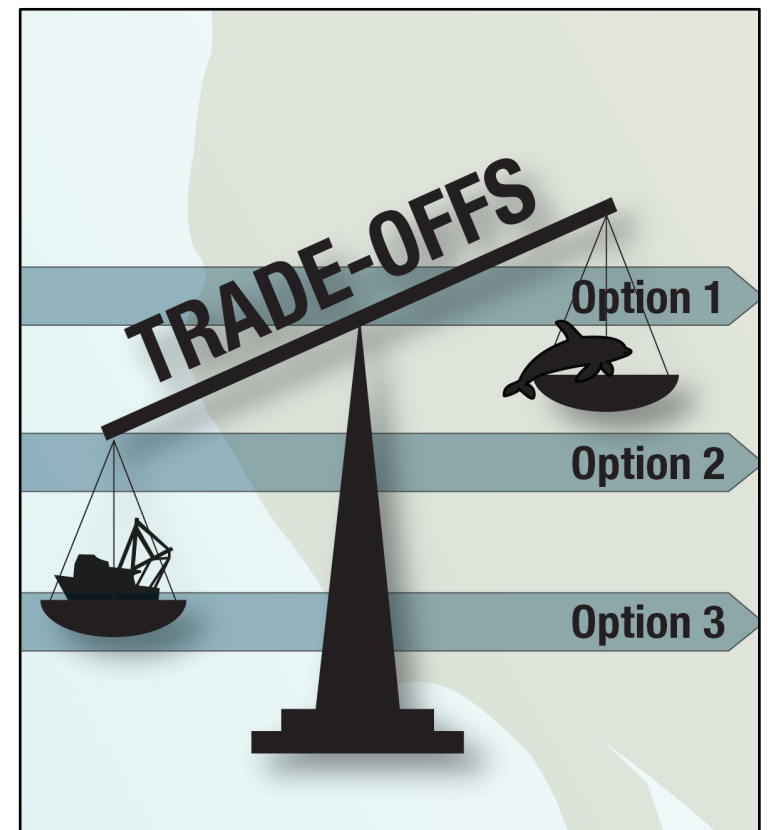



Chasing the moving target of sustainability: understanding tradeoffs between fisheries and conservation goals in a changing ocean

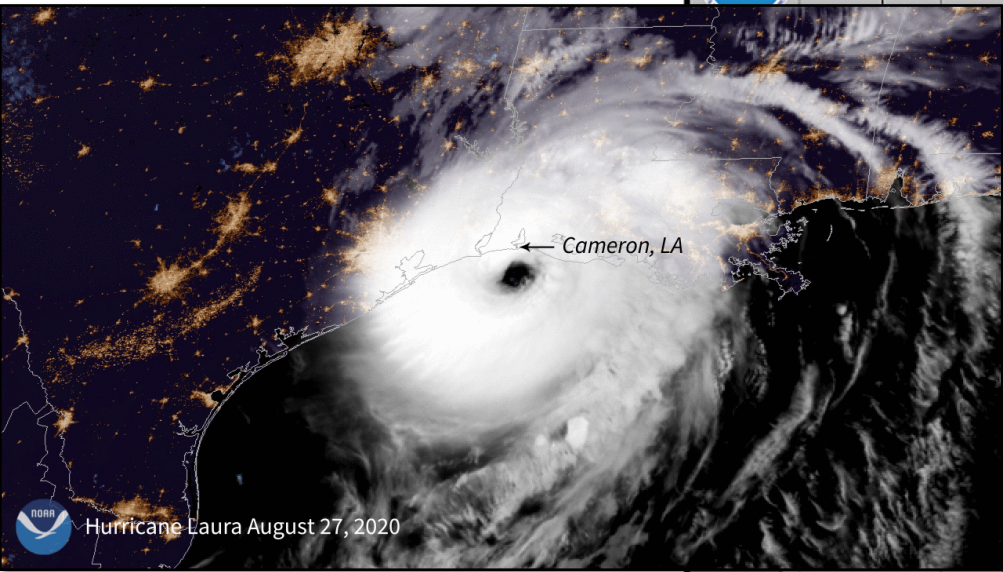
Jameal Samhuri, Briana Abrahms,
Blake Feist, Mary Fisher, Karin
Forney, Elliott Hazen, Dan Lawson,
Owen Liu, Jessica Redfern, Lauren
Saez, Sam Woodman



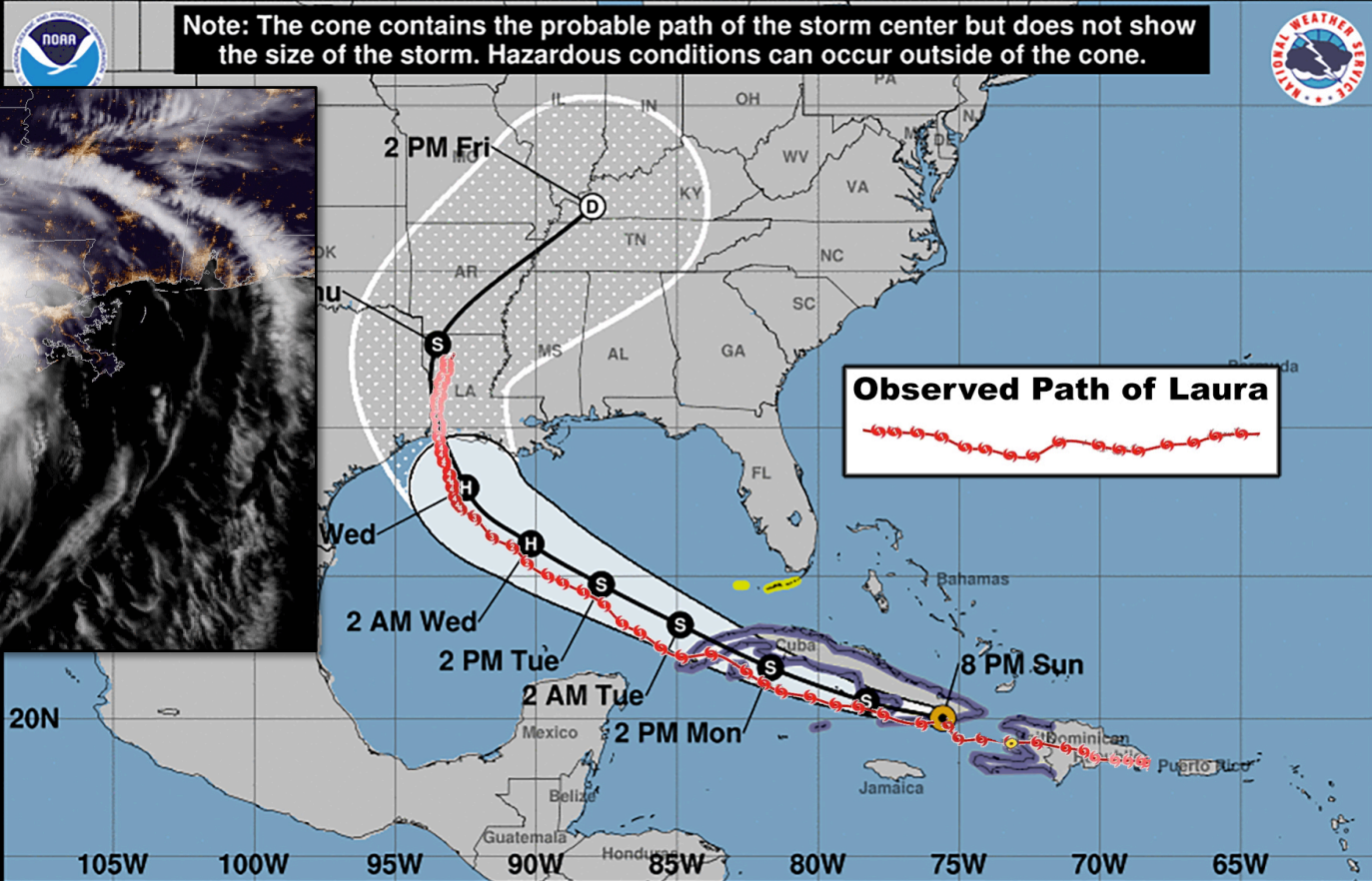


We are drowning in information, while
starving for wisdom.

- E. O. Wilson



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Tropical Storm Laura
Sunday August 23, 2020
8 PM EDT Intermediate Advisory 16A
NWS National Hurricane Center

Current information: ●
Center location 20.0 N 75.6 W
Maximum sustained wind 60 mph
Movement WNW at 21 mph

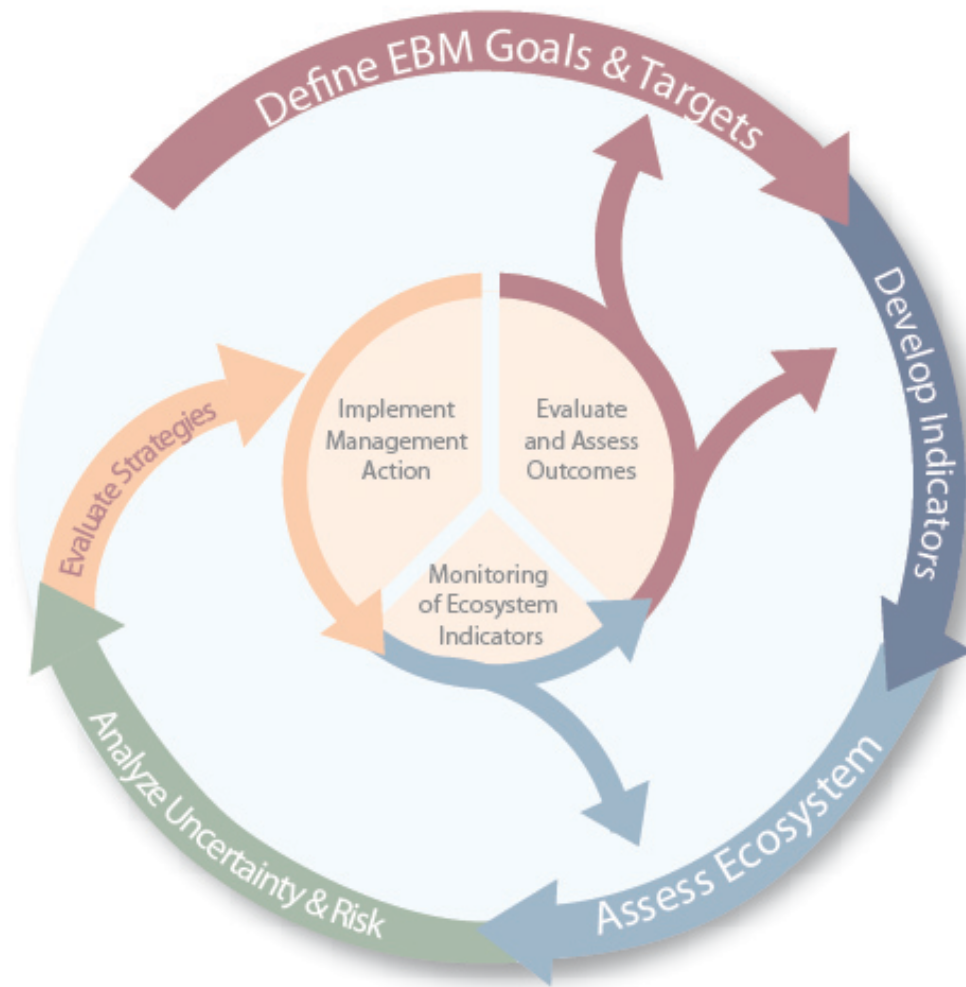
Forecast positions:
● Tropical Cyclone ○ Post/Potential TC
Sustained winds: D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:
Day 1-3 Day 4-5

Watches:
Hurricane Trop Storm

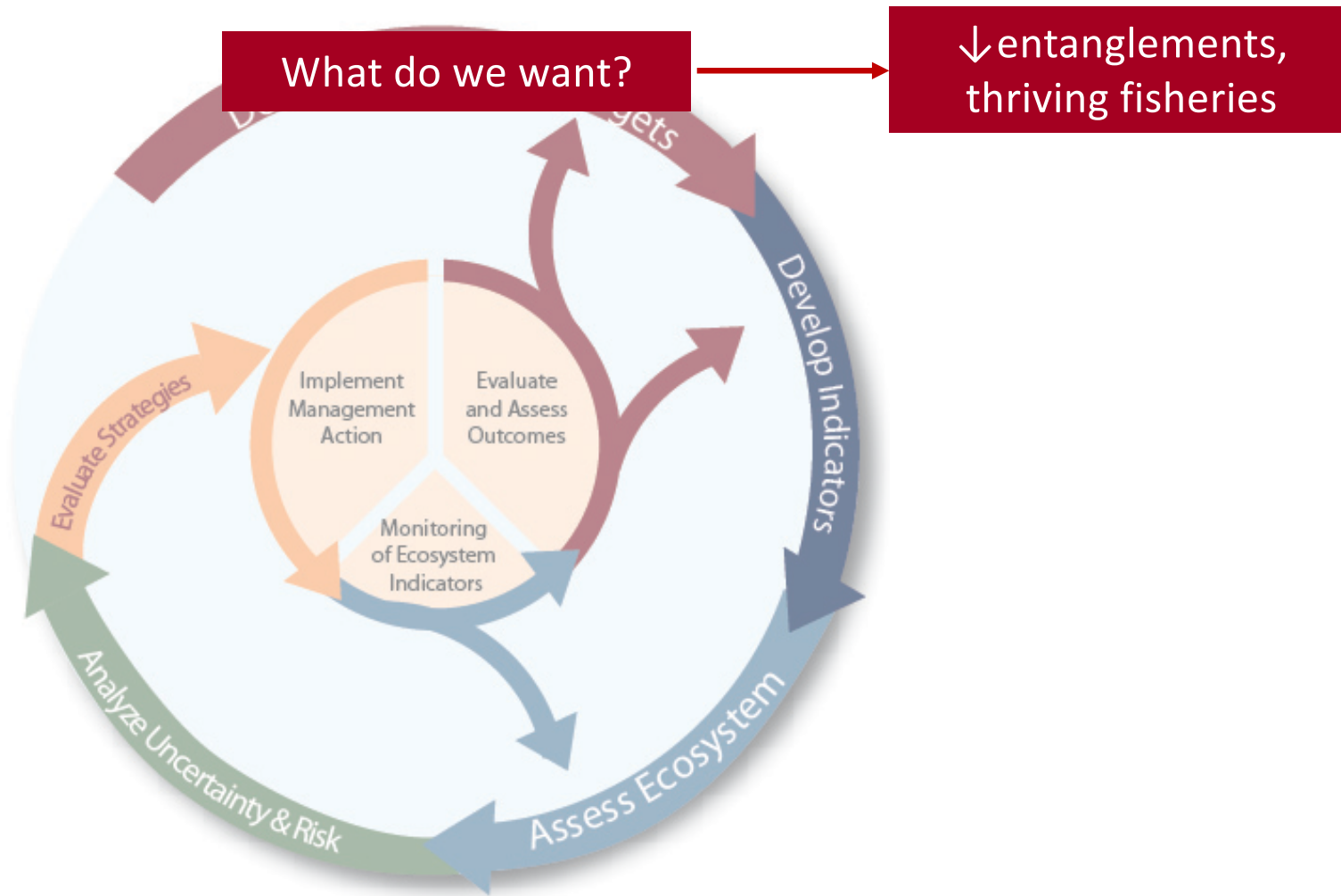
Warnings:
Hurricane Trop Storm

Integrated Ecosystem Assessment: *a framework for organizing science in order to inform decisions in marine management*

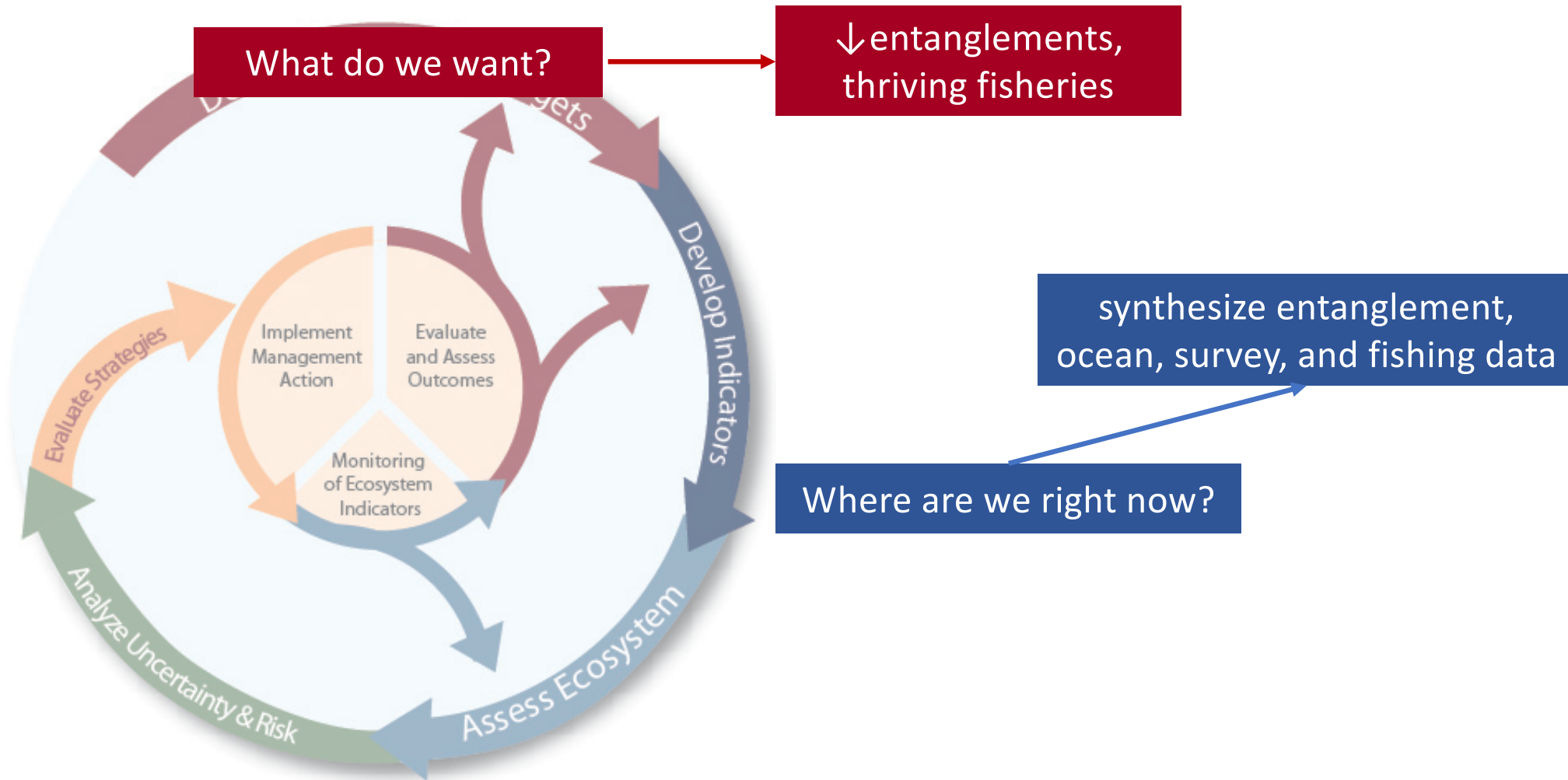


Levin et al. 2009, *PLoS Biology*

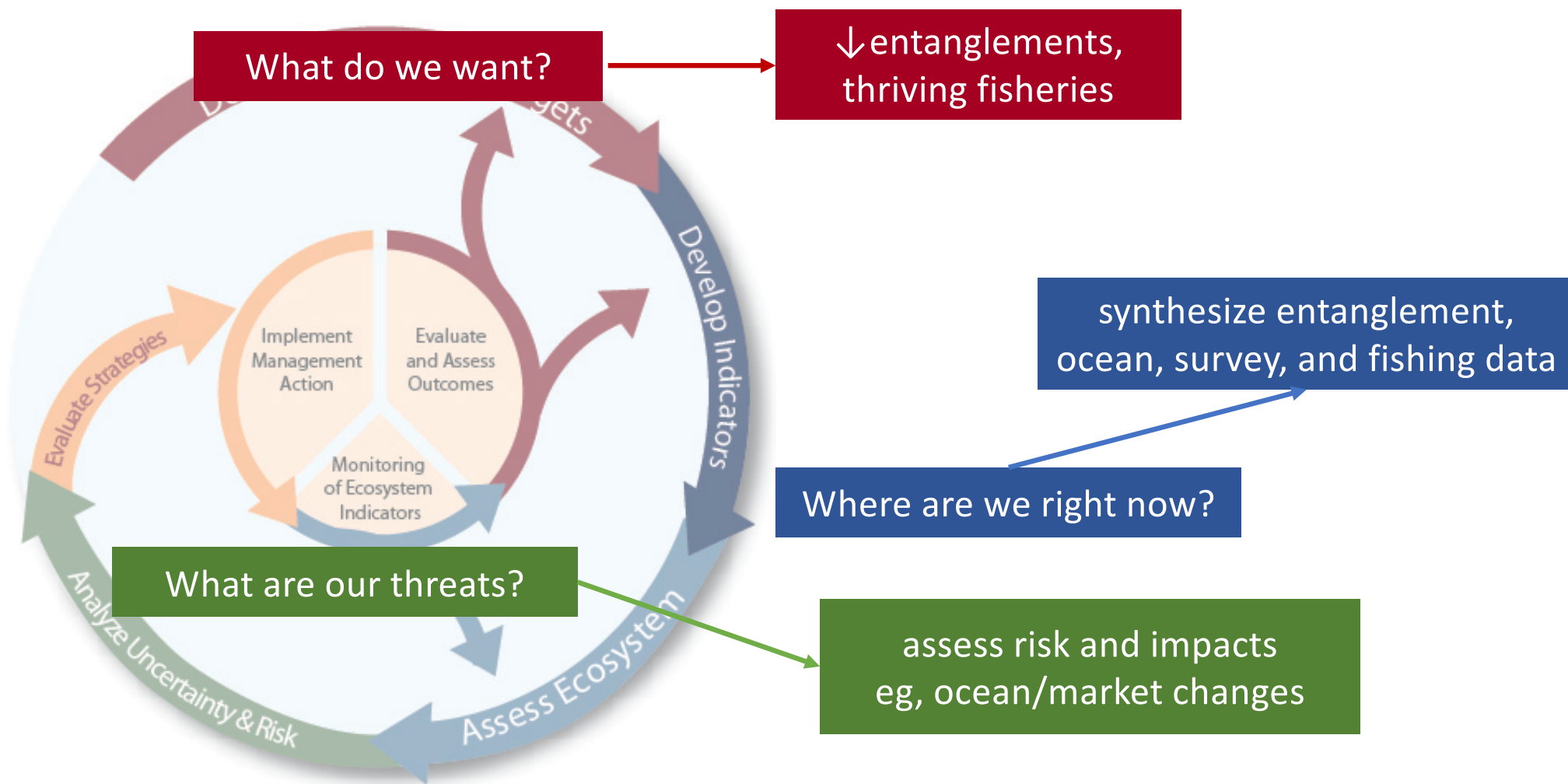
IEA to tackle entanglements



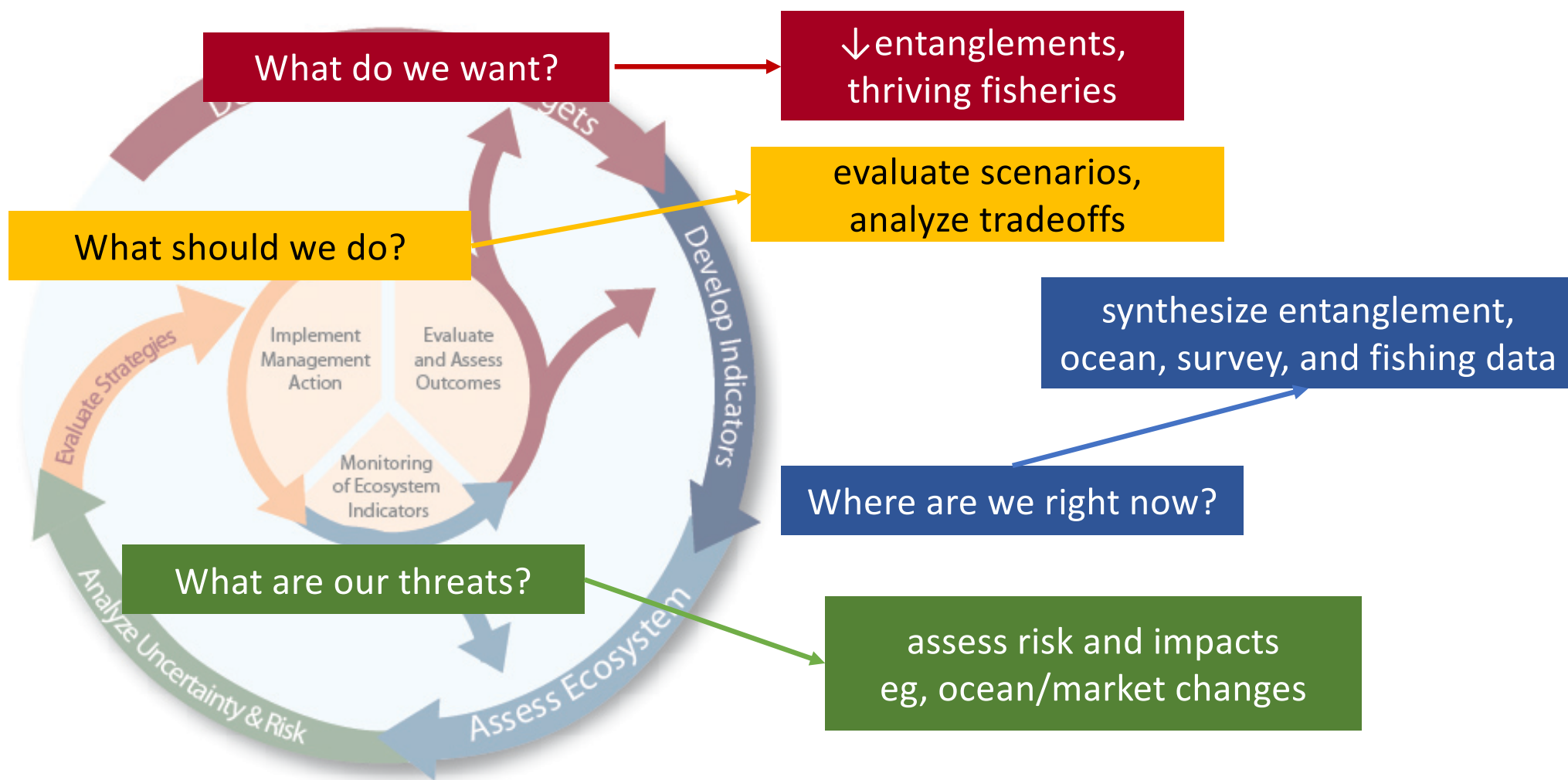
IEA to tackle entanglements



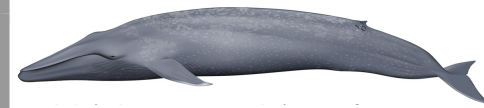
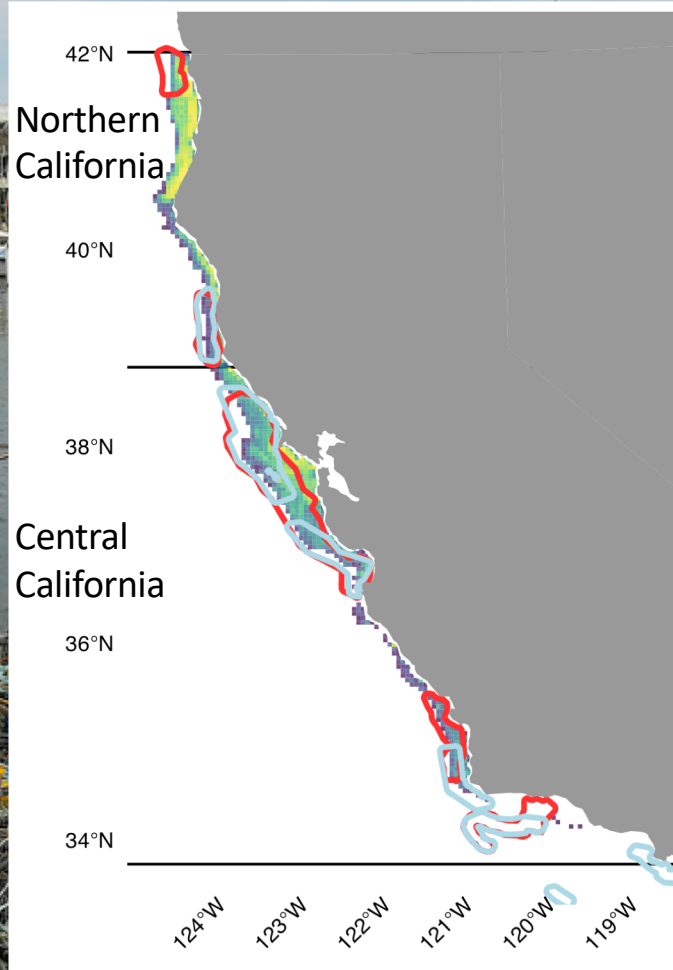
IEA to tackle entanglements



IEA to tackle entanglements

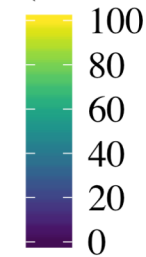


Retrospective analysis of whale risk and California Dungeness crab fishery revenue 2009-19



- Blue Whale BIA
- Humpback Whale BIA

DCRB Pings
(Percentile)



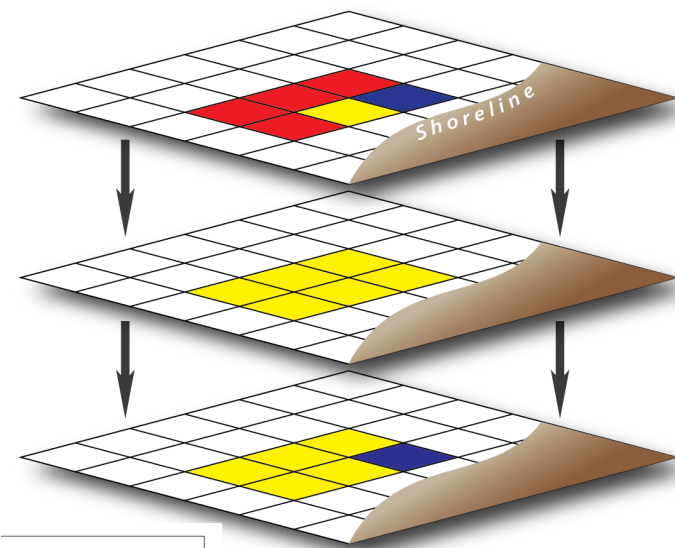
(Mean, Nov-Mar 2009-2018)



Quantifying whale risk and fishery revenue



Co-occurrence of whales and fishing



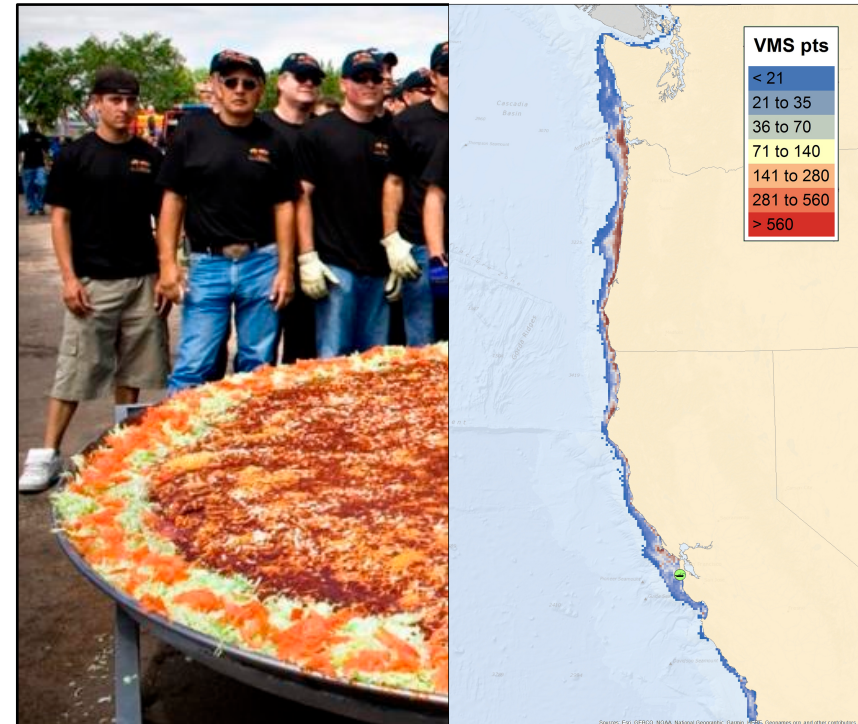
Fishing activity

Species distribution

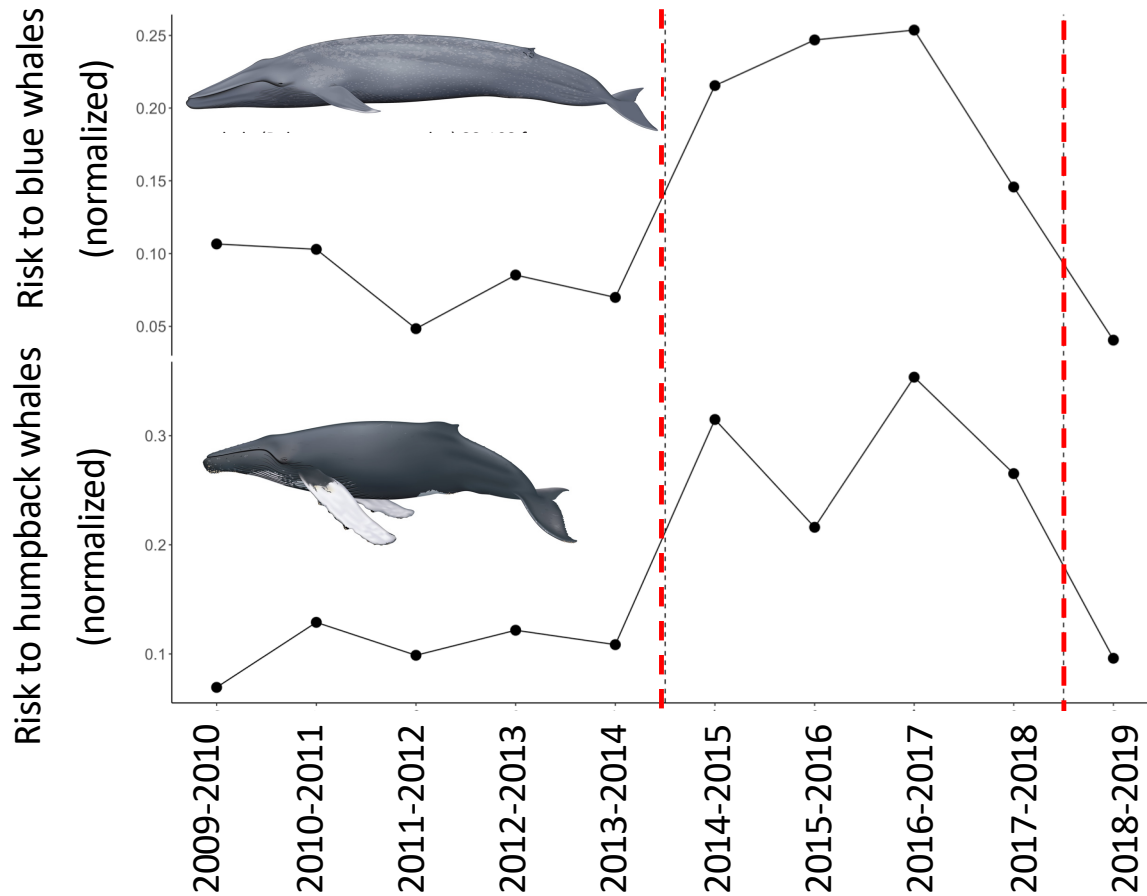
Risk

Abrahms et al. Feist et al.
Forney et al. Liu et al.

Fish-ticket informed VMS data



Whale risk high from 2014-2018

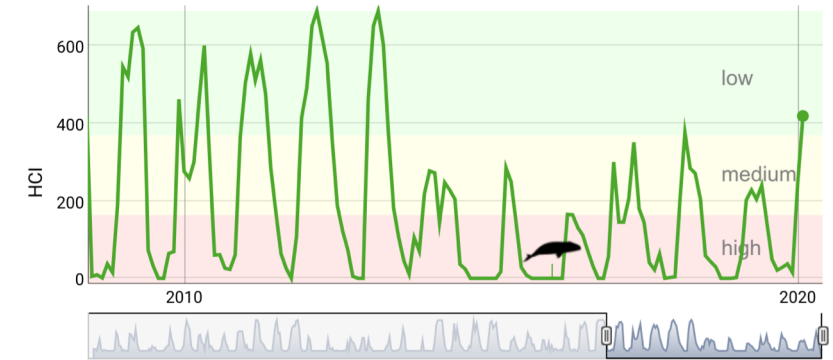


Habitat Compression

Shaded regions indicate relative likelihood of compressed habitat heightening entanglement risk

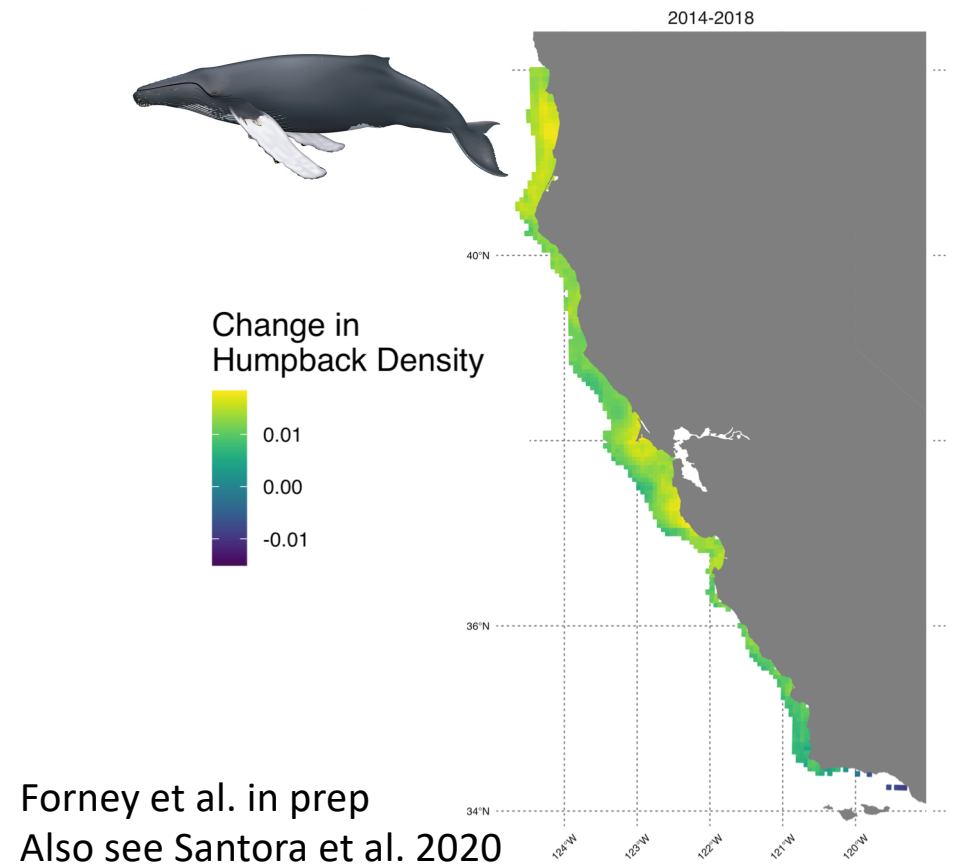
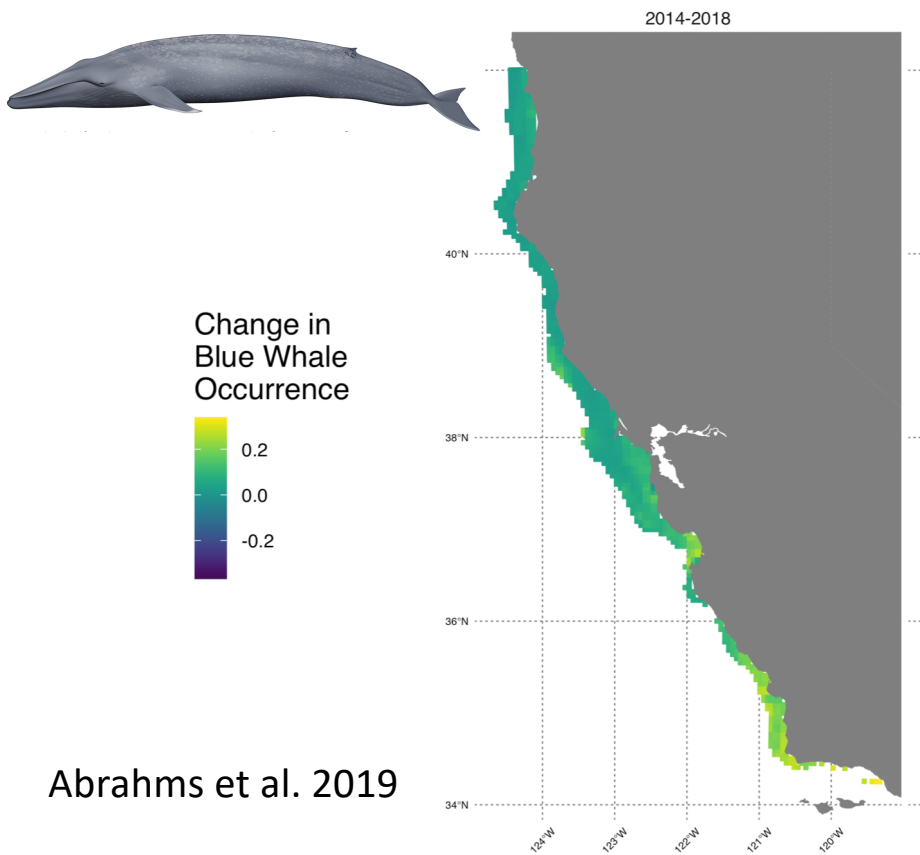
2020/02/01:

Habitat Compression Index (100 km²): 419

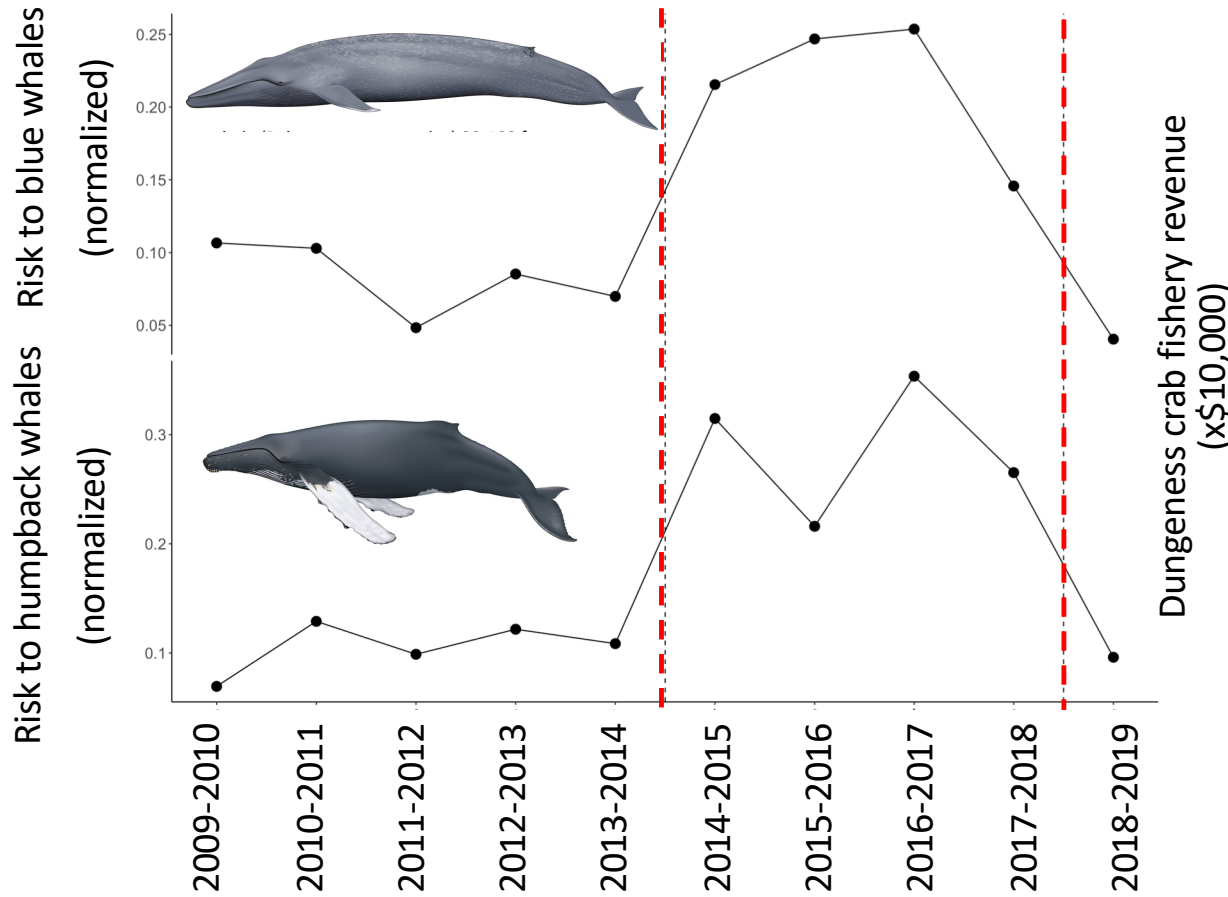


Courtesy Jarrod Santora / CCIEA

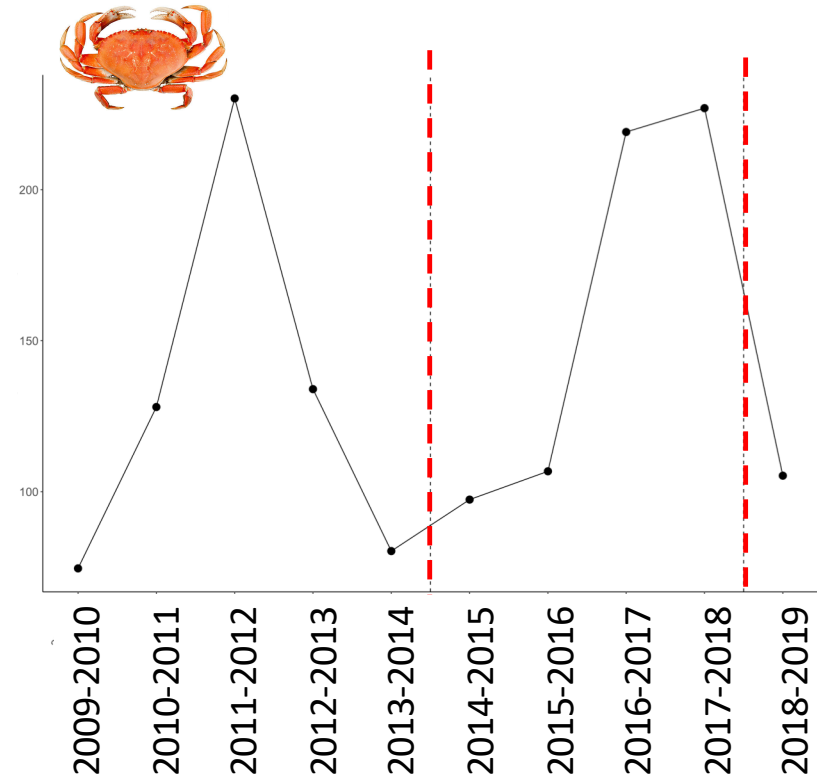
Whales more common on Dungeness crab fishing grounds during 2014-18 than before or after



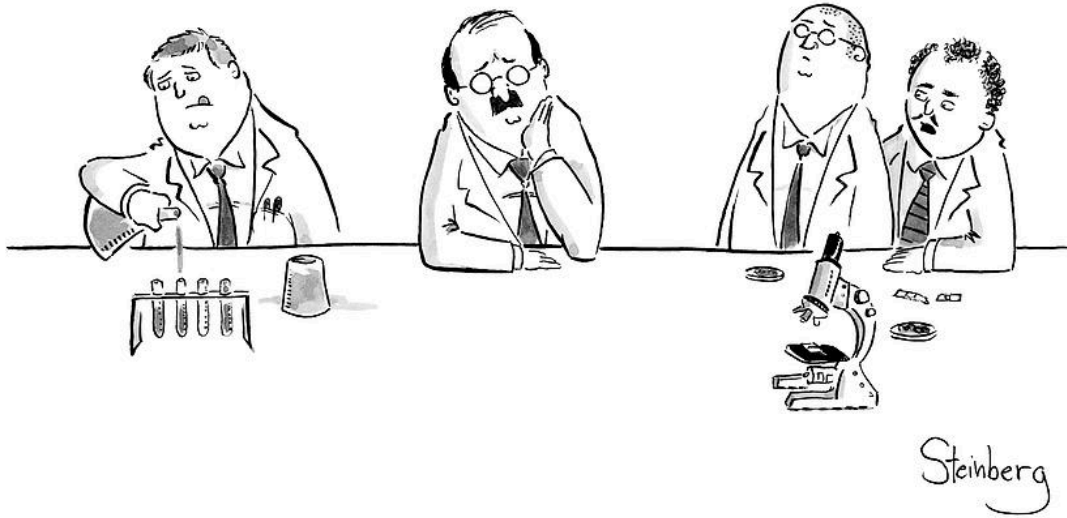
Fishery performance mixed 2014-18



Dungeness crab fishery revenue
(x\$10,000)



Tradeoff analysis to identify approaches for reducing risk to whales with least cost to the CA Dungeness crab fishery

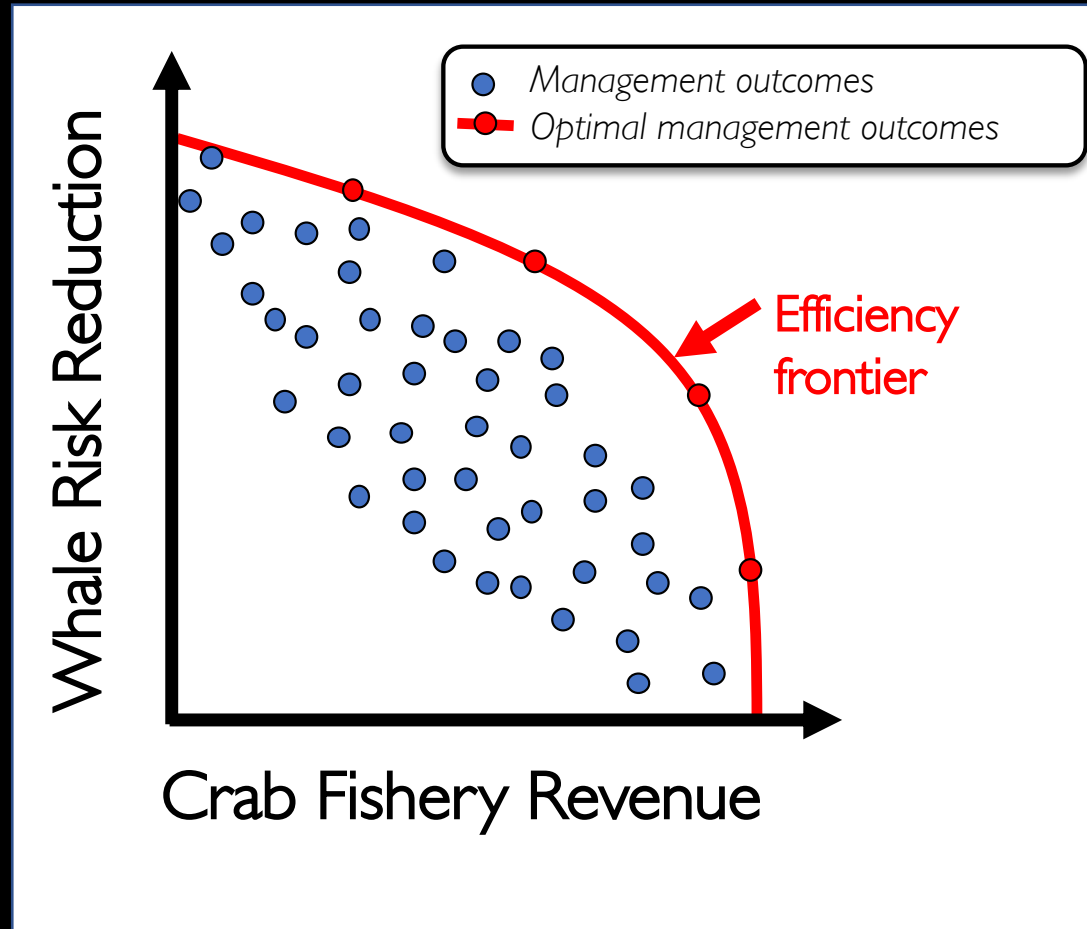


"His is a thought experiment."

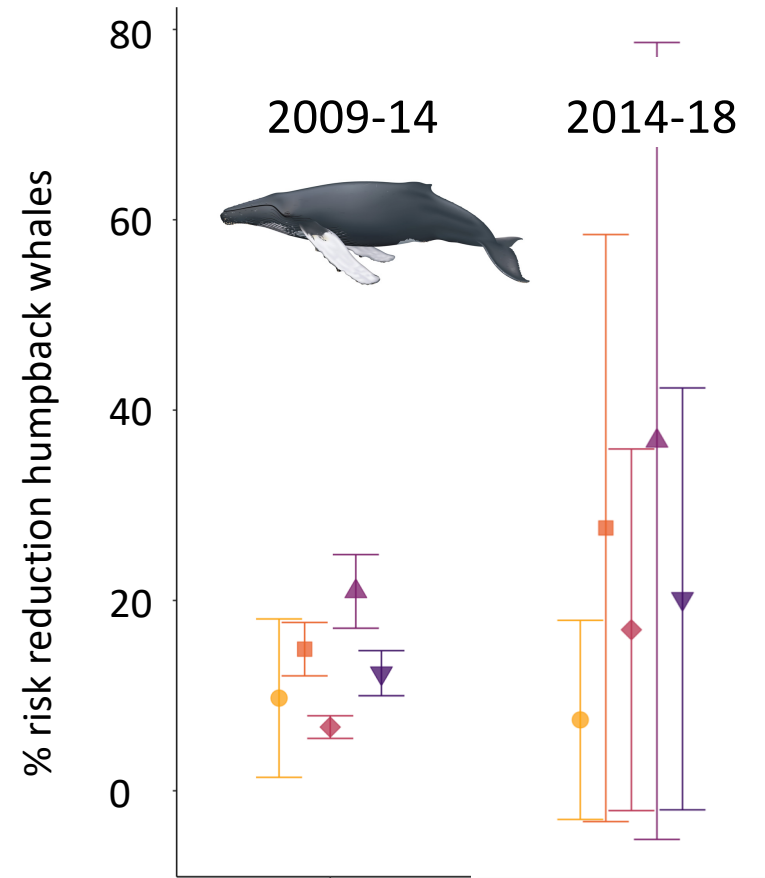
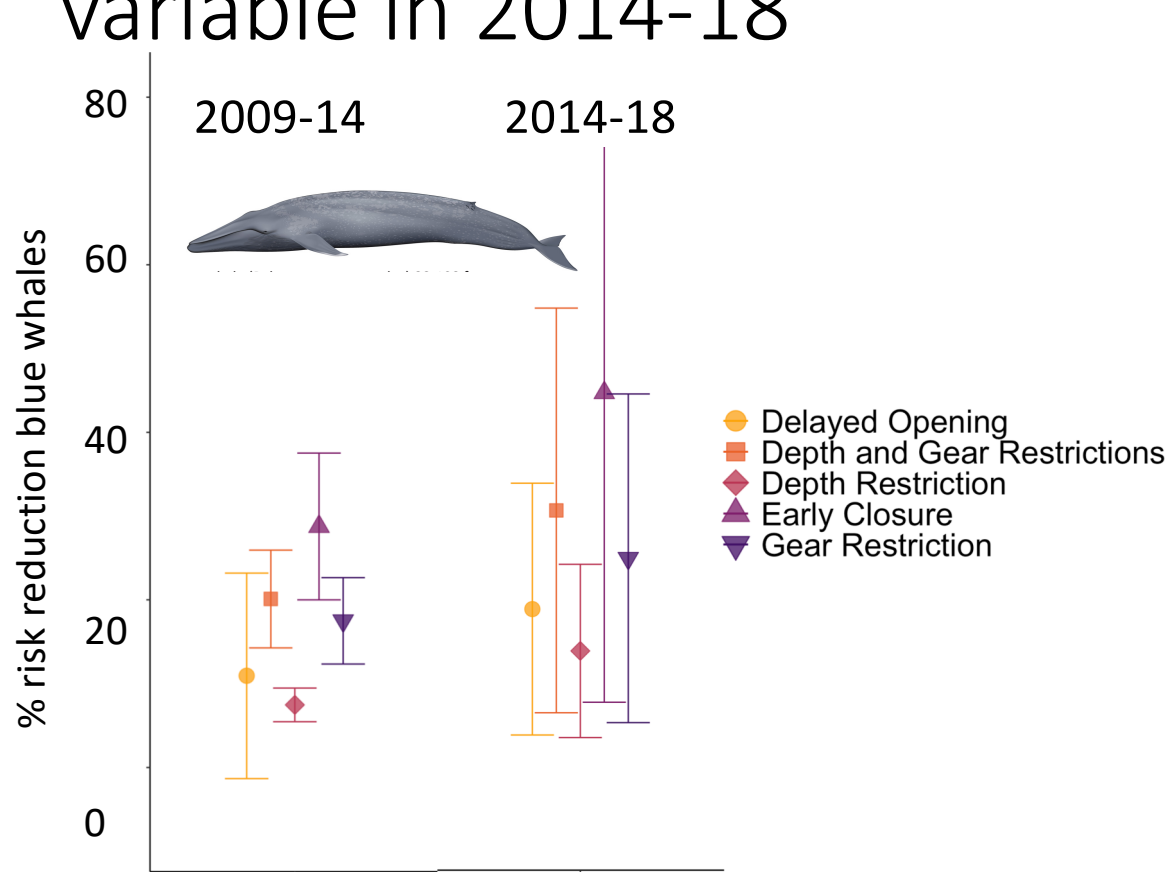


What
might
have
been?

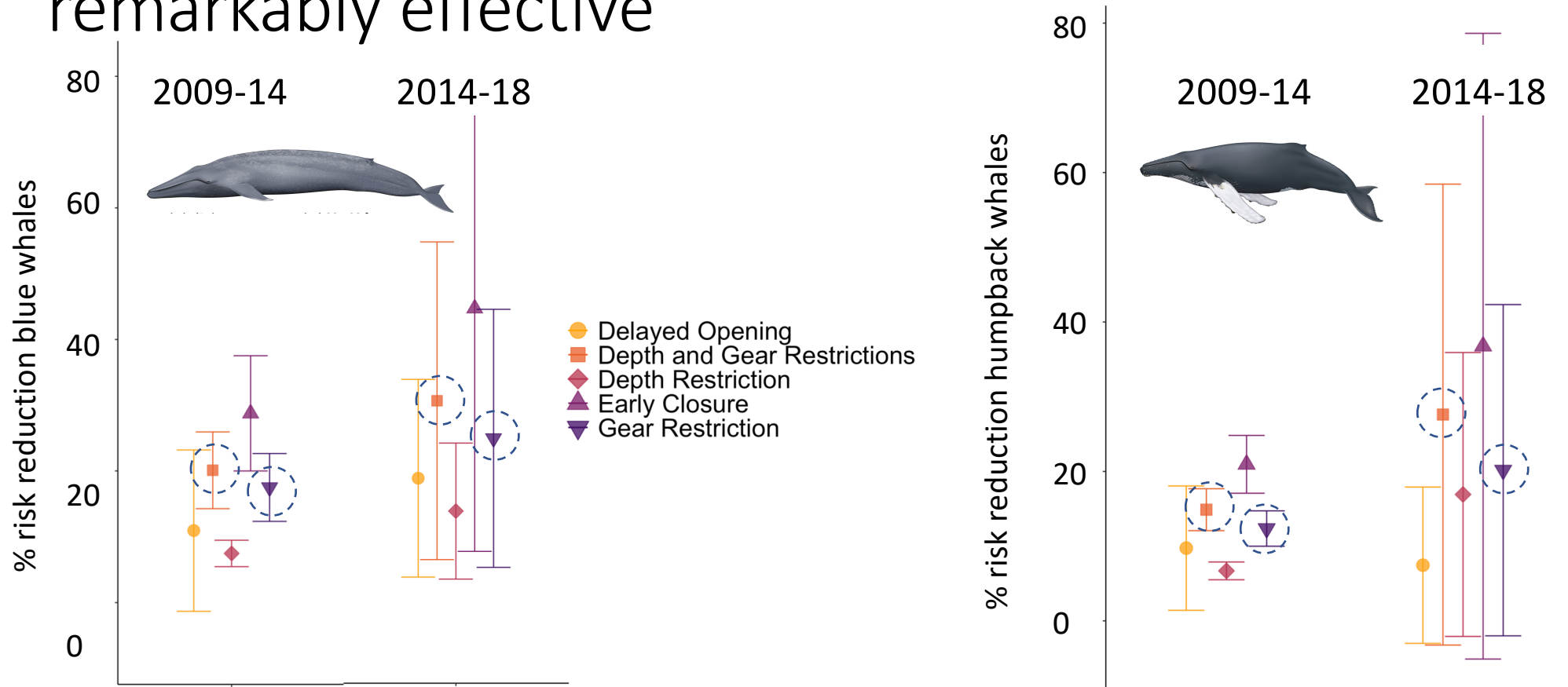
1. Delayed openings
2. Early closures
3. Spring gear reductions
4. Spring depth restrictions



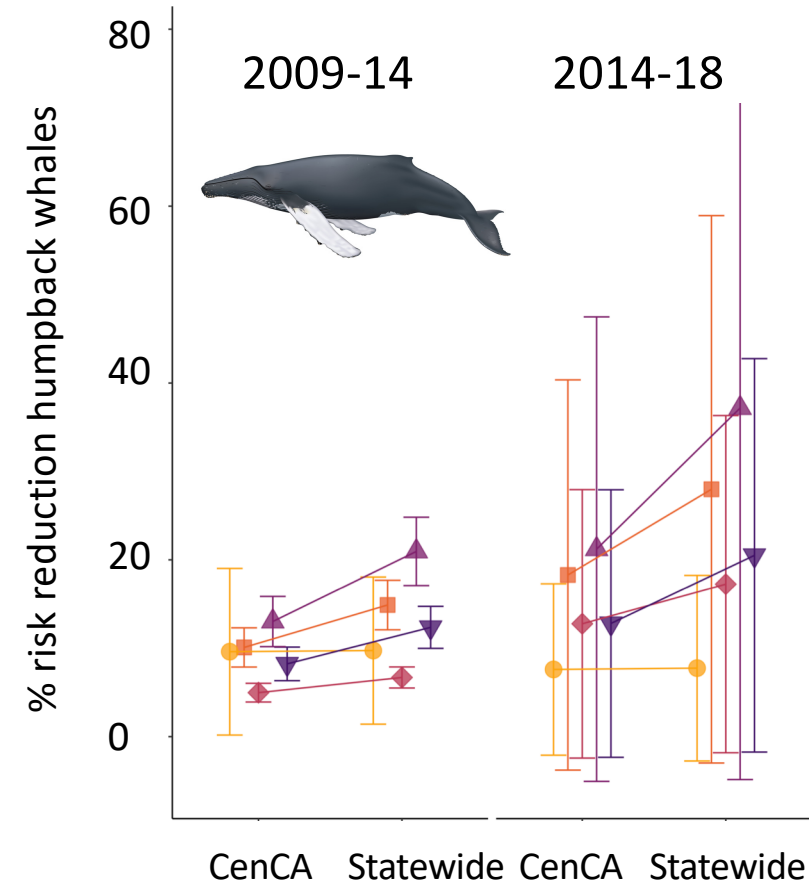
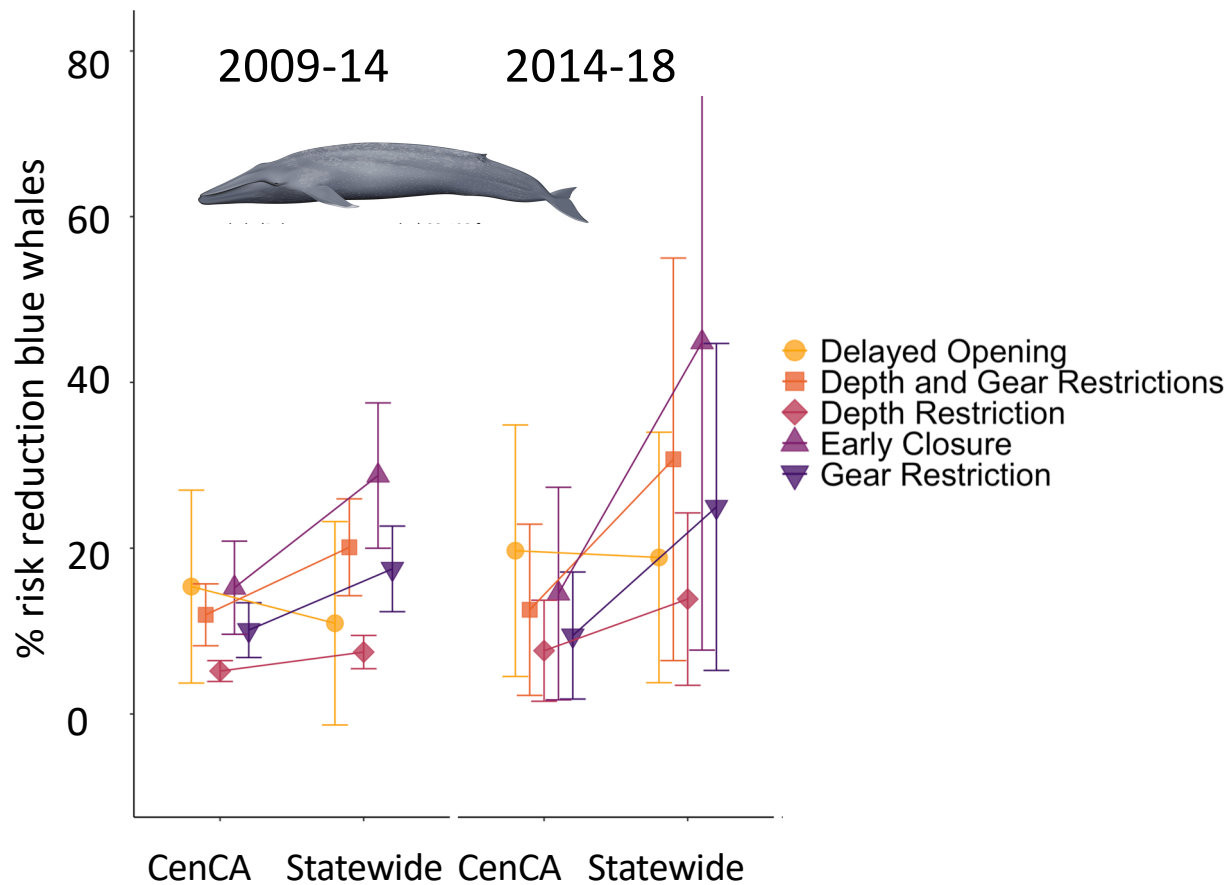
1. Expected risk reductions greatest and more variable in 2014-18



2. Spring gear and depth restrictions remarkably effective

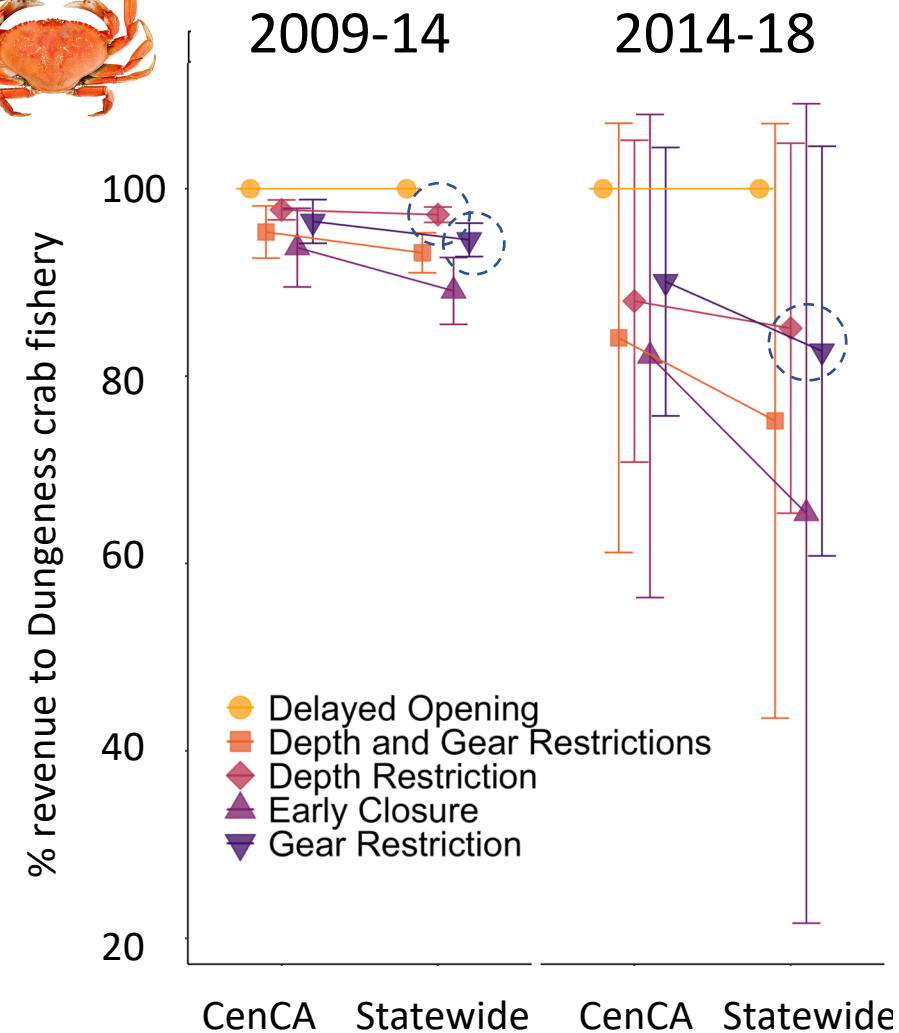


3. Statewide management actions reduce risk more than those affecting central California only



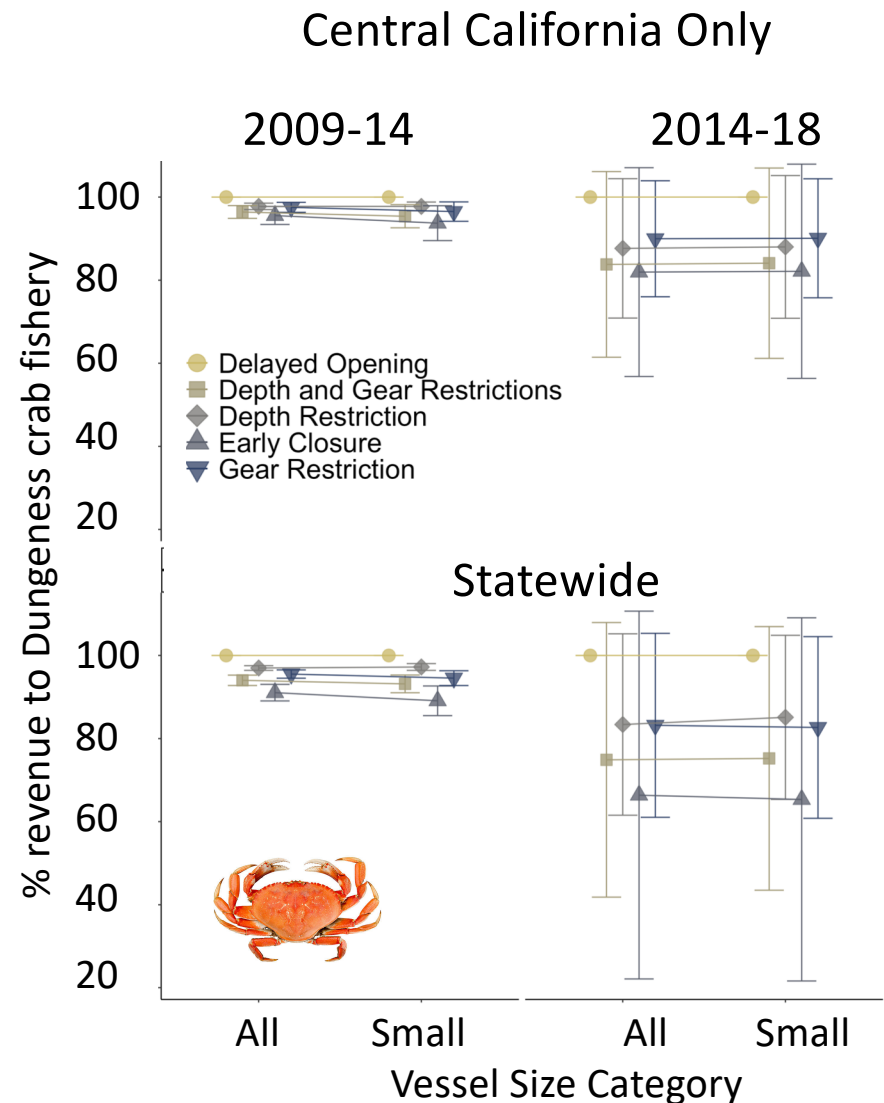
What about the fishery?

- Costs greatest and most variable in 2014-18
- Gear and depth restrictions less costly
- Statewide management actions cost the fishery more than those affecting central California only



Similar costs for small vessels

- Costs greatest and most variable in 2014-18
- Gear and depth restrictions less costly
- Statewide management actions cost the fishery more than those affecting central California only



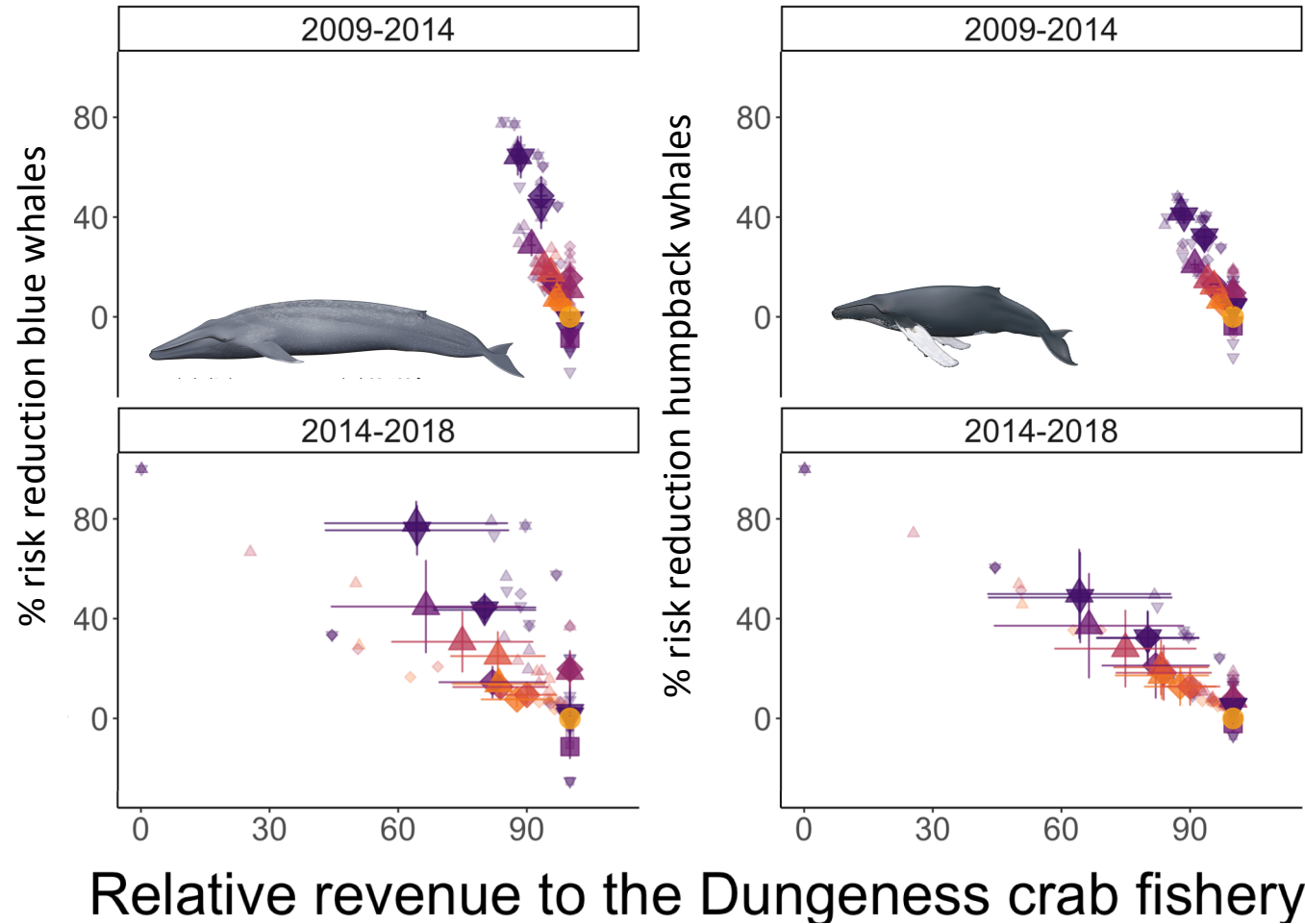
Tradeoff to the fleet is most stark in 2014-18

Scenario type

- Status Quo
- Depth Restriction
- Gear Restriction
- Depth and Gear Restriction
- Delayed Opening
- Early Closure
- Delay and Early Closure

Spatial domain

- Status Quo
- BIA
- ◇ Central California
- △ Statewide
- ▽ Hybrid



Take-homes

- Management strategies have different benefits to whales and costs to the fishery under alt. ocean conditions
- Depth and gear restrictions in spring alone provide substantial risk reduction at lower cost

Future work

- Hindsight is 20/20 → forecasting tools
- Consider add'l complexities: fleet heterogeneity, HABs, reactive measures

