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Community informed social indicators for the California **Dungeness Crab Fishery** under whale entanglement mitigation regulations

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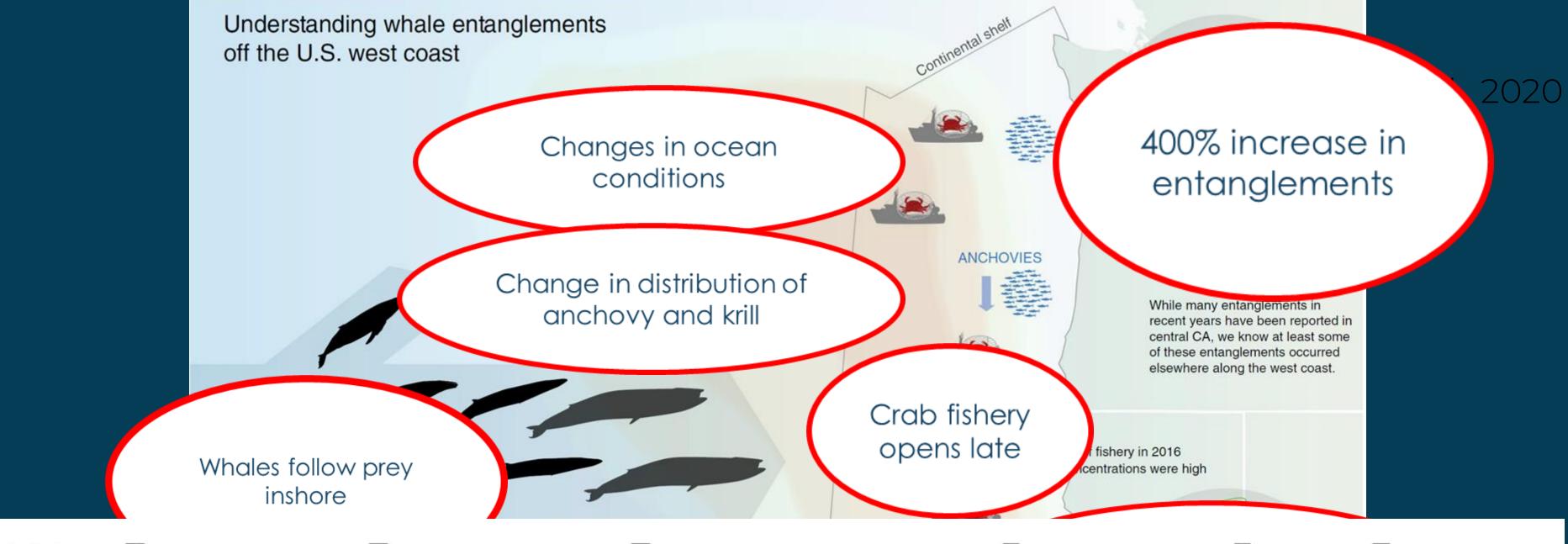




Southwes Fisheries Science







Feds sued over danger to humpback whales from pot-fishing gear

"Migrating whales shouldn't have to dodge deadly commercial fishing gear especially in national marine sanctuaries," a Center for Biological Diversity attorney said.

Two objectives

Understand how and why actions taken to mitigate whale entanglements are impactful to the fishery (to develop a set of considerations that could guide decision making)

Develop a set of community-informed social indicators (variables that can be monitored to tell us how well the fishing community is doing beyond state level landings and revenues)



Why social indicators?

Sometimes large
revenue losses are
associated with
delays/closures

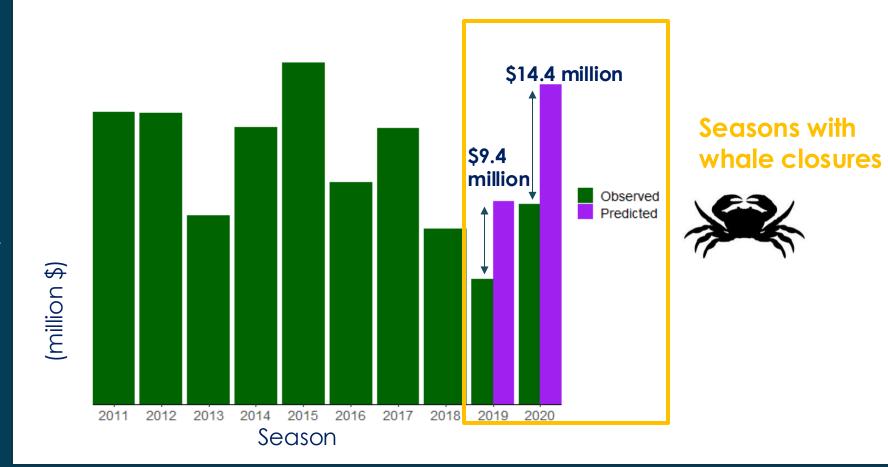
2. Even when the majority of crab available gets caught(more complex than just reducing fishing opportunity)

3. Highly variable betweenmanagement areas and vessels(it doesn't affect everyone equally)

Seary, R., Santora, J., Tommasi, D., Thompson, A., Bograd, S., Richerson, K., Brodie, S., Holland, D. (2022). Revenue loss due to whale entanglement mitigation and fishery closures. Scientific Reports. https://doi.org/10.1038/s41598-022-24867-2.

Dungeness crab revenues in Central California

Figure: Estimated revenues lost during seasons with closure periods (green = observed revenue, purple = predicted revenue)



Why social indicators?

- California level landings and revenues are not the full picture
- Social indicators specific to this fishery to monitor the situation in the context of the (continuing) regulation change



Photo: NOAA Fisheries

Sopiatind idet in stabley variable that indicates Theogises syt ooverd suare regulation picture impact on both ecological and ecologia objectives whale

entanglement

social objective = a productive and

equitable fishery

Photo: CDFW

Communityinformed approach Interview Participants (N=42)

Likert scale questions to test a-priori indicators & open ended questions

3 sections:



Impact and adaptive actions

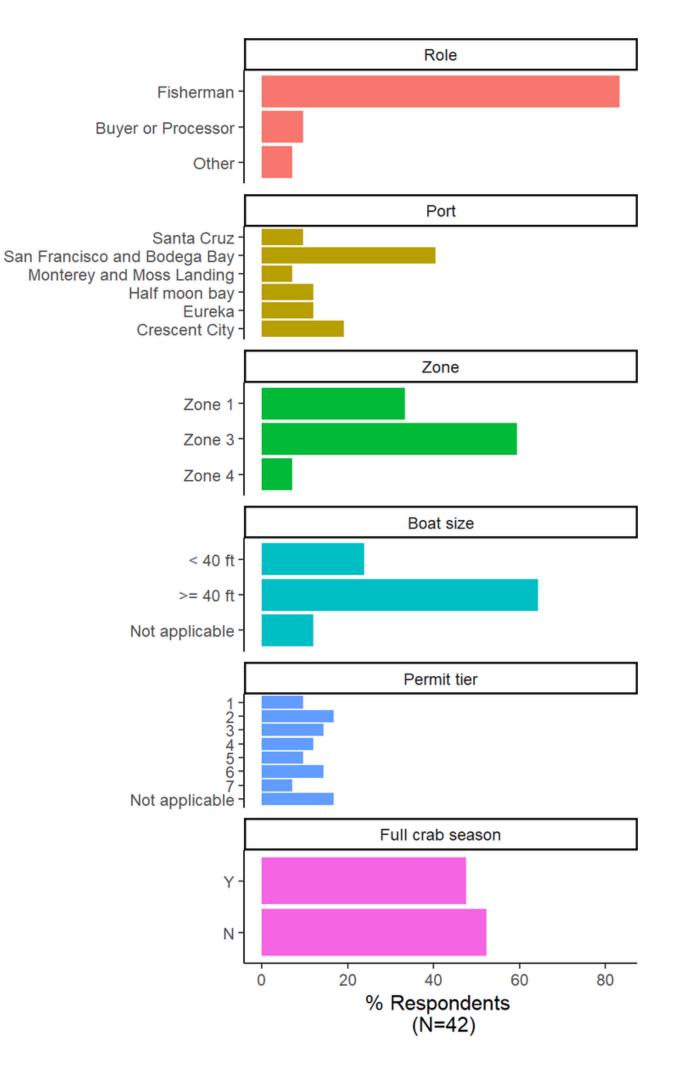


Indicators



Management recommendations

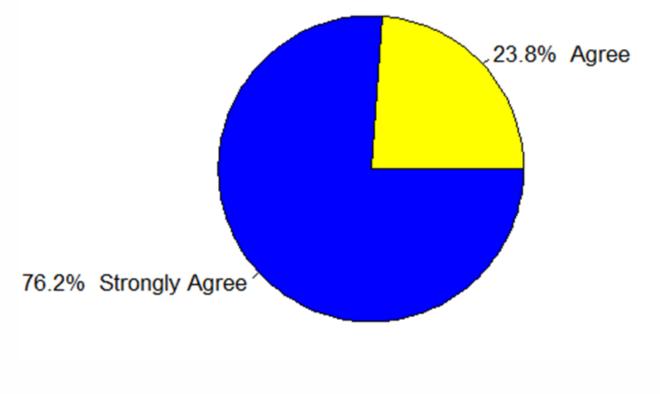
Demographics Participant



RESULTS

Ranking of impacts

Statement: Delays or closures because of whales affect me



• All participants affected in some

way

• But impact of interventions ranked differently by some groups

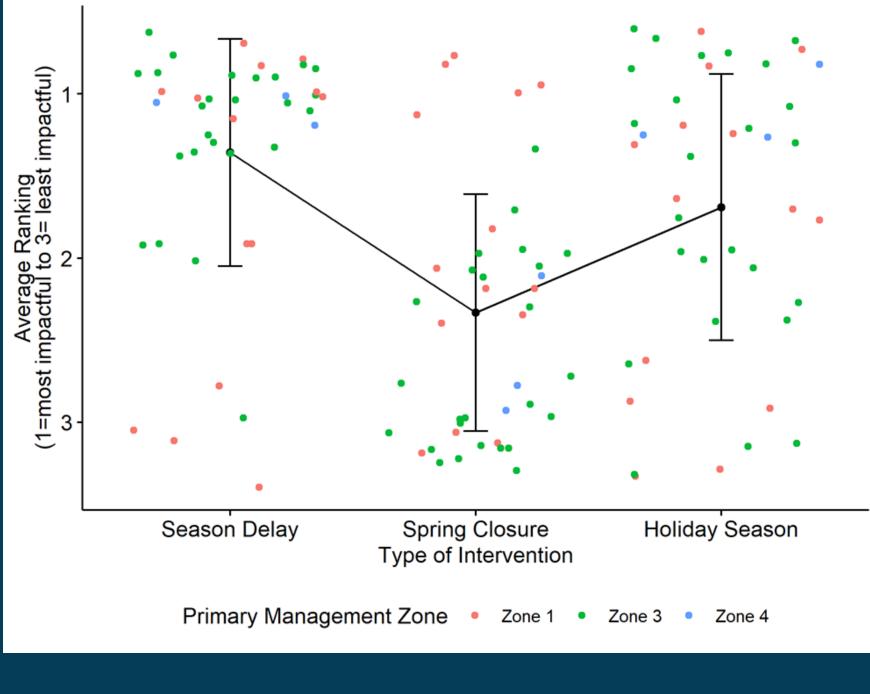
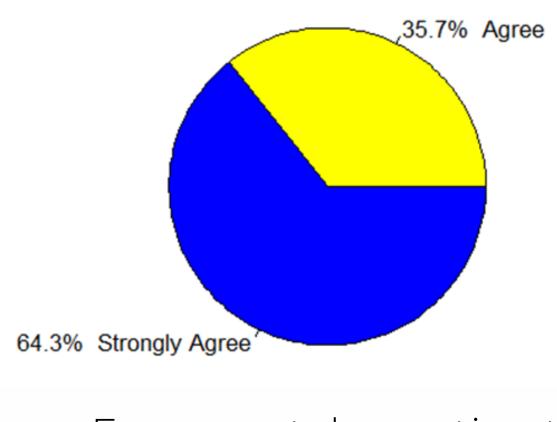


Figure: Ranking of impacts from worst (1) to least (3) by participants, by fishing zone.

RESULTS

Adaptive actions

Statement: I have changed my routine or behavior



• Everyone takes action to adapt



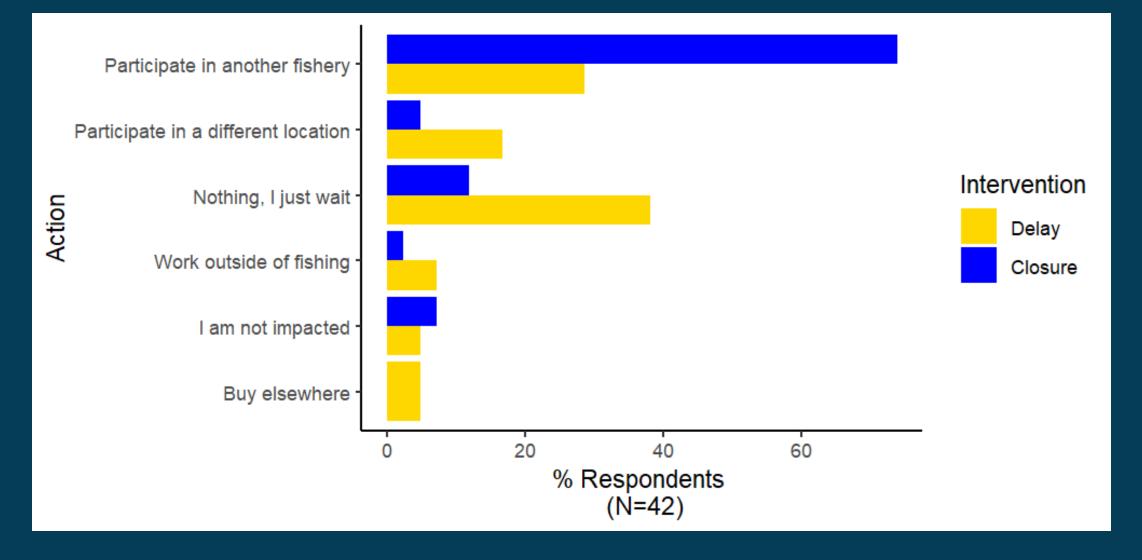


Figure: Actions taken by participants in the event of a delay or a closure to the fishery.

• But different adaptive actions between different types of management interventions

RESULTSA-priori indicators tested

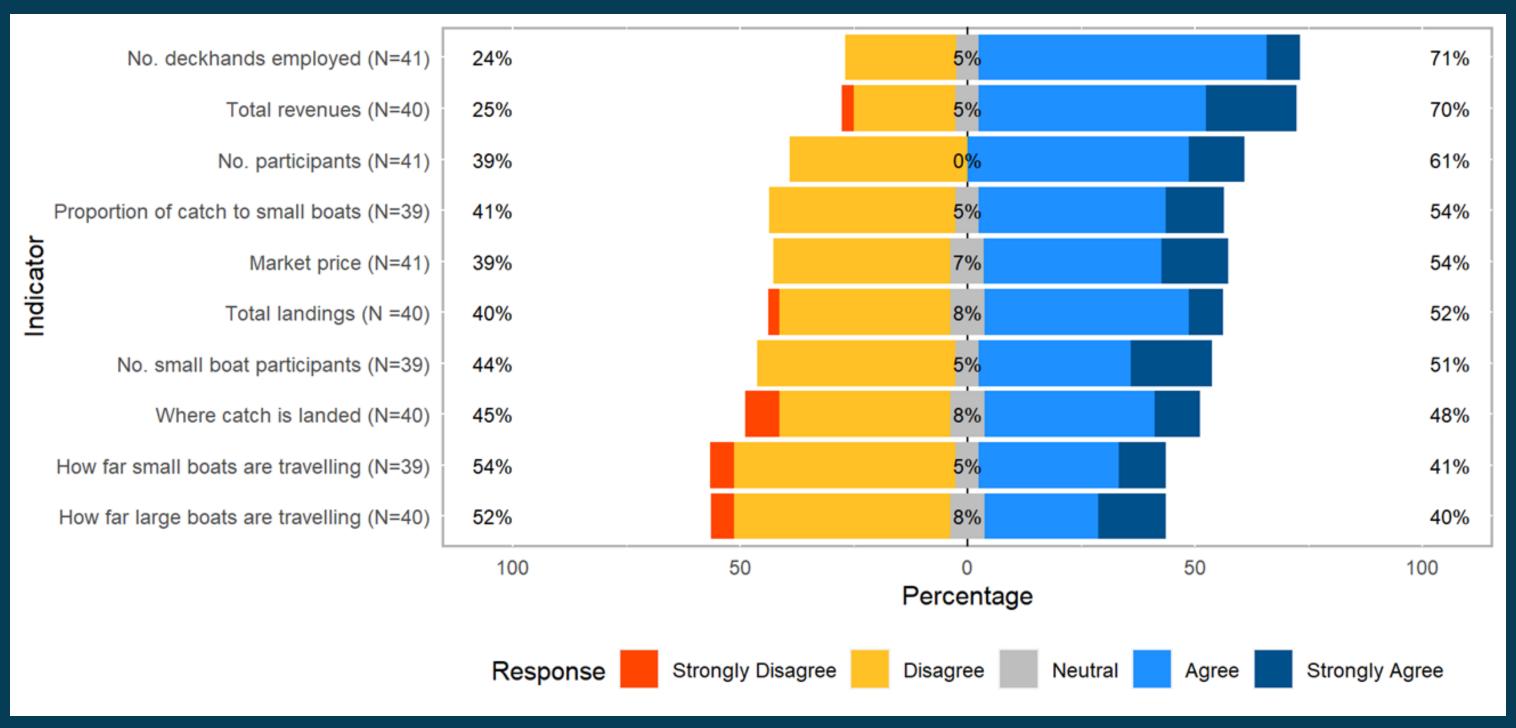


Figure: % of agreement across participants for each indicator tested

RESULTS - New indicators

Cost of participation

Travelling Small boats travelling Fuel price Bait price Cost of participation Large boats travelling License fee Tag fee

Coping behaviours

Effort shift to other fisheries

State of the salmon fishery

Employment outside of fishing

Fishing out of state

Diversification

Availability of alternate fisheries

Shift in species purchased by buyers

Opportunity for other employment

Shift in buying to different zones

Adoption of supplemental fisheries

Shift to conglomerate operations

Wellbeing

Mood of the fishermen Bad press Complaints Mental health Conflict between fishermen Port atmosphere Stress Family impacts **Fisherman struggling** Community Conflict between north and south Drinking and smoking Frustration in the fleet

Reliability of the fishery

Advanced warning on regulation Deckhand availability Permit value How far deckhands are coming from Transparent regulation Uncertainty on regulation Fishery buy-in Consistent regulation Quality of deckhands Boat value Deckhand earning potential Young participants Information available on whale distribution

State of the market

Market price Freezer stocks Timing of north and south openers Out of state crab buying Early start to the season Flooded markets Buyers purchasing indirectly though larger live buyers Price by large buyers Public perception

Investments

New equipment Boat maintenance Investments New trucks Reduced spending New boats New permits New houses Upsizing for resilience

Port economy

Harbor business revenues The economy Spending Coastal community's economy Bait sales Impacts on restaurants and bars

Demand Buyers present Customer demand Demand from buyers Direct from boat sales Direct to consumer sales Customers at the port

Financial wellbeing

Fishery exits

Haul-outs

Debt

New loans

Savings for retirement

Disaster relief payments

Tax schedule

Holiday period opportunity Deckhands employed Effort shift between zones Total landings State of the resource Domoic acid events Poor weather Season length **Fishing opportunity** Crab volume Location of catches Small boat catch proportion Crab available for purchase Work effort Quality delays Whale population status Crab cycle Closures COVID pandemic Crabs on the clutch entanglements Boats tied to the dock Crabs on the bite RAMP scoring Time on the water Individual landings Frequency of offloads Local level landings Lost gear Regulations Catch Heatwaves Abundance of short crab Aggressive fishing Catch per unit effort (days) Home port landings Lost opportunity for buyers Ocean health Port level landings Sales of whale safe crab Stacking out early Water temperature Whale distribution

Use of alternate management options Experimental fishing permits Non-crab gear or unconfirmed Ability to use alternative gear Crab being sold by buyer processors Whale entanglements the season prior Widespread good landings

Safety Safetv **Risk taking** Risk taking in bad weather

Bad decision making by fishermen

Income

Total revenues Making bill payments Loss of income Periods of no income Individual revenues

Revenues to small boats Local level revenues Small boat income loss

Income

Agency

Opinions heard by managers Lawsuits against regulators Transparency on whale counts Transparency on whale population status

Fishery exits

Boat sales Permit sales Trap sales

Figure: Community informed potential indicators by theme

Opportunity to fish crab

Next steps

- Refine list of measurable indicators
- Refine further to those with existing data and test them
- Deliver a set of social indicators that can be monitored via a publicly available platform

TAKEAWAY MESSAGES

Social Indicators

Indicators approach is robust to other climate and extreme event disturbances (not just whales)

COUNCI

Community informed

Community informed social indicators can provide useful insight to the management of complex socio-ecological challenges

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