



## CALIFORNIA WETFISH PRODUCERS ASSOCIATION

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Mr. Phil Anderson, Chair, and  
Members of the Pacific Fishery Management Council  
7700 NE Ambassador Place #100  
Portland OR 97220-1384

October 12, 2019

RE: Agenda Item D.2      PROPOSAL FOR CONTINUATION OF EXEMPTED FISHERY PERMIT (EFP)  
TO ALLOW TAKE OF PACIFIC SARDINE IN 2020 NEARSHORE RESEARCH PROGRAM

Dear Mr. Anderson and Council members,

On behalf of CWPA and California's wetfish industry, I'm again requesting a renewal of our Exempted Fishery Permit (EFP) that the Council and NOAA Fisheries approved in April 2019. The justification remains as stated last year: *"The goal of the Coastal Pelagic Species Nearshore Cooperative Survey (CPS-NCS) research is to continue to develop sampling methodology for estimating CPS biomass in shallow waters that are not accessible to NOAA ships."* Our objective in 2019 was to collect sufficient data to qualify nearshore aerial survey estimates for use in the 2020 sardine Stock Assessment. This EFP proposes to build on the work conducted in 2019 to strengthen the aerial observer bias correction factor and continue work in Monterey.

This letter provides an update of our 2019 EFP request: in summary, our objective in 2020 is to complete the scientific matrix of point sets established in 2018 in S.CA., seeking point sets of larger sardine schools as well as additional transects. Besides work in S.CA. we also intend to continue in Monterey, conducting both transects and point sets. This extended sampling will enable us to provide a bias correction factor for the Monterey – Central Coast area as well as S.CA, thus qualifying aerial surveys conducted by the Department of Fish and Wildlife in both areas for use as minimum estimates of nearshore biomass. To the extent possible, this work will be conducted in coordination with NOAA offshore surveys, both spring and summer.

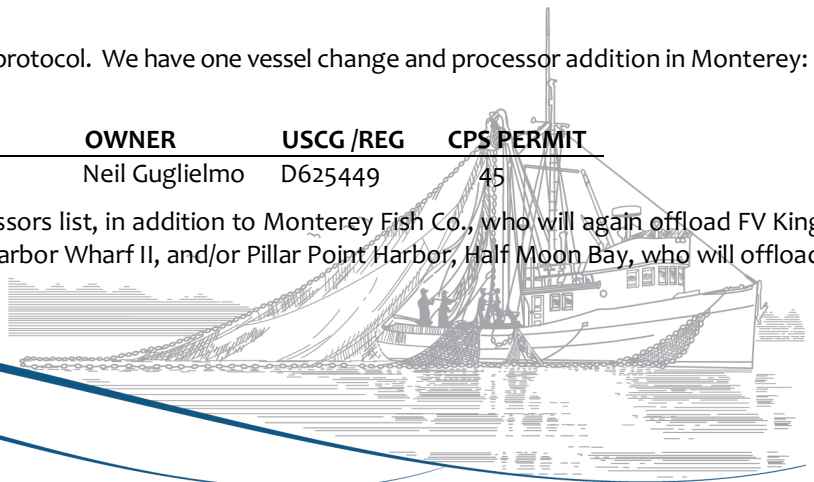
Survey protocol calls for aerial estimates of school biomass over established transects, with point set capture of CPS schools of various sizes to validate aerial estimates. Appended to this letter is a figure highlighting the valid point sets captured in S.CA. since 2010, including spring 2019. Although not shown, we also succeeded in capturing 8 valid point sets in Monterey during summer 2019. This work was accomplished notwithstanding challenging ocean and weather conditions. Our updated EFP request for 2020 point sets **is not to exceed 300 mt sardine**, including the estimated tonnage identified in the scientific matrix to account for larger schools.

As noted above, the goal of our 2020 EFP survey will be to continue survey protocol as described in our 2019 EFP. In addition, we hope to conduct nearshore acoustic survey(s) with sampling, in coordination with the NOAA survey(s), if sufficient funding is available and the SWFSC can analyze the data.

I am attaching our 2019 EFP Application re: aerial survey protocol. We have one vessel change and processor addition in Monterey:

VESSEL NAME	SKIPPER	OWNER	USCG /REG	CPS PERMIT
FV Trionfo	Neil Guglielmo	Neil Guglielmo	D625449	45

FV Trionfo will replace FV Sea Wave, and, for the processors list, in addition to Monterey Fish Co., who will again offload FV King Phillip, we're adding Southern Cal Seafood, Monterey Harbor Wharf II, and/or Pillar Point Harbor, Half Moon Bay, who will offload FV Trionfo, contact Pete Guglielmo.



We plan to submit a Supplemental Report including analysis of the 2019 data and other relevant information, and the revised vessel list, for final consideration in April 2020.

Thank you very much for your consideration of our request to continue this EFP research in 2020.

Best regards,



Executive Director

**Table 2.** CPS schools by size categories and number of purse seine point sets targeted and realized during 2010 and the 2018-19 NCS survey in southern California. All sets met the criteria of > 80% of school wrapped. The goal in 2020 is to attempt to capture large (i.e. 80-100 mt) pure sardine schools, as well as mixed CPS schools containing sardine.

Note: Eight valid point sets of various sizes, including both anchovy and sardine, were captured in Monterey in summer 2019, not included here.

<b>Pacific sardine point sets</b>				
<b>School Size (mt)</b>	<b>2010</b>	<b>2018</b>	<b>2019</b>	<b>Total</b>
0-10	4	12		16
10-20	6	4	1	11
20-30	3	0	3	6
30-40	2	0		2
40-50	6	0	1	7
50-60	0	0	2	2
60-70	2	0		2
70-80	1	0		1
80-90	2	0	1	3
90-100	0	0		0
100+	0	0		0
<b>Total</b>	<b>26</b>	<b>16</b>	<b>8</b>	<b>50</b>

## [REVISED 2019 EFP APPLICATION SUBMITTED FOR 2020 RESEARCH]

- 4a.** Date: March 15, 2019
- 4b.** Applicant: California Wetfish Producers Association (CWPA)  
Diane Pleschner-Steele, Executive Director  
PO Box 1951, Buellton, CA 93427  
(805) 693-5430

On behalf of CWPA and California's wetfish industry, we would appreciate the Council's consideration of and support for the following EFP request:

**Background:** At its June 2017 meeting, the Pacific Fishery Management Council conditionally approved the California Department of Fish and Wildlife (CDFW) / CWPA aerial survey methodology for use in future CPS stock assessments, consistent with recommendations contained in the **Southern California Coastal Pelagic Species Aerial Survey Methodology Review** report (PFMC 2017).

This research project intends to sample CPS schools using aerial spotter pilots with plane and aerial camera system to fly aerial surveys near shore and photo-document schools, coupled with qualified purse seine vessels chartered to capture a subset of the schools identified while the pilot photographs the "point sets." The purpose is to address issues identified in the aerial survey methodology review. The 2019 survey is planned for a period from July 1, 2019 through June 30, 2020 (providing flexibility to account for weather delays, especially in Monterey).

- 4c.** The proposed survey plan provides the following explanation of purpose and goals (excerpted from the draft survey plan):

**Overview and Justification**

*The goal of the Coastal Pelagic Species Near-shore Cooperative Survey (CPS-NCS) research in 2018-19 is to continue a pilot study to develop sampling methodology for estimating CPS biomass in shallow waters that are not accessible to NOAA ships. Current biomass estimated for anchovy and sardine stocks is believed to be negatively biased, because substantial fractions of these stocks reside in shallow nearshore waters (< 40m) that cannot be surveyed by NOAA vessels. Although the California Department of Fish and Wildlife (CDFW) and the California Wetfish Producers Association (CWPA) have conducted aerial surveys in nearshore waters of the Southern California Bight (SCB) since 2012, and in the Monterey-San Francisco area since summer 2017, it has been difficult to quantify the uncertainty of estimated biomass, due to lack of replication among other issues. Further, there are not adequate data to validate biomass and school composition by species estimated by spotter pilots during the CDFW-CWPA aerial surveys, making it difficult to quantify their bias. We aim to develop methodology for quantifying the level of bias and uncertainty of aerial surveys... [K]nowledge gained from the pilot CPS-NCS survey could be applied to conduct broader sampling surveys, to... [account for] bias and ... variance estimation when assessing CPS stocks in the future.*

This research plan seeks to address recommendations identified by the aerial survey methods review Panel. For example (excerpted from the methodology review report):

- Point set data are limited and hard to collect ..., but are a core source of information to validate the survey estimate of biomass. Noting the difficulty for collecting point sets, the Panel nevertheless recommends that additional point set data be collected (or alternative approaches for ground-truthing survey estimates be applied, such as using the volume of schools combined with estimates of packing density).
- Conduct replicate transects and surveys to allow estimation of variance for density (no fish caught).
- Further work is needed to develop a variance estimator to more fully account for the various sources of uncertainty.

The methods review report also stated: The estimates of biomass from surveyed transects can be extrapolated to unsurveyed areas, but this will require additional sampling to ensure that the extent of between-area differences in density can be quantified to inform proper stratification of expansions and to allow variance to be estimated.

Please note that since 2017, aerial surveys have been conducted in both the SCB and Monterey area. The intent of this EFP is to conduct the additional sampling needed to produce a “minimum estimate of biomass by basing the estimate of biomass only on areas surveyed” (PFMC 2017). Conducting point sets in Monterey will increase the likelihood of capturing anchovy schools (pure or mixed) to improve the validation of observer species identification. This will improve future stock assessments by providing a minimum estimate of abundance in the nearshore area in both the Southern California and the Monterey–Central Coast areas.

For both aerial transect flights and point sets, two spotter pilots flying in the same plane will make independent estimates of school size and species composition and record their individual tonnage estimates and species identification on separate log sheets. For point sets, the aerial observers will photograph vessels approaching and wrapping the schools. Fishermen will also record on log sheets during the capture process the school depth, shape and density depicted on their sonar and fathometer, along with any other observations. Participating processors will record species composition and weight for each set. Examples of photo series and logs are appended to this EFP request (Appendices 1-3).

Attempts will be made to capture entire schools of CPS, to the degree possible, thus adding to the 80+% capture point set archive currently used in the CDFW / CWPA nearshore aerial surveys. All schools captured will be stored in separate hatches onboard, and will be weighed individually at the dock and sampled for species composition by the participating processors. In addition, biologists will pull samples from the beginning, middle and end of each set and preserve fish on ice for later processing to obtain biological characteristics of the sampled fish.

All fish captured, including sardines requested in this EFP application, will be processed and sold by participating processors, and fishermen will be paid for their catches at the usual rates. Aside from the sale of fish captured in this project, processors are not compensated for the extra labor they will incur in weighing and sorting each school individually, and documenting species composition by school, versus the normal procedure of offloading the entire catch and documenting by load. Point sets must be weighed and bucket sampled by individual set for the point set validation data to be useful. The revenue derived from the sale of the fish captured, including EFP fish, will help offset the extra labor, time and other costs that both fishermen and markets will accrue when participating in this research project. Further, sale of the EFP fish provides a beneficial use of the resource and avoids waste.

**4d. Rationale for issuing the EFP:** In light of the probability of continued closure of the directed sardine fishery in 2019, this EFP will allow fishermen to retain the entirety of any school they are directed to catch without question, including pure sardines or mixed schools exceeding the allowed incidental catch rate. This EFP will facilitate fulfilling the goals and objectives of this research and will avoid wasting a valuable resource. Absent an EFP, fishermen would be limited in targeting observed schools, or risk a violation if the captured schools contained sardine above incidental catch limits.

In November 2017 the Science and Statistical Subcommittee (SSC) reviewed this EFP application and recommended: (1) to conduct a power analysis to determine the effective sample size needed for validating school biomass estimated by spotters; (2) to perform an analysis on school distribution along the coastline in order to more clearly determine the percent of schools and areas that cannot be surveyed by purse seine vessels.

The most recent years of consistent field methods of the aerial survey were 2015-2017. The survey observed both sardine and anchovy in 2016 and 2017 (Table 1). Accordingly, we have conducted statistical analyses using point set

data from 2010 (Table A1, see Appendix 4) and 2016-2017 data to select the number of point sets needed to be conducted in the 2018 and 2019 project, and present various scenarios in Table 2 below based on the level of precision that can be achieved during an estimated 7 to 10 days of study (spread strategically within the July 1 – June 30 sardine season study window), using prior information on variance estimated from a study conducted in the SCB in 2010 (PFMC 2017, see Appendix 4).

**Table 1.** Summary data from 2016-17 aerial surveys for Pacific Sardine and Northern Anchovy observations.

	2016-17 Aerial Survey
Survey days	15
Observed Schools	1,920
Observed Tons	107,040
Mean School Size (mt)	56
Mean Schools per Day	128
Total Schools for 7 Days	896
Sardine tons > 7m depth	18,690 (55%)
Sardine tons < 7m depth	15,589 (45%)
Anchovy tons > 7m depth	69,642 (96%)
Anchovy tons < 7m depth	3,119 (4%)
Proportion of sardine	32%

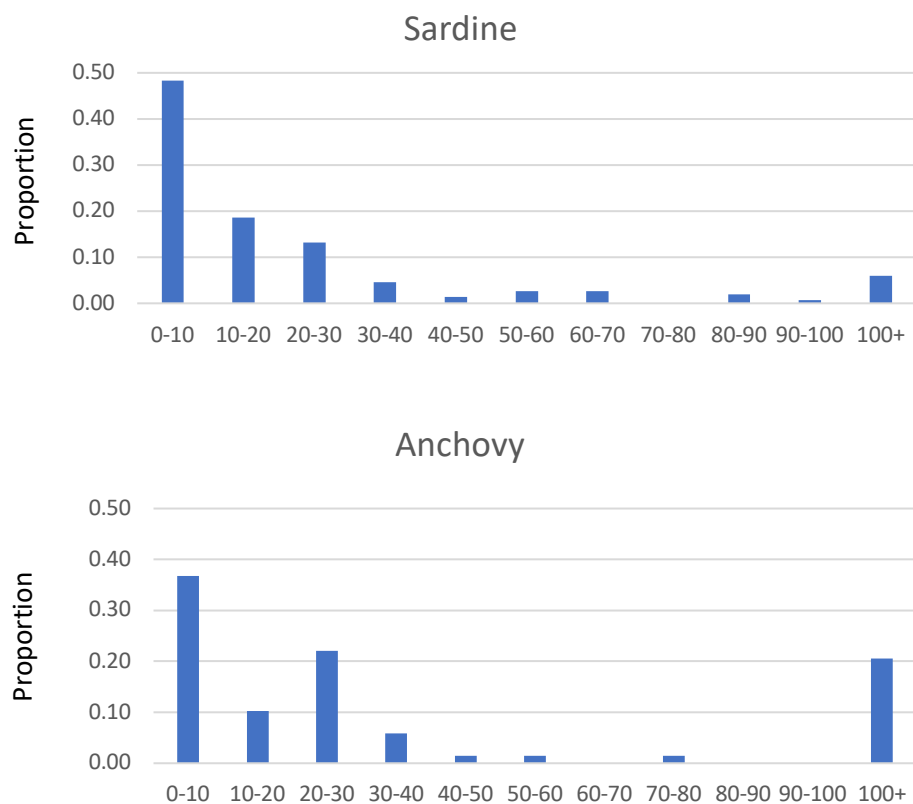
**Table 2.** Selection of sample size ( $n$ ) and related target catch (mt) for conducting point set surveys based on various levels of bound ( $b = 2 \sqrt{V_r}$ ) on percent of error when estimating the ratio ( $r=1.07$ ) between purse seine catch and school biomass estimated by spotter. Approximate estimation of the CV of the ratio is also provided.

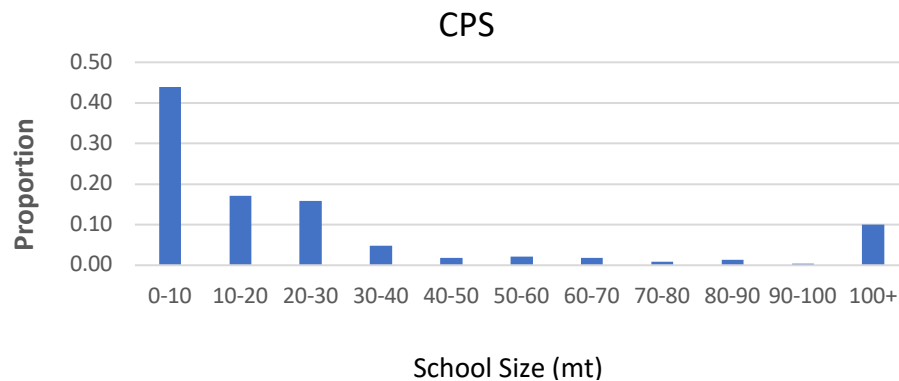
$b$	$CV_r$ (%)	Target $n$ (EFP)	Target Catch (mt)
0.11	5.1	9	510
0.10	4.7	11	623
0.09	4.2	14	770
0.08	3.7	17	974
0.07	3.3	23	1272
0.06	2.8	31	1732
0.05	2.3	45	2494
0.04	1.9	70	3896
0.03	1.4	124	6927

Our target  $n$  sample size is 23 schools, which we believe is a reasonable goal for this project. This number corresponds to an expected target catch of 1,272 mt (Table 2). This tonnage estimate includes all CPS. After CPS schools are identified (and their tonnage estimated) by the spotter pilot, fishermen will be directed to catch CPS schools that represent the proportion of school sizes seen during the past 2 years of the survey (Figure 1, Table 3). For those school sizes where the point set target is < 1 school, the selection for those will be pooled with adjacent size schools (see “Expected Point Sets” column on Table 3).

It is expected that nearly all CPS observed in these nearshore areas will be sardine and anchovy, as in previous surveys. The proportion of sardine to total tons for 2016-2017 sardine and anchovy observations was 32% (Table 1). This is then applied to the expected catch of 1272 tons from 23 schools, resulting in more than 400 tons of sardine. The Council approved the EFP request from April 2018 of 600 mt to allow for possible catch of larger sardine schools.

During summer 2018 we collected 16 sardine schools, comprising 103 mt of the requested 600 mt. The valid point sets completed the matrix for smaller school sizes, e.g. 12 schools in the 0-10 mt range, and 4 schools in the 10-20 mt range. Additional work from last year's EFP sardine allocation will continue in spring 2019, focusing on larger schools. It is expected that approximately 100 tons may be used for this spring's research, weather permitting. We are requesting 400 mt of sardine, the approximate balance remaining from last year's EFP, to target large schools and complete, possibly enhance, the scientific matrix of school sizes. These schools may be pure sardine, or mixed schools with sardine proportions exceeding the incidental harvest limit.





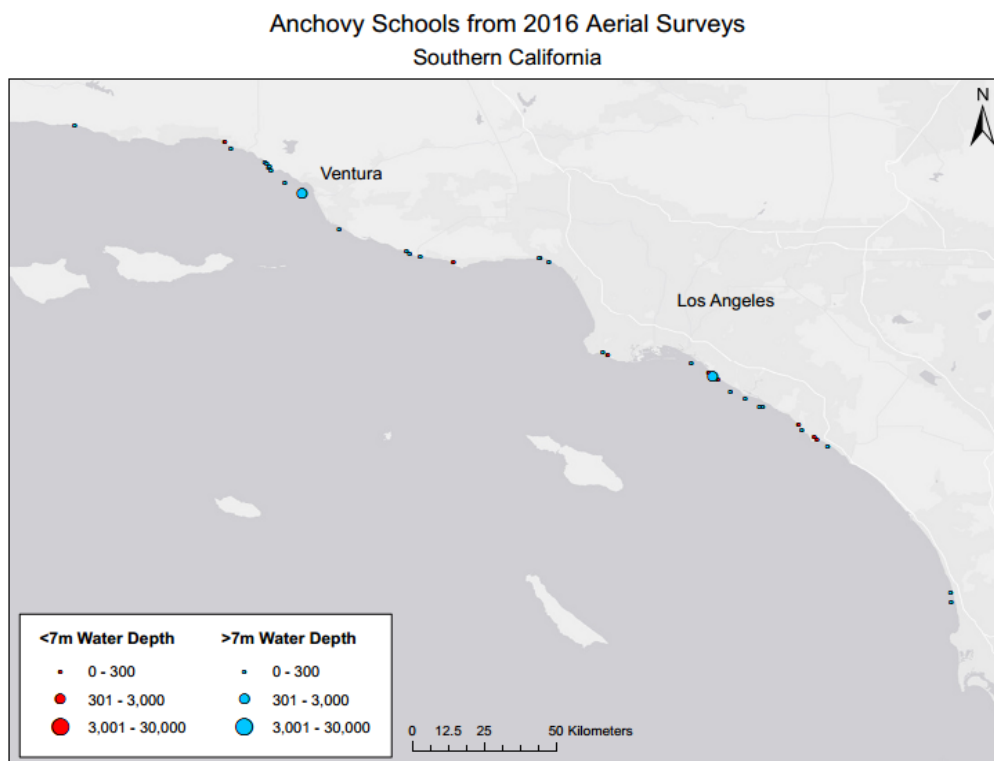
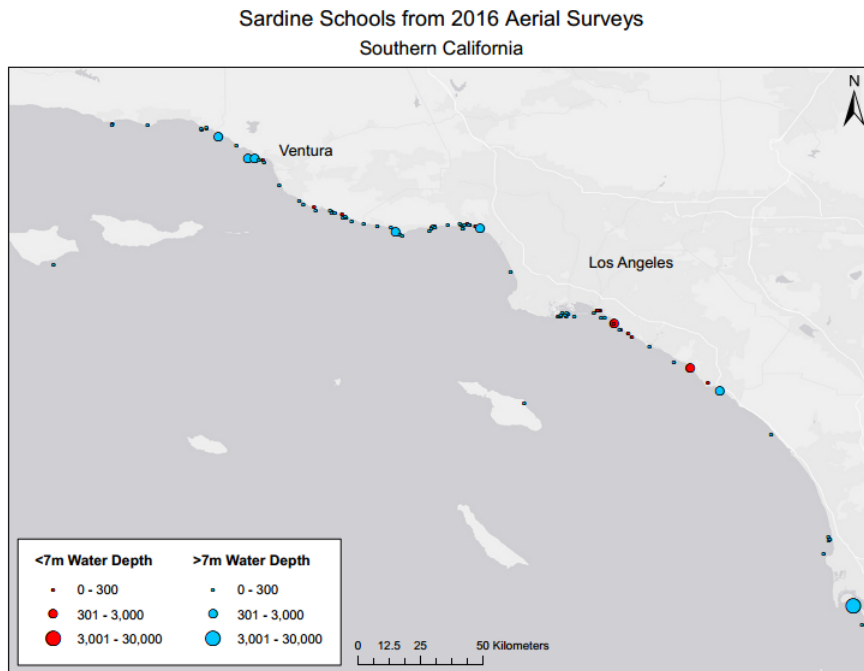
**Figure 1.** Sardine (top), anchovy (middle) and CPS (bottom) school size distribution from 2016-2017 aerial surveys.

**Table 3.** Targets of CPS schools by size from observed proportions from Figure 1. Number of point sets is based on goal of 23 total point sets over study period.

School Size (mt)	n	Proportion	Point Set Target	Expected Point Sets
0-10	100	0.44	10.1	10
10-20	39	0.17	3.9	4
20-30	36	0.16	3.6	4
30-40	11	0.05	1.1	1
40-50	4	0.02	0.4	1
50-60	5	0.02	0.5	
60-70	4	0.02	0.4	1
70-80	2	0.01	0.2	
80-90	3	0.01	0.3	
90-100	1	0.00	0.1	
100+	23	0.10	2.3	2
Total	228	1	23	23

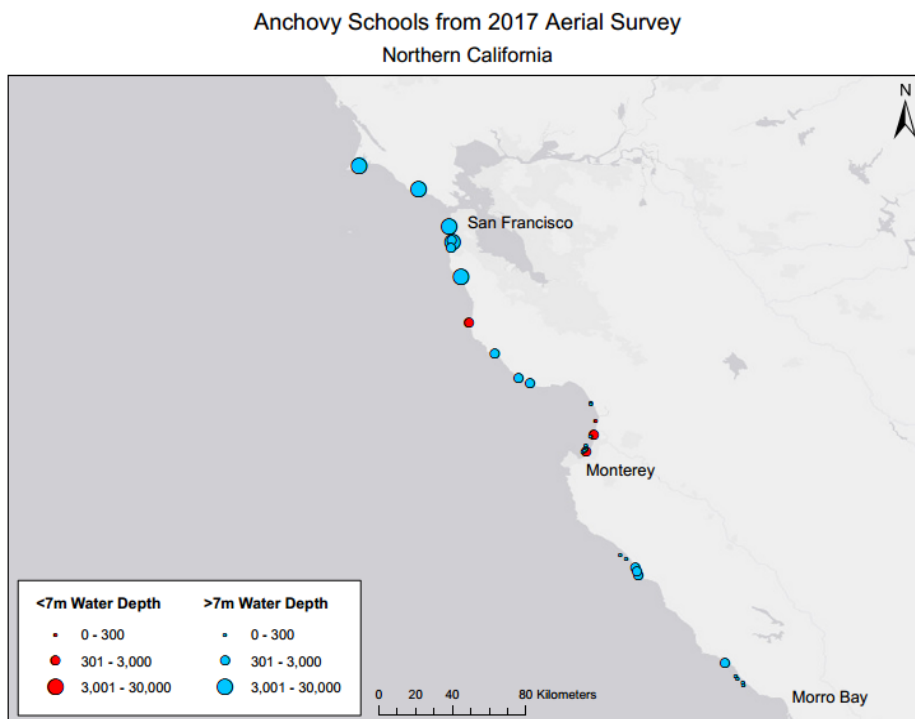
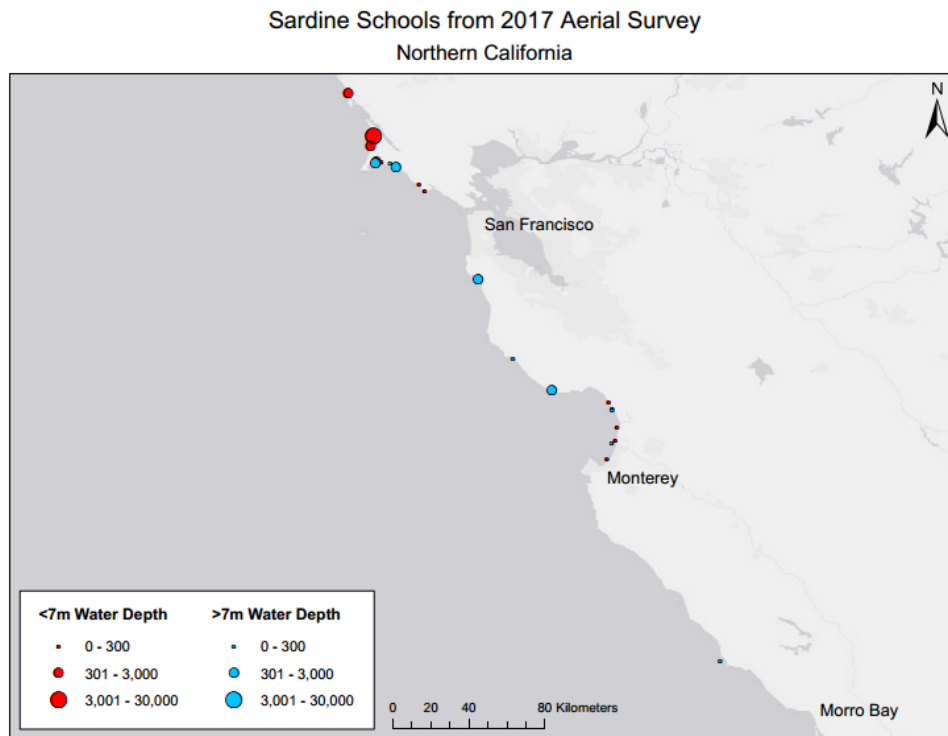
We suggest that, to facilitate and simplify accounting, the Council follow the protocol established for other EFPs and designate the 400 mt sardine requested in this EFP as a research set aside off the top of the ACL, separate from the incidental catch allowance. Any amount unused would simply roll back into the ACL at the conclusion of the research period.

Not all research areas and issues recommended by the 2017 Review Panel can be fully addressed in 2018-19 research. The 2018 and 2019 surveys will be conducted primarily in shallow water between 7m and 40m, where 96% of anchovy and 55% of sardine biomass observations occurred in 2016-2017 surveys (Table 1, and Figures 2-3 below). CPS schools also occur inside 7m depth, ranging into the surf zone. Based on observations corroborated by fishermen, school properties in extreme shallow water are similar to schools sampled at the inshore extent of this survey. Additional point set data can be collected to obtain the optimal sample size for the survey. Therefore, we are proposing to replicate the nearshore survey in summer 2019 to cover additional area of school occurrence, including Monterey, to obtain increased sample size for the survey, and meet the recommendations of review panels.



**Figure 2.** Nearshore distribution of Pacific Sardine (top) and Northern Anchovy (bottom) by school size (mt) and depth strata (< 7m and > 7m) during the 2016 Southern California CDFW-CWPA aerial surveys.





**Figure 3.** Nearshore distribution of Pacific Sardine (top) and Northern Anchovy (bottom) by school size (mt) and depth strata (< 7m and > 7m) during the 2017 Northern California CDFW-CWPA aerial survey.

**4e. Significance of this EFP:** This research is essential to develop useful and cost-effective survey methods to quantify the biomass of CPS in the nearshore area where large NOAA ships cannot transect. The survey methods developed in this project can be expanded to other nearshore areas coast-wide, which would improve the accuracy of future stock assessments. In addition, the collaboration between industry, the scientific community, and federal and state agencies mandated to assess and manage fisheries is a win-win for all, facilitating increased understanding of the uncertainties in quantifying highly variable CPS resources, utilizing fishermen's knowledge of the ocean and providing a practical, efficient method for measuring fishery resources.

**4f. Continuation of this EFP:** The longevity of this EFP is contingent on a number of factors, chief among them sufficient funding to continue and possibly expand the survey, and the status of the sardine fishery in the future. We plan to replicate the nearshore survey research for at least one more year beyond summer 2019, if needed, to obtain optimal sample size for the survey, improve survey coverage of school occurrence, and meet the recommendations of review panels.

**4g. Participating vessels:**

CWPA has identified 4 vessels that meet the criteria for this research project:

VESSEL NAME	SKIPPER	OWNER	USCG /REG	CPS PERMIT
<i>Southern CA</i>				
Triton	Pete Ciaramitaro	Triton Fishing Inc.	CF7218UH	14
Provider	Jamie Ashley	Provider LLC	D572344	1
<i>Monterey</i>				
King Philip	Anthony Russo	Sea Wave Corp	D1061827	9
Sea Wave	Andy Russo	Sea Wave Corp	D951443	10

**Participating processors:**

Two wetfish processors have been identified – each processor normally offloads two of the participating vessels:

Southern Coast Trading Company, 2148 West 16th Street, Long Beach CA 90813  
(offloads FV Provider, FV Triton; Contact: Lillo or Dominic Augello)

Monterey Fish Company, 960 South Sanborn Road, Salinas, CA 93901  
(offloads FV King Philip, FV Sea Wave; Contact Anthony Tringali or Jenn Cabotage)

**4h. Description of species harvested:** Under this project, purse seine vessels will be directed to capture schools of CPS observed by aerial spotter pilot (or potentially, backscatter observed by acoustic trawl). The schools could contain sardine, anchovy, Pacific or jack mackerel, or other coastal pelagic species. An EFP is necessary because the directed sardine fishery is closed, and will likely remain closed in 2019. There are no constraints on capturing the other CPS species other than Annual Catch Limits, which this project will not exceed. No measurable impacts to non-target species are anticipated.

**4i. Justification for EFP request:** This EFP application requests 400 mt be allocated as a research set-aside for a projected 7- to 10 days of research (spread strategically within the July 1 –June 30 study window). Vessels will be directed to capture as many schools as possible in a given day, and will strive for 100 percent capture of individual schools, if possible. In light of recent-year observations of abundant sardine in nearshore waters, the likelihood is

that sets will capture sardine, either in pure schools or in mixed schools exceeding the incidental catch of sardine by weight. Without an EFP, such captures would be in violation. The issuance of an EFP also allows the sale of the fish to help offset additional costs incurred by participating fishermen and processors. Please also see the distribution matrix and information provided under Item 4d.

**4j. Accounting for EFP fish:** Biologists will take a subset of each set at the dock for later processing to obtain biological characteristics of individual fish. As noted above, all schools captured will be stowed in individual hatches in the hold, and when delivered to market each set will be weighed and sampled for species composition following established protocol. Processors will maintain records of the weight of individual species groups, including sardine, to validate species composition.

CWPA will notify Enforcement approximately 12 hours before vessel(s) go out to inform them of vessel name(s) and location(s) to be surveyed, and processors(s) who will be receiving research fish that day. The survey plan anticipates sending no more than two vessels per day in each area. Participating vessels will fly CWPA research flags for identification purposes.

CWPA will also maintain a record of the volume / total weight of each species captured and will monitor progress toward attaining the EFP limit. These weights and species composition per set will also be included in the final report.

**4k. Data Collection Methods:** According to the survey plan:

#### *Biological sampling*

*The catch taken from each school will be subsampled throughout the pumping of each haul. CDFW biologists will obtain a 5-gallon subsample of fish at quarterly intervals of pumping each set, using a quantitative bucket sampling method. The four collected fish subsamples will be stored in plastic bags and preserved on ice. Up to 50 fish per species per point set will be collected by a CDFW biologist/sampler upon landing of the daily catches. At the CDFW laboratories these samples will be sorted by species and measured for biological characteristics (length, weight, sex, maturity etc.). For each species and each school, the catch will be additionally subsampled to obtain up to 25 otoliths for ageing.*

#### *Statistical analyses*

*Based on the objectives of this pilot research, CPS biomass and associated variances will be estimated from data collected during the aerial and purse seine survey. The sampling unit of the survey will be one transect flown for a number of hours during the day.... Further, purse seine data will be used to validate aerial tonnage estimates, school species composition, and [to obtain] length, and age composition ..., providing additional information to quantify uncertainty surrounding biomass estimated by the pilot and observer. More details regarding the process of biomass estimation from the CPS-NCS will be provided in a separate document.*

Scientific data collection and analysis will be supervised by CDFW and CWPA scientists, who will collaborate on procedures to ensure and evaluate data quality during the survey, and data analysis methodology through completion of the project. Weather permitting, we will strive to have multiple replications of each transect, as well as purse seine sets on schools of various sizes (in proportions as depicted in Figure 1), to derive unbiased estimates of biomass and associated variances.

**4l. Vessel selection:** Criteria were established to qualify vessels for participation in this research project. From those requirements CWPA identified four vessels meeting the criteria for vessel size, equipment and skippers' experience, whose skippers, importantly, committed to participate in this research, notwithstanding any other fishing opportunities during the project period.

**4m. Time and Place of Research Fishing:** This project will take place in nearshore waters of Monterey Bay and/or the Southern California Bight, depending primarily on weather constraints. The tentative time frame for the survey window is July 1, 2019 – June 30, 2020. If timing and sufficient funding permit, this project will also attempt to

coordinate with the 2019 NOAA summer survey, if the NOAA survey vessel is surveying outer waters on schedule. Fishing gear used is purse seine net of suitable mesh size and length for capturing CPS schools observed by aerial spotter pilots (or potentially by acoustic backscatter).

Thank you for your consideration.

Best regards,



Diane Pleschner-Steele  
Executive Director

Attachments:

- Appendix 1 - 2010 Point Set Photographs
- Appendix 2 - Fishermen's Log Form
- Appendix 3 - Flight Log Form
- Appendix 4 – Selecting sample sizes for 2019 purse seine and aerial survey point sets

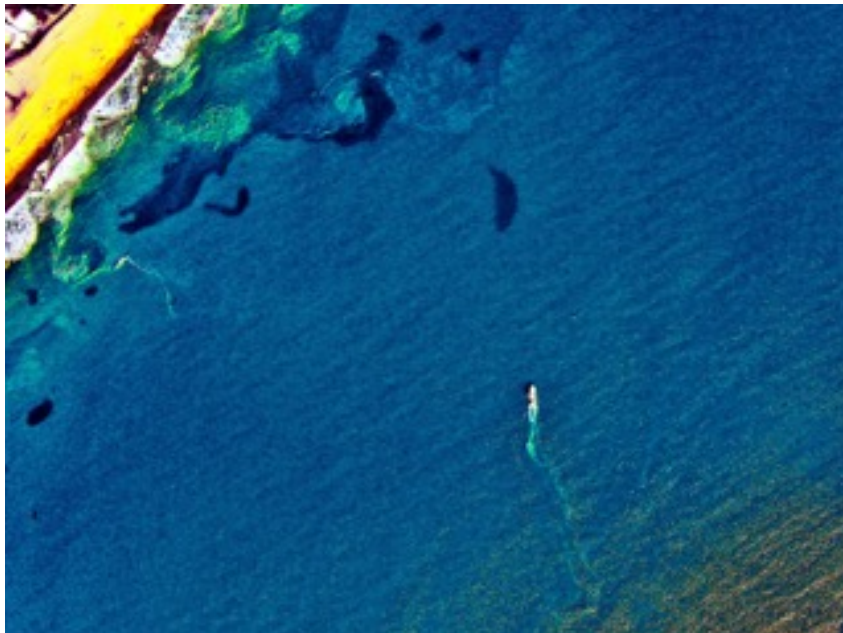
**References**

Jagiello, T. H., Hanan, D., Howe, R., and M. Mikesell. 2010. West Coast Aerial Sardine Survey. Sampling Results in 2010. Prepared for Northwest Sardine Survey and the California Wetfish Producers Association. Pacific Fishery Management Council, Portland, OR, October 15, 2010. 51p.

Lynn, K, D. Porzio, T. Nguyen, and L. Ryley. 2017. Southern California aerial survey for Pacific sardine (*Sardinops sagax*) and Northern anchovy (*Engraulis mordax*). PFMC June 2017 meeting, Agenda Item D.2.a, CDFW Report.

PFMC. 2017. Southern California coastal pelagic species aerial survey methodology review. PFMC June 2017 meeting, Agenda Item D.2, Attachment 1, Methodology Review Panel Report.

**Appendix 1.** 2010 point set photographs. Note the typical schooling pattern of CPS in nearshore waters in CA. Individual schools break away from the shoaling fish for a short period, and often outrun the vessel in the capture attempt.



FV Eileen approaches 20-ton sardine school in 2010 summer aerial survey.



FV Eileen in process of wrapping school. This was a 100% capture point set.

**Appendix 2.** Fisherman's log form.**2018 CPS Nearshore Cooperative Survey*****Fisherman's Log Form***

Date: \_\_\_\_\_ Captain: \_\_\_\_\_

Vessel: \_\_\_\_\_ Processor: \_\_\_\_\_

**Hydroacoustic Gear**

Type	Manufact.	Model	Frequency
Sounder			
Sonar			

**Net Dimensions**

Net Length (fath)	Net Depth (fath)	Mesh Size

**School and Ocean Data**

Point Set No.	Time	Latitude	Longitude	Depth to Top of School (fath)	Depth to Bottom of School (fath)	Ocean Depth (fath)	Temp.	Weather Condition

**Captains Estimate and Delivery Information****Office Use Only**

Point Set No.	Species Observed	% of school captured	Total Est. School Tonnage (mt)	Fish Hold (FP, FS, MP, MS, AP, AS)	Sampled By Biologist on Board (Y/N)	Other Vessel utilized: Name, est. weight, fish hold	*Delivered Weight (mt)	*Fish Ticket Number

Comments: \_\_\_\_\_

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Weather Codes: 1= calm, clear; 2= light wind, good visibility; 3= moderate wind, fair visibility; 4= poor fishing conditions.

**Appendix 3.** Flight log form.**2018 CPS Nearshore Cooperative Survey*****Flight Log Form*****Date:** \_\_\_\_\_ **Pilot:** \_\_\_\_\_ **Plane:** \_\_\_\_\_**Processor:** \_\_\_\_\_ **Observer:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

Set #	Time	Photo #	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)	% Species Composition

**Comments:** \_\_\_\_\_

**Appendix 4.** *Selecting sample sizes for 2019 purse seine and aerial survey point sets (Extract from 2018 Nearshore Cooperative Survey draft design, In Preparation by E. Dorval, K. Lynn, B. Macewicz and D. Griffith)*

In the fall of 2010, a study was conducted by the fishing industry to validate aerial survey biomass estimates by using purse vessels to wrap and catch CPS schools that were spotted by an airborne observer (Jagiello et al. 2010). A subset of these purse seine samples (namely “point sets”) has been used to estimate the ratio between aerial survey observations and catch landed per school, providing a mean to correct for potential bias in biomass estimated from aerial surveys conducted by CDFW-CWPA from 2012 to 2016 (Lynn et al. 2017). However, a 2017 Review Panel found purse seine data used by Lynn et al. (2017) were insufficient to provide adequate precision and accuracy for biomass estimation for the 2012-2016 surveys (PFMC 2017). Thus, the panel recommended that additional point sets be collected to increase the accuracy and precision of the correction factor for use in future aerial survey data analyses. Here we conducted an analysis to determine the effective number of purse seine samples that will need to be collected during the 2018 and 2019 CPS Nearshore Survey (NCS), using point set data collected in 2010 and aerial school and biomass data collected during the last 2 years of aerial surveys conducted by CDFW-CWPA, i.e. 2016-17.

Although the CDFW and CWPA began aerial surveys in the Southern California Bight in 2012, the last two years of surveys (2016 and 2017) contained data that were collected using similar standardized methods. Further, because anchovy abundance was reportedly low in 2015, no schools of this species were observed in daylight hours from this survey in 2015 (although fishermen reported an abundance of anchovy when fishing at night). With the observed increase of the anchovy stock off California (starting in 2015-16), the dynamics and composition of nearshore CPS schools that may be observed during the 2018 CPS-NCS are more likely to be similar to the 2016-17 period than to previous years. These data are summarized in Table 1, showing that on average 128 schools have been observed per day of aerial survey, with a mean school size of 56mt. Purse seine ground-truthing did not occur during these three years and thus no point set data exist to directly account for bias in these aerial survey biomass estimates. However, we can reasonably assume (as in Lynn et al. 2017) that the 2010 school size estimates likely represent a random sample of any one of the surveys conducted in 2016-2017. Likewise, parameters estimated from the 2016-17 and 2010 survey data (Table 2) could be used to compute the approximate number of purse seine point sets that should be conducted during the 2018 CPS-NCS.

Assuming that the adjusted landed tons ( $y'_i$ ) and the estimated school size ( $x'_i$ ) is linearly related through the origin (Table A1), an estimate of the ratio of these observations (i.e. the slope of the regression line) could be provided by:

$$(1) \quad r = \frac{\sum_i^n y'_i}{\sum_i^n x'_i}$$

Hence, based on Table A1 data,  $r$  is estimated to be 1.07; and the variance of the observed sample could be estimated as:

$$(2) \quad s_r^2 = \frac{\sum_i^n (y'_i - r x'_i)^2}{n-1},$$

Likewise  $s_r^2 = 87.28$  (i.e. using data in Table A1).

Based on equation Eq. 1 and 2 and assumptions made above, an approximate estimate of the variance of the ratio ( $V_r$ ) for the population we expect to survey in 2018 is given by the formula:

$$(3) \quad V_r = \frac{(N-n)}{nN} \times \left( \frac{1}{\mu_{x'}^2} \right) \times s_r^2$$



Where,  $N$  is the finite population size (i.e. 896 schools for a 7-day survey) for the 2018 survey,  $n$  is the number of point set collected in 2010 (i.e. 26) and  $\mu_{x'}$  is the mean size of CPS schools observed during the 2016-17 aerial surveys off California. We assume the composition of schools by species and size in 2018 will be similar to 2016-17. Note that  $V_r$  is an approximation because we don't know the variance of the population we expect to sample in 2018, but it is reasonable to replace it by  $s_r^2$  computed from the 2010 aerial survey data (Table A1).

Assuming the data are normally distributed, a 95% confidence interval of  $V_r$  can be provided by  $2 \times \sqrt{V_r}$ ; and an approximate number of samples ( $n$ ) that would be required to estimate the ratio with a bound ( $b$ ) on the error of estimation (i.e.  $2 \times \sqrt{V_r}$ ) can be calculated as:

$$(4) \quad n = \frac{Ns_r^2}{b^2 \times \mu_{x'}^2 + N \times \frac{s_r^2}{4}}$$

Again,  $n$  is an approximation because we do not know the variance of  $r$  for the targeted population and thus we used the  $s_r^2$  as an estimate of it. In Table 2 different estimates of  $n$  are presented, based on various levels of  $b$ .

**Table A1.** Point set data collected from 2010 study (Jagiello et al. 2010).

<b>Aerial observation</b>	<b>Purse seine sampling</b>	<b>Aerial observation</b>	<b>Purse seine sampling</b>		
Est. Size_Pilot (t)	Est. % school wrapped	Adj. Est_Size_Pilot (t)	Landed biomass (t)	Adj. landed biomass	Residual squared
<b>x'</b>		<b>x</b>	<b>y</b>	<b>y'</b>	<b>(y<sub>i</sub>' - rxi')<sup>2</sup></b>
5	100	5	4.8	4.8	23.5
30	90	27	40.2	44.6	1993.3
30	100	30	38.5	38.5	1485.2
15	100	15	10.9	10.9	118.6
15	100	15	15.4	15.4	236.0
10	95	9.5	15.0	15.7	248.1
5	100	5	6.7	6.7	45.3
12	90	10.8	17.9	19.9	396.4
10	100	10	2.8	2.8	8.1
10	100	10	9.6	9.6	92.5
10	95	9.5	14.9	15.6	244.5
25	100	25	20.0	20.0	401.3
12	95	11.4	10.7	11.3	127.8
50	95	47.5	58.7	61.8	3819.1
25	100	25	31.3	31.3	981.3
35	100	35	44.0	44.0	1931.9
65	95	61.75	67.4	71.0	5035.0
45	100	45	45.0	45.0	2028.1
55	90	49.5	38.8	43.1	1861.0
55	95	52.25	23.9	25.2	635.5
45	95	42.75	46.8	49.3	2429.1
80	100	80	84.9	84.9	7208.0
25	95	23.75	20.2	21.2	451.5
50	100	50	64.2	64.2	4120.2
35	90	31.5	40.5	45.0	2022.8
75	100	75	84.6	84.6	7157.2