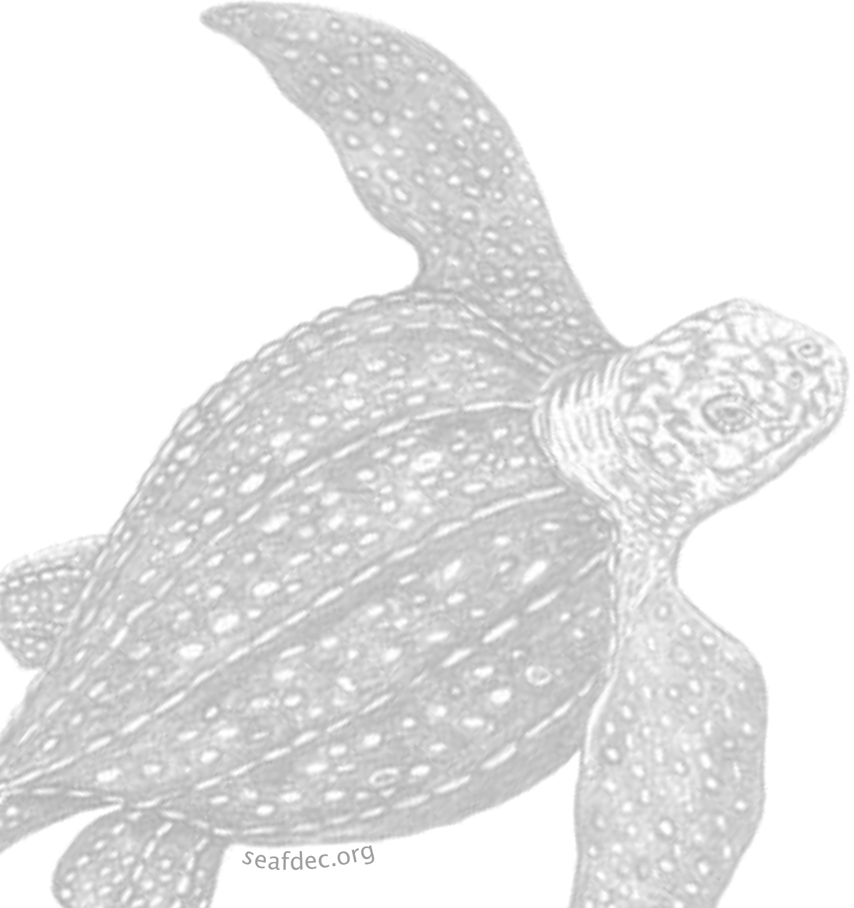


Julia Mason

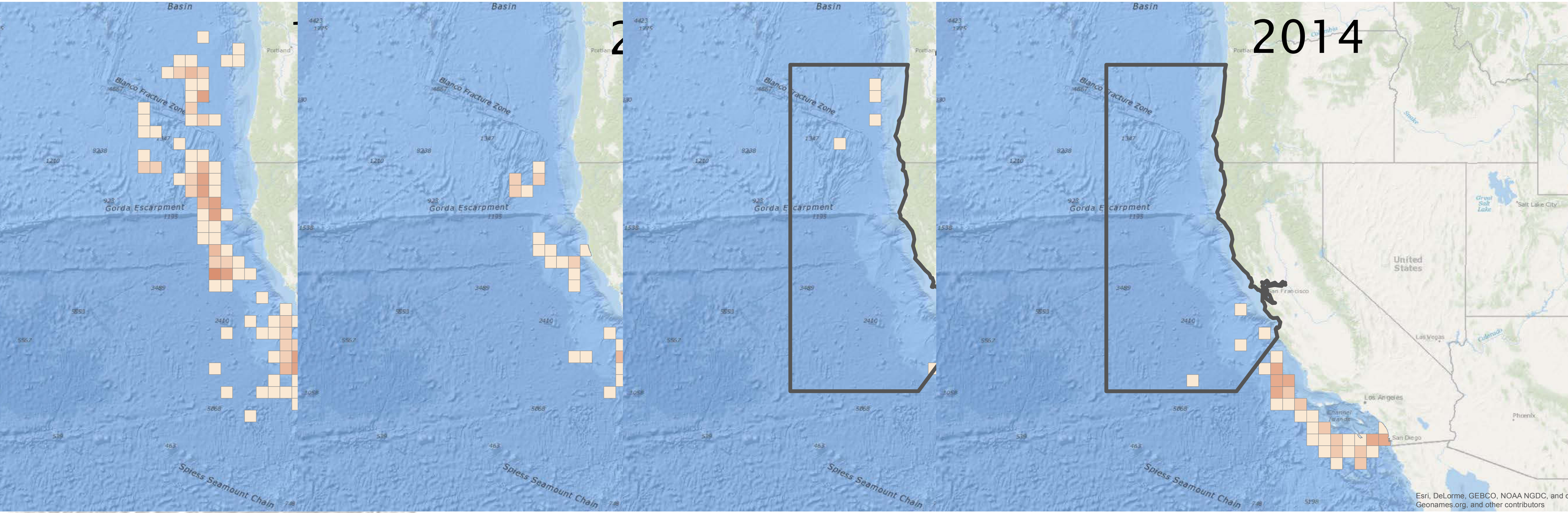
Hopkins Marine Station,
Stanford University

June 15, 2017

Disclaimer! I’m a student, and this is preliminary, unpublished work.



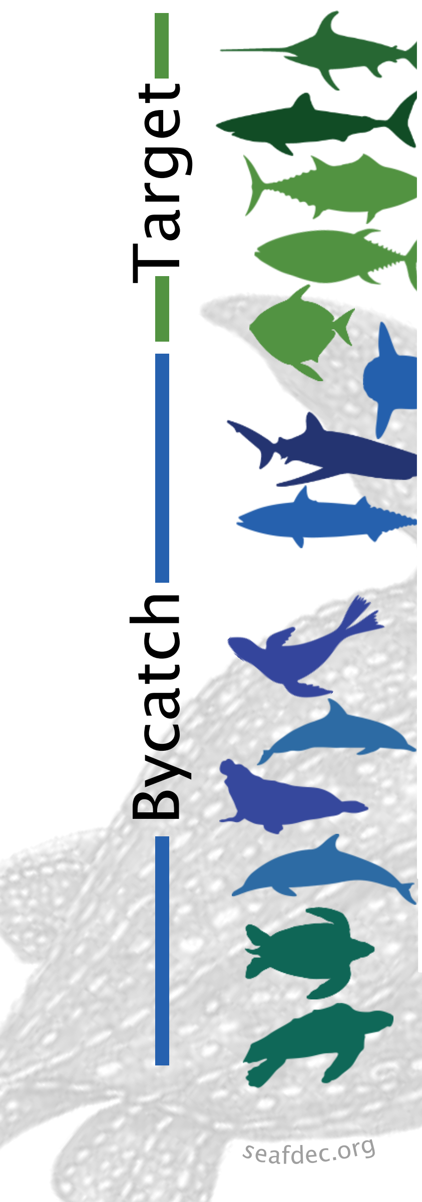
PLCA drives southward shift in effort



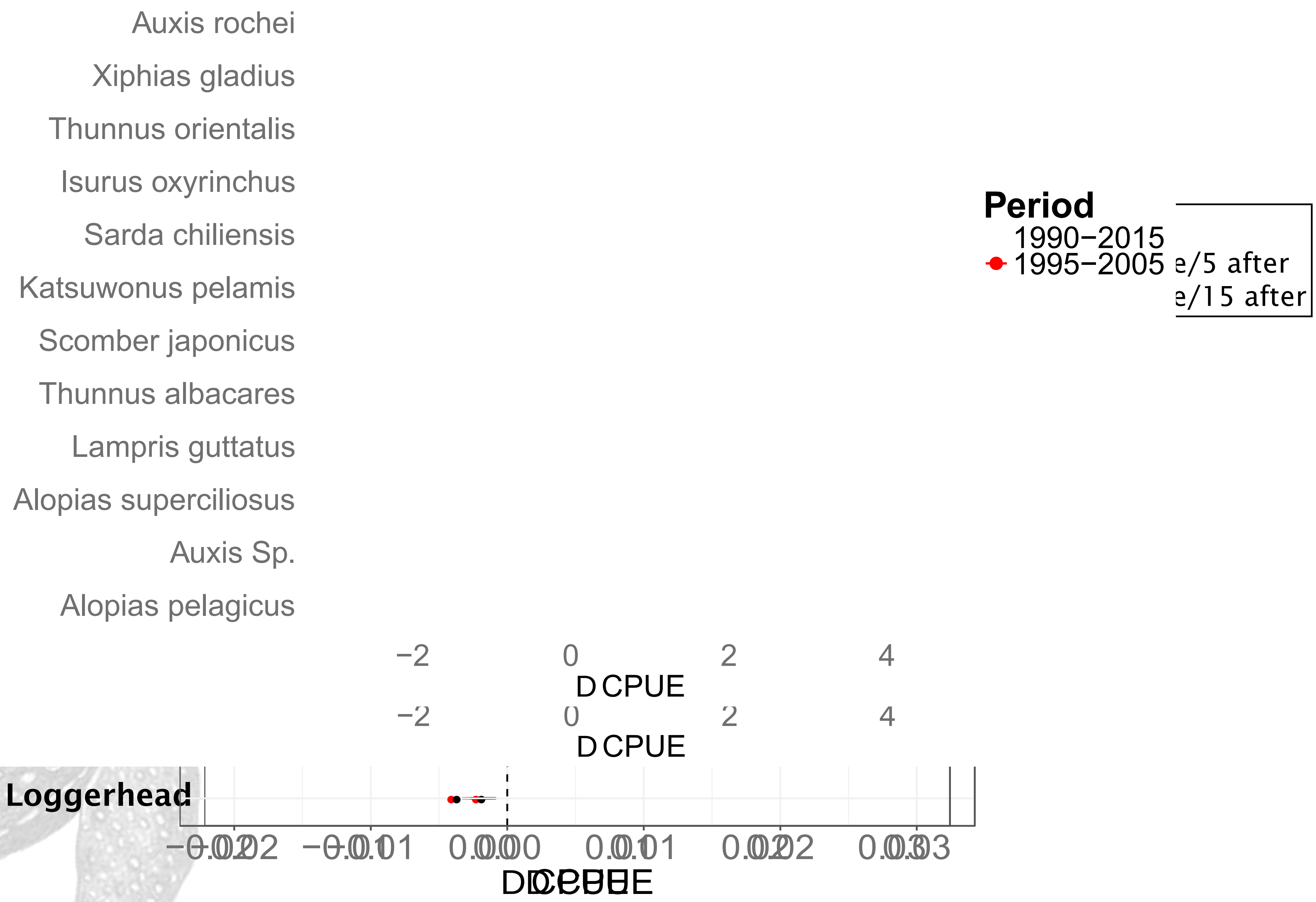
Effort, sets per 900 nm^2

3 10 30 60 100

Changes

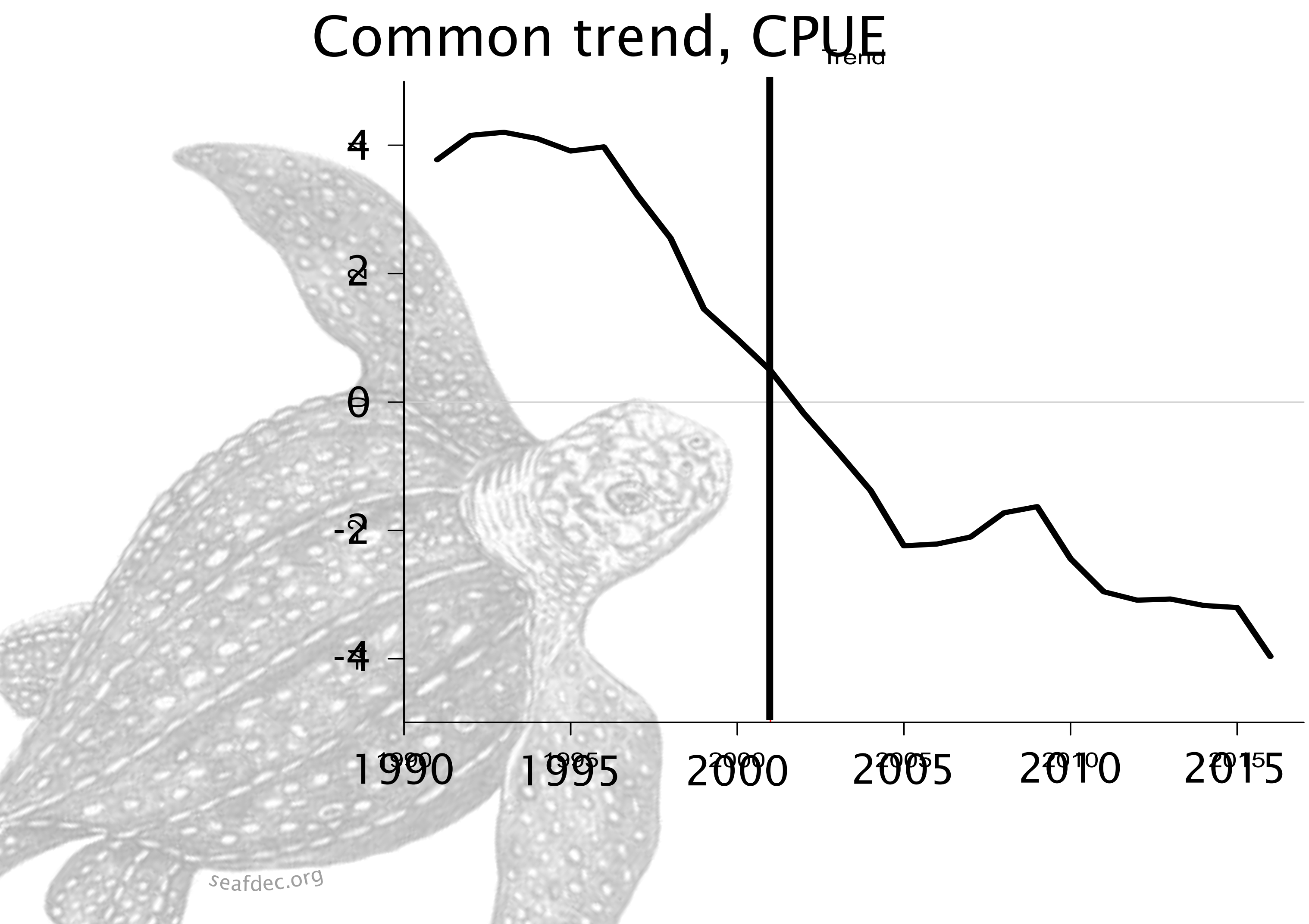


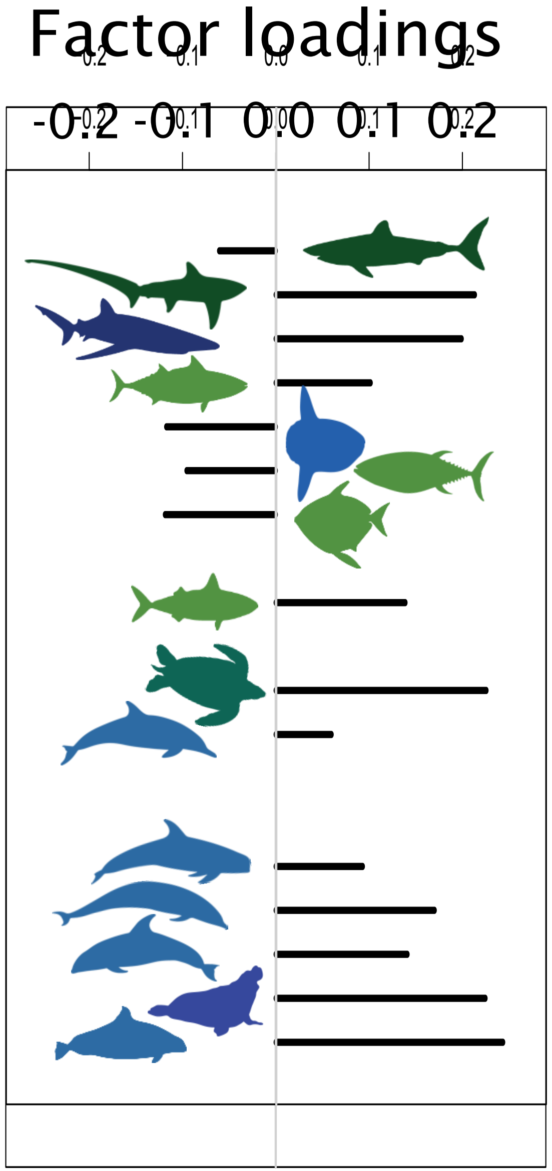
Target
Bycatch
seafdec.org



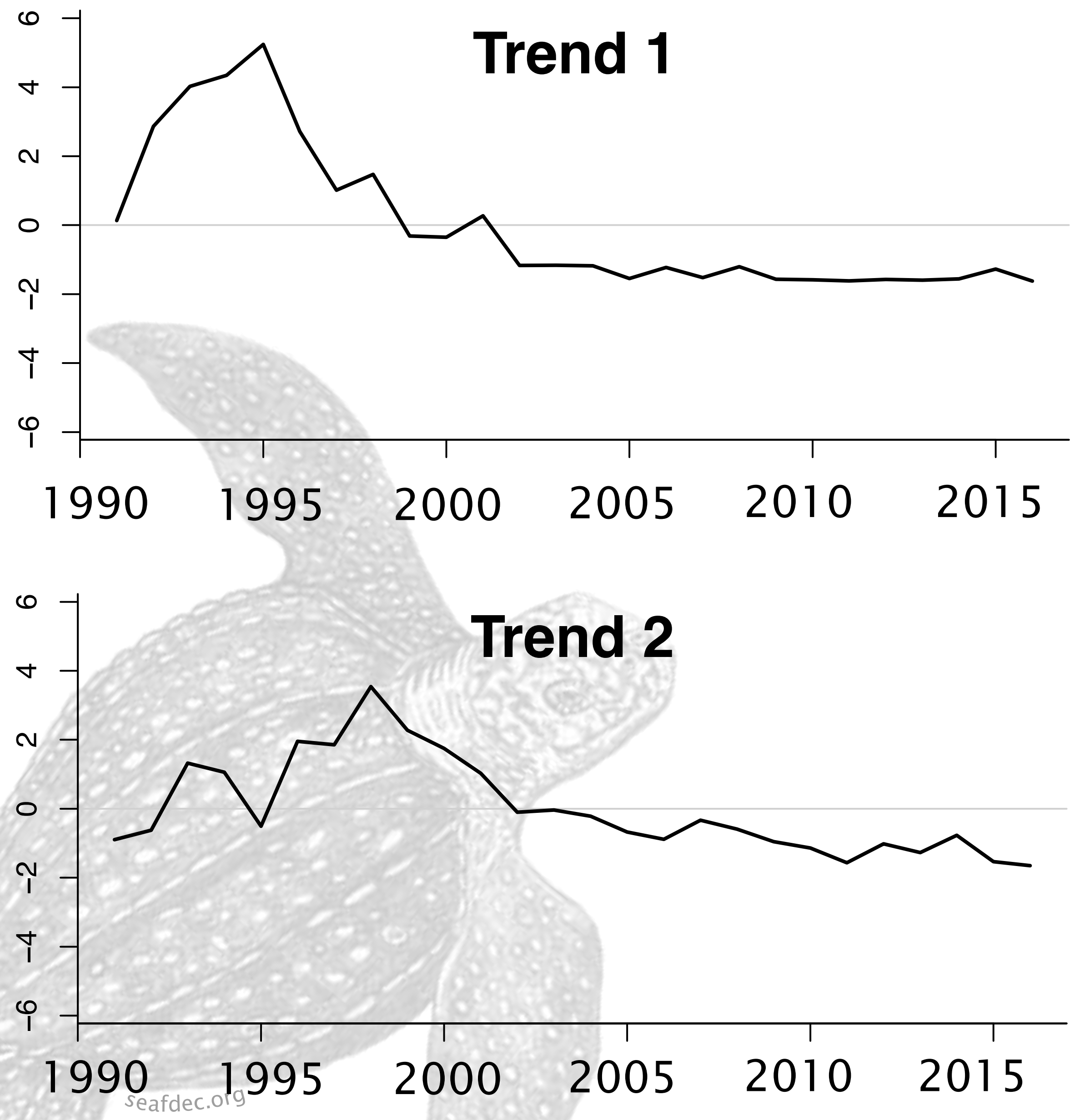
Auxis rochei
Xiphias gladius
Thunnus orientalis
Isurus oxyrinchus
Sarda chiliensis
Katsuwonus pelamis
Scomber japonicus
Thunnus albacares
Lampris guttatus
Alopias superciliosus
Auxis Sp.
Alopias pelagicus
−2 0 2 4
D CPUE
−2 0 2 4
D CPUE
Loggerhead
−0.02 −0.01 0.00 0.01 0.02 0.03
D CPUE
Period
1990−2015
1995−2005
e/5 after
e/15 after

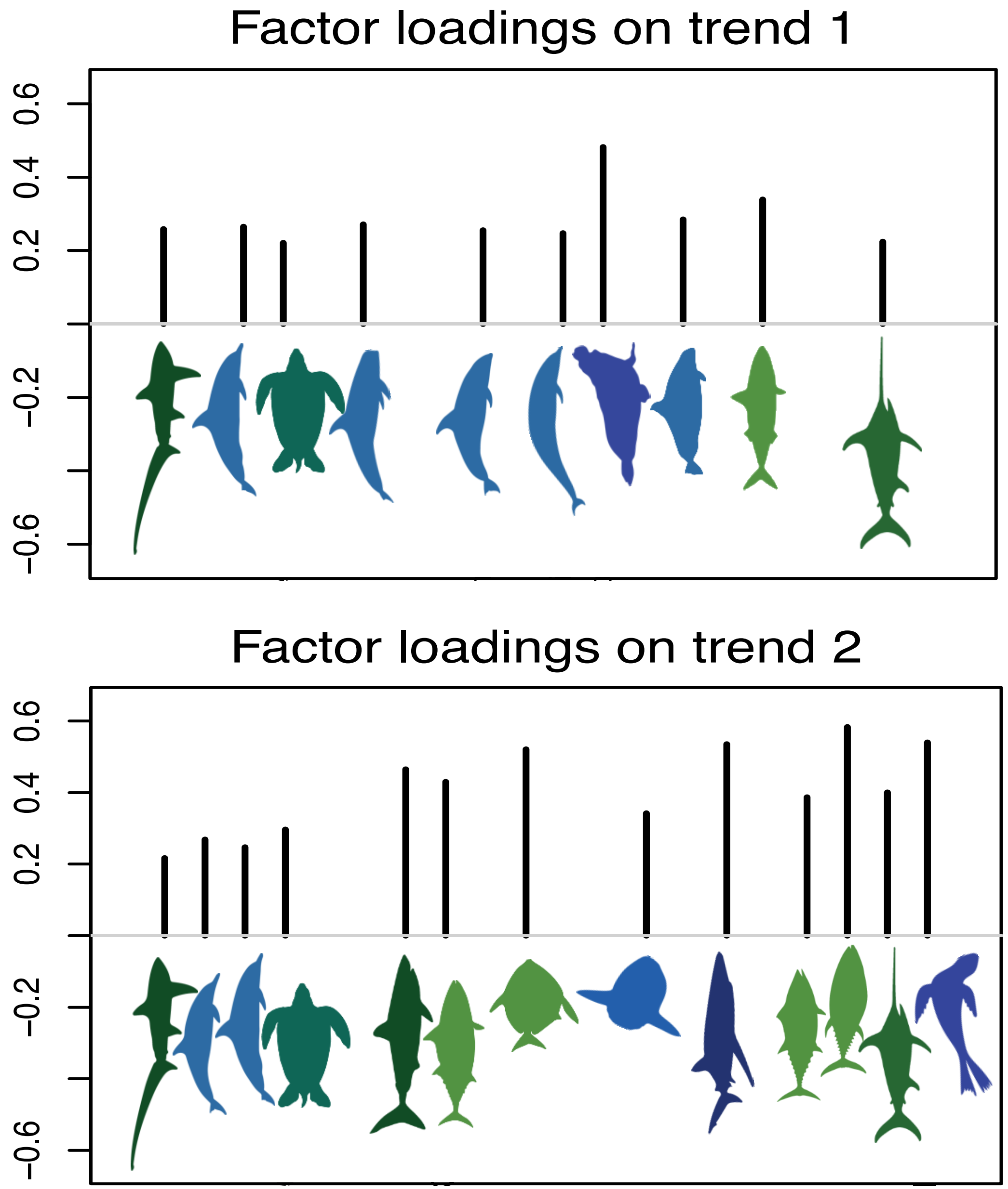
Time series analysis shows earlier decline



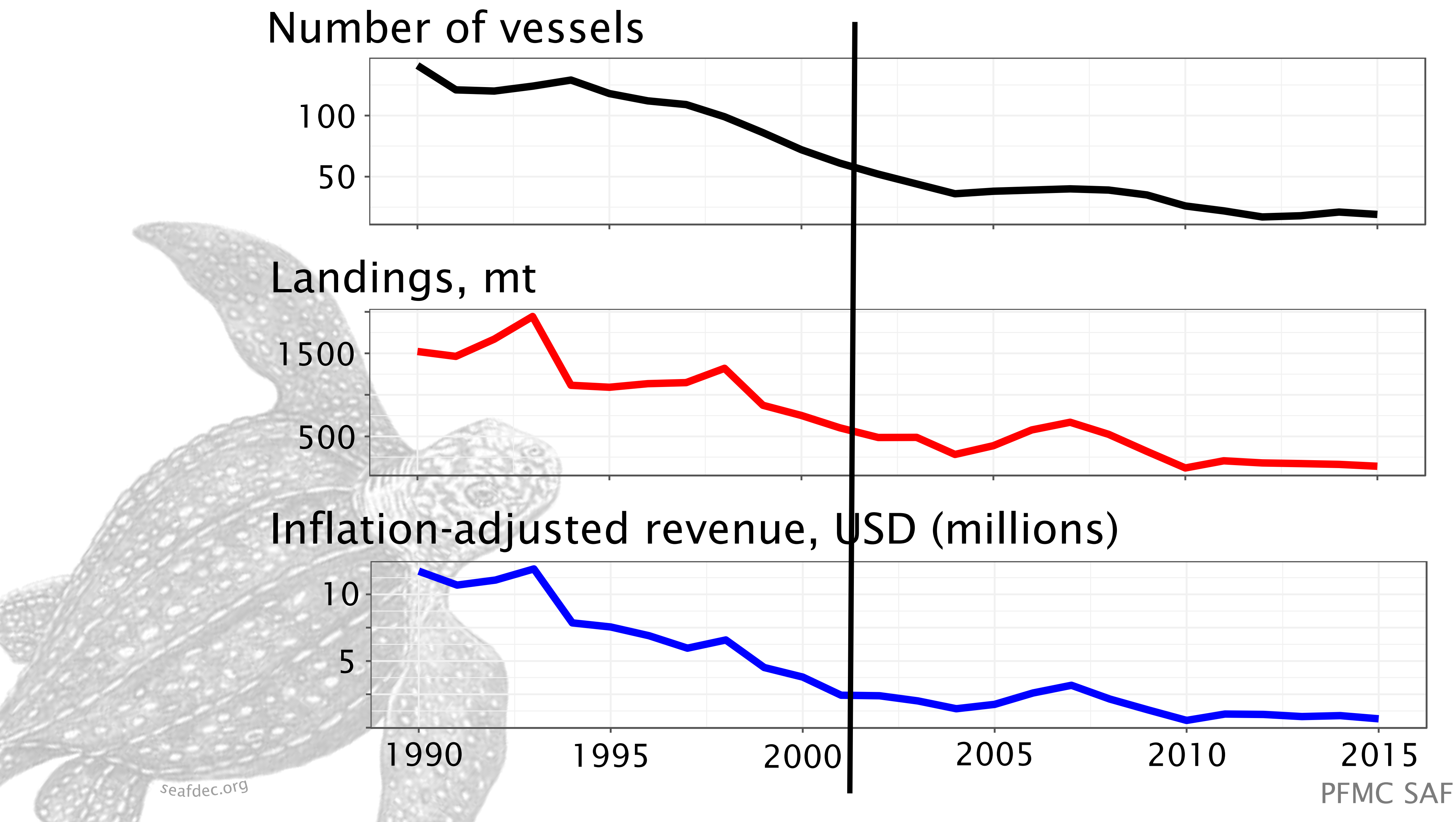


Common trends, total catch





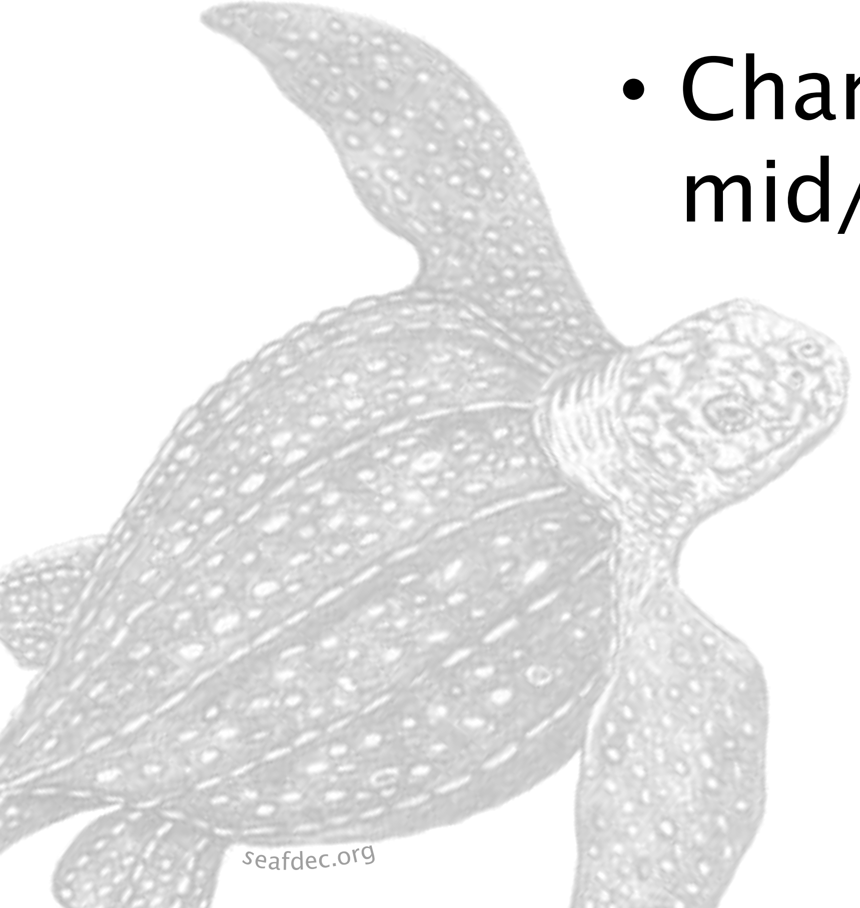
Overall declines in the fishery



PFMC SAFE

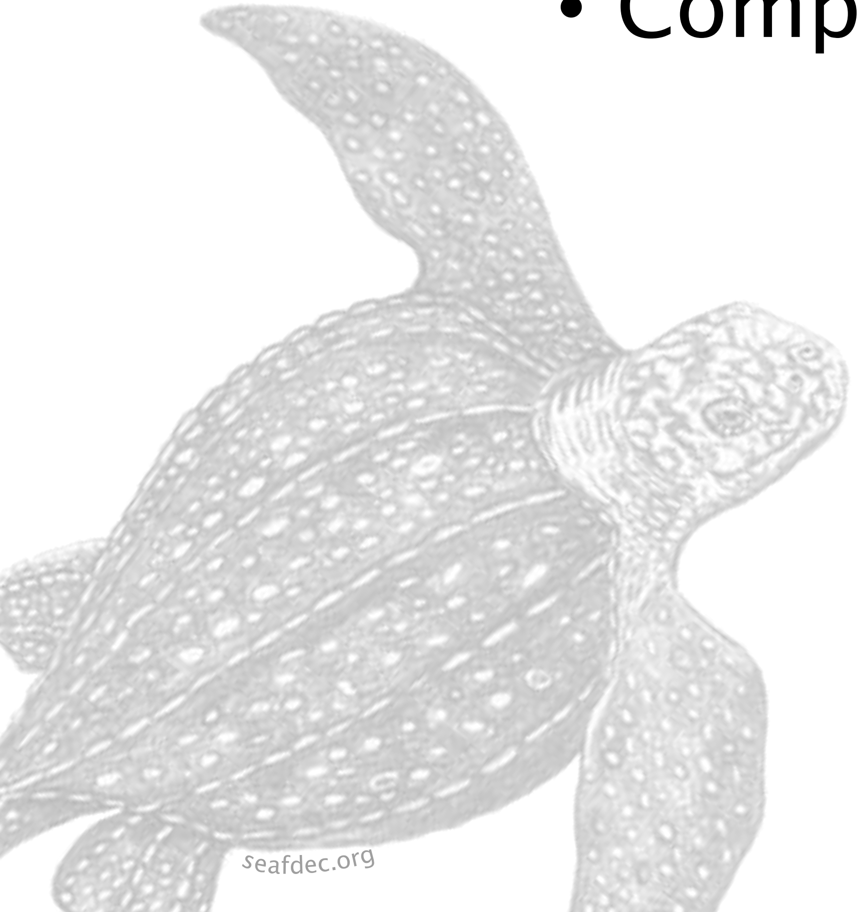
Conclusions:

- PLCA was beneficial for other protected species
- Changes were occurring earlier, in the mid/late 1990s



Future work:

- Interviewing fishermen
- Comparing El Niño events before/after PLCA



Thank you!

jgmason@stanford.edu