Squid Fishery Advisory Committee Meeting 3
Via Zoom Teleconference
May 16, 2023, 9am-1pm

Key Outcomes Memorandum

OVERVIEW

The Squid Fishery Advisory Committee (SFAC or Committee) held its third meeting on May 16, 2023 via Zoom. The goals of the meeting were to:

- Review key takeaways from the April 18, 2023 SFAC meeting;
- Review constituent feedback on fishery management effectiveness related to fishing effort, refine ideas and consider strengths and limitations;
- Provide an update on Empirical Dynamic Modeling (EDM) and data exploration and invite dialogue around testing various management strategies; and
- Review MLMA goals in the FMP.[1]

PARTICIPANTS

The following SFAC members attended: Caitlin Allen Akselrud, Richie Ashley, Ryan Augello, John Barry, Ken Bates, Joe Cappuccio, David Crabbe, Mark Fina, Russell Galipeau, Corbin Hanson, Greg Helms, Porter McHenry, Tom Noto, Brian Susi-Blair, Ken Towsley, Joe Villareal, Anna Weinstein, Anthony Vuoso, Dan Yoakum.

Katie Grady, Briana Brady, John Ugoretz, Dianna Porzio, Julia Coates and Trung Nguyen with the CDFW convening team participated. Scott McCreary and Debbie Schechter with CONCUR served as neutral facilitators. Stephan Munch and Lucas Medeiros with UC Santa Cruz (UCSC) and the National Oceanic and Atmospheric Administration (NOAA) participated as scientific support. Scott Cohen of CDFW participated as a law enforcement representative.

MEETING MATERIALS

The following meeting materials were provided:

- SFAC Meeting 3 Agenda
- SFAC Meeting 3 Discussion Guide

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[1] This last item was not covered in the meeting due to time constraints and will be covered at the next meeting.

KEY OUTCOMES

Below is a summary of the main topics discussed during the SFAC meeting. This summary provides an overview of the main topics, primary points and options raised in discussions, and next steps. It is neither a detailed transcript nor a decision document.

1. Welcome, Agenda Review

Katie Grady welcomed SFAC members. CONCUR facilitators Scott McCreary and Debbie Schechter reviewed the agenda and Zoom meeting protocols. Katie shared the schedule of SFAC meeting dates and topics.

2. Recap of April 18th SFAC Meeting in Santa Cruz, CA

Katie reviewed key takeaways from the April 18th meeting as follows. Changes in the fishery were briefly discussed and key points are captured below:

- The management context and guiding documents for the SFAC process are the Marine Life Management Act (MLMA) and Master Plan Update, the Enhanced Status Report (ESR) and the Market Squid Fishery Management Plan (FMP).
- What has changed in the fishery (summarizes SFAC member comments from both the April 18th meeting and this meeting):
  - Monitoring and fishery data have improved
  - Changes in economy and infrastructure
  - Fishing effort fluctuates but is below what it was before the FMP.
  - Increased dependence on squid due to fewer opportunities in other seine fisheries
  - Geographic shifts of squid due to climate change
  - Marine protected areas reinforce sustainability[2]
  - In the Monterey Bay region:
    - Increased competition and nets setting in deeper water, which may intercept squid prior to reaching egg beds or catch squid that could be spawning deeper[3]
    - Fishery has a derby quality when it opens Sunday at noon; safety concerns for fleet; more overall users of Monterey Bay
- Reviewed EDM approach and data sets

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[2] A question was posed about whether there is empirical evidence supporting this idea and it was suggested to review available information at subsequent SFAC meetings.

[3] This point may merit further clarification at the next meeting.

- Began discussing which harvest control strategies to evaluate and which are feasible to evaluate using EDM.

3. Review Constituent Feedback on Fishery Management Effectiveness

Katie explained that the goal is for the SFAC to evaluate the ideas received so far for changing existing effort or catch controls. She requested that SFAC members elaborate on and refine these ideas, discuss their utility and feasibility, consider their strengths/benefits and identify limitations and concerns. Feedback received from SFAC members on fishery management scenarios is summarized in the table below. Ideas that were deemed feasible to test using EDM are shaded (see p. 6 for further discussion).

SFAC Member Comments Regarding Fishery Management Ideas[4]

Management Idea	Potential Strengths	Limitations/Concerns
No change to existing regulations, status quo	• Market squid fishery is currently sustainable	
Extending the weekend closure in Monterey: move the start time to later on Sunday (e.g., sundown) or Monday morning	• Could address user group conflicts in Monterey Bay by avoiding interactions • This would address the problem of limited processing capacity in both N and S on Sundays ; staffing is difficult for Sundays and creates a longer work week. • Allows fishermen to rest/have time off • Quality of squid delivered Monday morning is subpar: can improve quality of squid caught • Data indicate that current closure allows for more squid spawning than without the closure	• Need to have fishery open Sunday night to allow processing Monday morning: ensure 5-day work week for processors • Need to identify the geographic boundaries of the closure and clarify the timing and duration • Show how weekend closure benefits squid • Is it needed in Southern CA?

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[4] Note: This table is intended as a summary of first-hand comments/observations reported at the SFAC meeting as part of the SFAC's ongoing deliberations; it is *not* meant to represent final analytical findings or concluding policy recommendations.

Management Idea	Potential Strengths	Limitations/Concerns
Daily limits on number of sets or trips		• Poses enforcement challenges • Not particularly effective or feasible • Not clear that this solves a problem • May create safety concerns • May impact fish quality
Minimize daytime fishing	• Allows squid to move to shallow waters and spawn	• Creates more fishing intensity by concentrating fishing in a small area at night (especially in Monterey Bay) • Some fisherman can't fish at night • There is less bottom contact during the day • Squid fishery is dynamic: sometimes squid are only there during the day • Need to quantify impacts to squid and ecosystem processes by comparing nighttime vs. daytime fishing
Seasonal closure early in spawning window	• Could benefit squid biology	• Hard to figure out when this would be due to variability in timing of spawning • Doesn't make sense because squid spawn year round • Area and weekend closures already protect spawning.
Daily catch limits or max gross tonnage endorsement		• Hard to enforce (herring example) • Can lead to a "race to fish" unless there is cooperative allocation among fishery participants

Management Idea	Potential Strengths	Limitations/Concerns
		• A max gross tonnage limit would penalize people who have modified their vessels to hold more fish
Revisit seasonal catch limit of 118,000 tons: Could consider a specific catch limit for open access (e.g., additional 10,000 ton seasonal limit and 10 ton daily limit per vessel)		• Seasonal catch limit not needed because fishery is driven by market conditions
Consider alternative harvest strategies for more adaptive management		• What is considered "alternative harvest strategies"?
Consider allocation of squid for forage species		• Need for data on squid as forage for marine mammals-there is some research • What would this look like and how would this be implemented?

SFAC members emphasized that empirical data should drive the selection of harvest strategies. Not all the ideas listed in the table above were fully discussed with respect to elaboration, strengths and limitations. The conversation and deliberation around fishery management strategies will continue at the next SFAC meeting.

4. Empirical Dynamic Modeling Updates and Harvest Strategy Analysis

EDM Updates:
Lucas Medeiros of UCSC/NOAA provided an update on EDM efforts. This included a recap of the data sets used for the analysis of the squid fishery, an explanation of catch per unit effort (CPUE), EDM prediction results of CPUE, and newly derived preliminary results of the EDM approach to evaluate effective yield. He noted that, as explained at the last meeting, this is work in progress and more results will be presented at future meetings.

Recap of data sets: Data sets being used for EDM are logbooks (catch, set times, searching times, lighting times), landings (landings, number of fishing vessels), dockside sampling (mantle condition, gonad weight) and satellite data (sea surface temperature). Quarterly temporal resolution is used because there are gaps in data at a monthly resolution and fluctuations are not observed at annual resolutions.

Lucas presented an infographic/conceptual diagram (see EDM PowerPoint slide 6) that indicates drivers of different variables in the context of the EDM analysis, where the product of the analysis is a set of predictions of fishery dynamics and future yield/abundance. These predictions are based on squid density, fishing effort and environment. As SFAC members pointed out, there are many important drivers that affect these three factors (e.g., effort is driven by market dynamics, economic variables and other factors). The diagram indicates that all of these factors are important and that they are effectively built into the metrics of the three primary measures.

Catch per unit effort: Catch per unit effort (CPUE) is defined as the average amount fished (tons) per set time (hours) in a given quarter at a given region. The use of this measure responds to the suggestion from the SFAC to look at catch relative to hours setting. It captures the efficiency of the fishery and serves as a proxy for squid density at aggregations. Fishery CPUE can be compared to paralarvae density data to see whether it is a good proxy for squid density. Computing CPUE and comparing it to paralarvae density from 2011 to 2022 in the same spatial block shows that the data are correlated with paralarvae two months forward from CPUE. This is a biologically relevant time lag due to the length of time it takes to hatch after eggs are laid. Accordingly, CPUE can be a reasonable proxy for squid density and can be used to evaluate how changes in fishing effort impact squid density. It was noted that the correlation between CPUE and paralarvae density seems weak but Steve responded that it is actually very good in the context of marine biology.

In response to a question about the P value[5] and whether the regression line is more influenced by the data points at higher density, Lucas and Stephan stated that the P value is low because there are many observations. Neither CPUE nor paralarvae density are an actual measure of squid biomass but they are pointing in the same direction.

In response to a question about whether lighting affects catch efficiency and whether that effect can be analyzed, the scientists explained that CPUE is a measure of density once you have an aggregation of squid. They can

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[5] P value is a statistical term that is defined as the probability of getting the observed results.

incorporate searching and lighting times into the modeling to improve CPUE as a measure of density. However, there is less logbook data for lightboats.

EDM Forecasting to Predict CPUE: Lucas explained that CPUE can be predicted by incorporating input variables at different time lags. The highest prediction accuracy was achieved using the variables of catch, CPUE and landings in the north and CPUE, number of vessels (seiners) and sea surface temperature in the south. Based on modeling to date, the variables that are most important for prediction accuracy are catch in the north and number of vessels in the south. The modelers used CPUE, number of vessels and SST to predict CPUE and found that the predictions were 4 times better than using the seasonal trend in CPUE in the north and 9 times better in the south.

Preliminary results of EDM approach to evaluate future yield: Using CPUE, different management scenarios can be tested to evaluate future yield. The modelers fit EDM on this set of three variables: historical data (2000-2022) for CPUE, number of vessels and SST. Then they simulated future scenarios with high fishing effort and low fishing effort (number of vessels). They also created scenarios for SST, showing a slight upward trend in temperatures. Using this, they can forecast CPUE and then compute expected future yield.

In response to a question about how the modeling would address a scenario like the first quarter of 2023 where 90% of the fleet was not fishing squid due to market conditions, Lucas explained that CPUE is computed based on logbook data. If there are even a few boats that fished in the first quarter, they would have caught a large quantity of squid per hour so CPUE would still give a good measure of squid density.

An SFAC member commented that the scenario shows high fishing effort (more vessels) flattens out the variability in CPUE. Stephan agreed that this is an unusual finding and explained that the forecast at this point is more conceptual but that future modeling results will have to make sense.

Regarding increases in SST and the concern about elevated bottom temperatures impacting egg survival, the modelers noted that EDM can help predict squid shifts as SST goes up.

Harvest Strategy Analysis:
After Lucas explained how EDM can be used to evaluate management strategies, Katie opened a discussion about which fishery management scenarios could lend themselves to be analyzed using EDM. Based on the professional judgement of the modelers, the strategies that are shaded in the table on pages 3 and 4 (and highlighted in the Meeting PowerPoint, slide 9) are

feasible for testing using EDM. The unshaded strategies cannot be analyzed due to the lack of data at daily resolution and the current lack of data on marine mammal foraging behavior. The latter variable could be analyzed if a proxy is identified.

Below are key points from the discussion about testing various management strategies:

- In using the historical dynamics to evaluate performance of different strategies, we are first testing status quo.
- The modelers will look at lighting and fishing during daytime vs. nighttime to see what impact it has on CPUE and future yield.
- The modeling will provide feedback on comparative differences of management strategies, e.g., the impact of extending the weekend closure on yield/abundance.
- While it would be helpful to identify a target for abundance/yield that would serve as a signal to do something more with management, it is not clear that we have seen enough fishing effort historically to test this.
- Squid are resilient to changes in the environment, particularly SST. The squid fishery catch rebounded from near zero after El Niño events caused warmer water temperatures. Squid appear to shift northward and can spawn deeper under warmer conditions.
- CPUE and squid density can be computed only in areas that are fished. The goal is to look at squid density in areas that are fished and analyze what is happening from one year to the next. The goal is not to measure total squid biomass. The modelers are considering whether and how best to obtain data on closed areas such as MPAs.

In summary, the EDM approach can help examine the impacts of potential management changes, provide predictions about what might happen with a specific management change, and compare various options. The modeling effort will continue to be updated and refined with new and relevant data and based on feedback from the SFAC as has been the case over the past two meetings.

7. Public Comment:

A member of the public expressed that paralarvae survive at a temperature range of up to 62 to 68 degrees and that squid can spawn even in warm waters. This commenter reiterated that the squid fishery is resilient, as it came back after total collapse during the 1997 El Niño.

SUMMARY, NEXT MEETING, NEXT STEPS

CDFW staff expressed appreciation for the feedback provided by SFAC.

The next SFAC meeting will be held via Zoom on July 12, 2023. The focus of the meeting will be discussions on evaluating and modernizing monitoring efforts.

Based on the Convening Team's deliberations, the following next steps were identified:

SFAC Members:
- Each SFAC member is asked to review the draft meeting summary after it is distributed and propose bounded edits to address key misstatements or omissions.
- Provide CDFW with advice on relevant documentation or analyses on squid as forage for marine mammals and seabirds.

Facilitation Team/Conveners:
- Prepare and distribute draft meeting summary for review by SFAC members.
- Share meeting materials and presentations.
- Continue to consolidate relevant documentation and analyses on MPAs as tools to support sustainable fishing and on squid as forage for marine mammals.

For questions regarding this meeting summary, please contact:
sfac@wildlife.ca.gov