NATIONAL MARINE FISHERIES SERVICE REPORT

Mr. Mark Helvey, of the National Marine Fisheries Service West Coast Region (NMFS WCR), will provide the Council with a regulatory update. Dr. Russ Vetter, NMFS Southwest Fisheries Science Center, will provide an update on the spring and summer research surveys.

Council Task:

Discussion.

Reference Materials:

None.

Agenda Order:

a.	Agenda Item Overview	Kerry Griffin
b.	Regulatory Activities	Mark Helvey
c.	Fisheries Science Center Activities	Russ Vetter
d.	Reports and Comments of Advisory Bodies and Management Entities	
e.	Public Comment	
f.	Council Discussion	

PFMC
10/10/13

E.1.c Coastal Pelagic Species Management: Fisheries Science Center Activities

NOAA FISHERIES

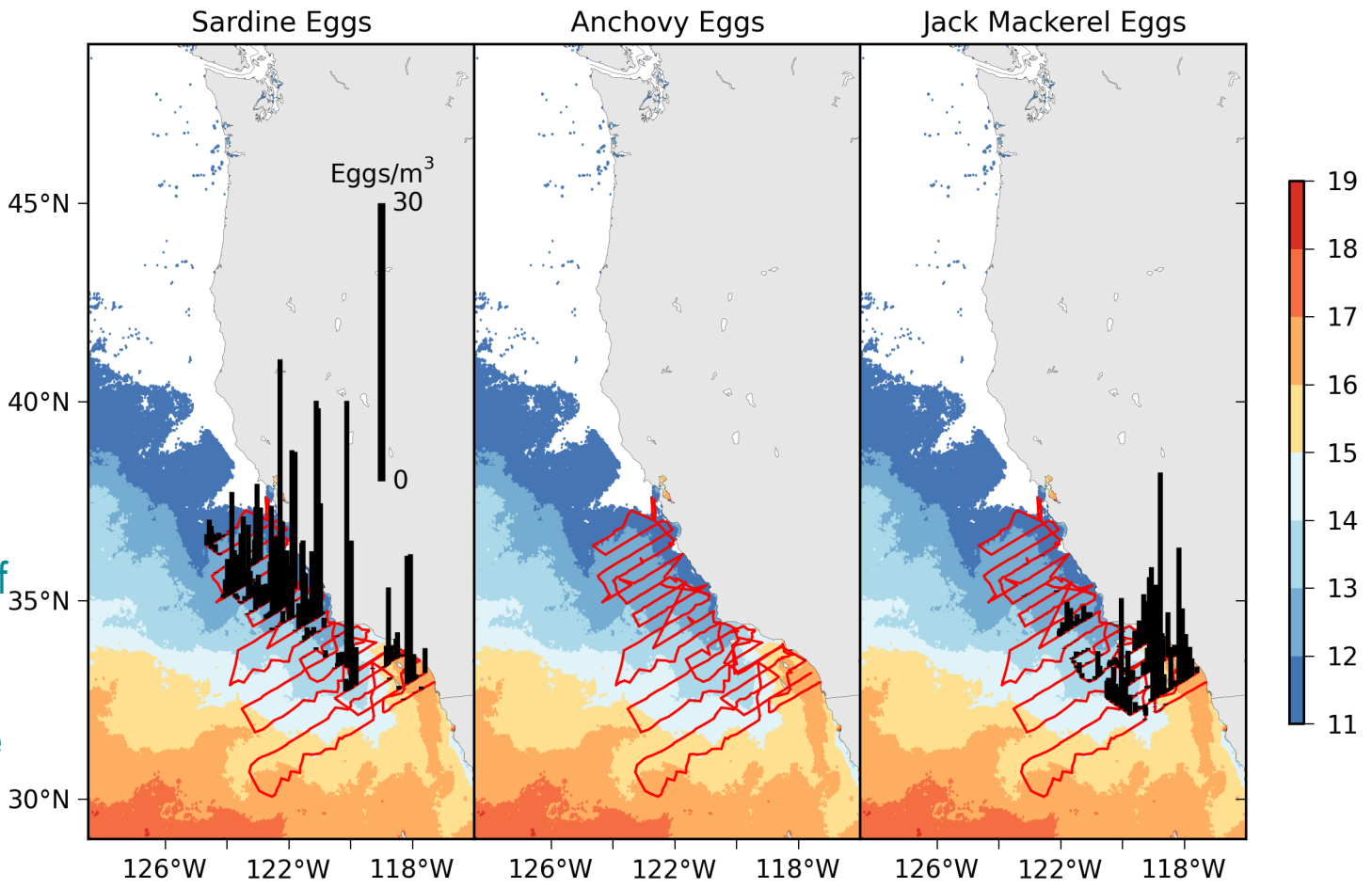
Southwest Fisheries Science Center

- Preliminary 2013 survey results to be used in the 2014 Pacific Sardine stock assessment
- Schedule of CPS Stock Assessments
- External MSRA Review - preliminary outcomes - July 2013
- New NOAA/SWFSC investments to enhance studies of California Current/West Coast ecosystem
- MexUS-Pacifico Bilateral Meeting outcomes - August 2013
- Trinational Sardine Forum December 2013, Ensenada, MX
- SWFSC hosting CalCOFI Conference, December 2013
- NWFSC/SWFSC SaKe Survey CIE Review, Jan/Feb 2014

Cisco Werner
Director, SWFSC

Preliminary 2013 CPS survey results

- Weather hampered the completion of these surveys
- Sufficient number of stations were sampled for utilization in sardine assessment



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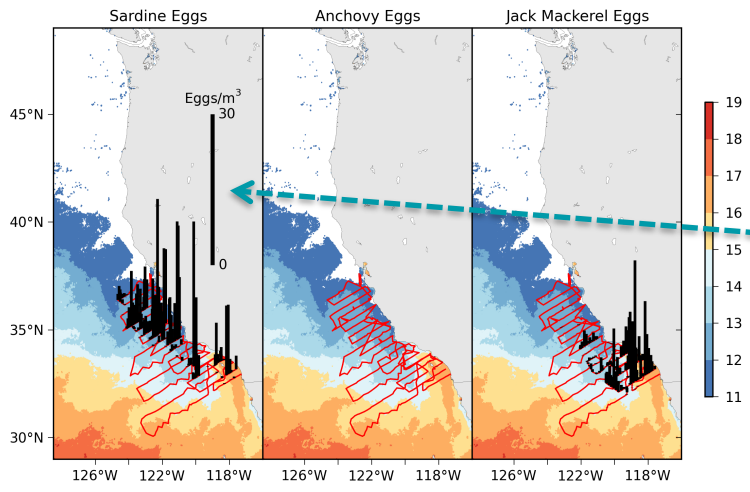
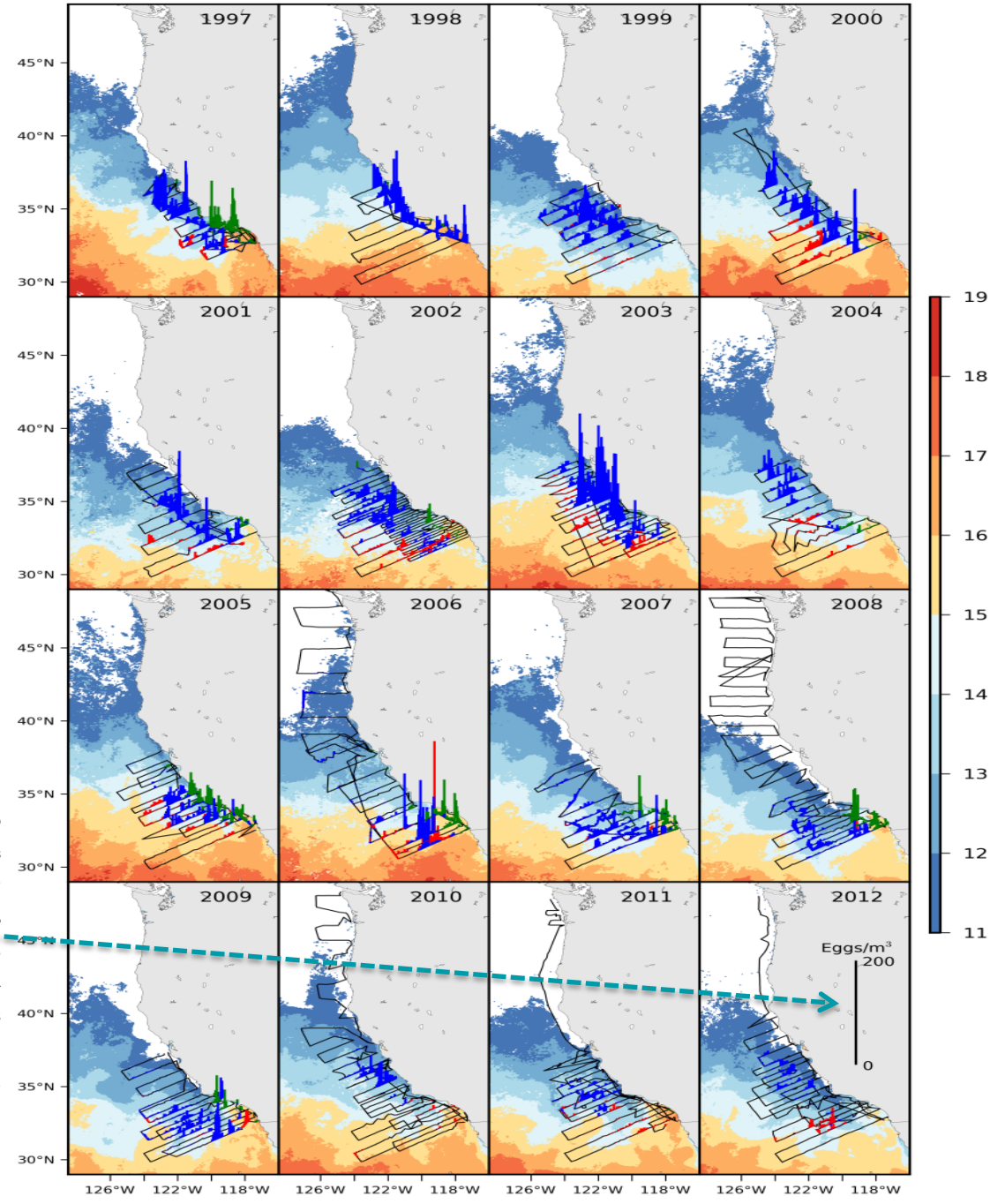
2013 CUFES results
NOTE DIFFERENT SCALES





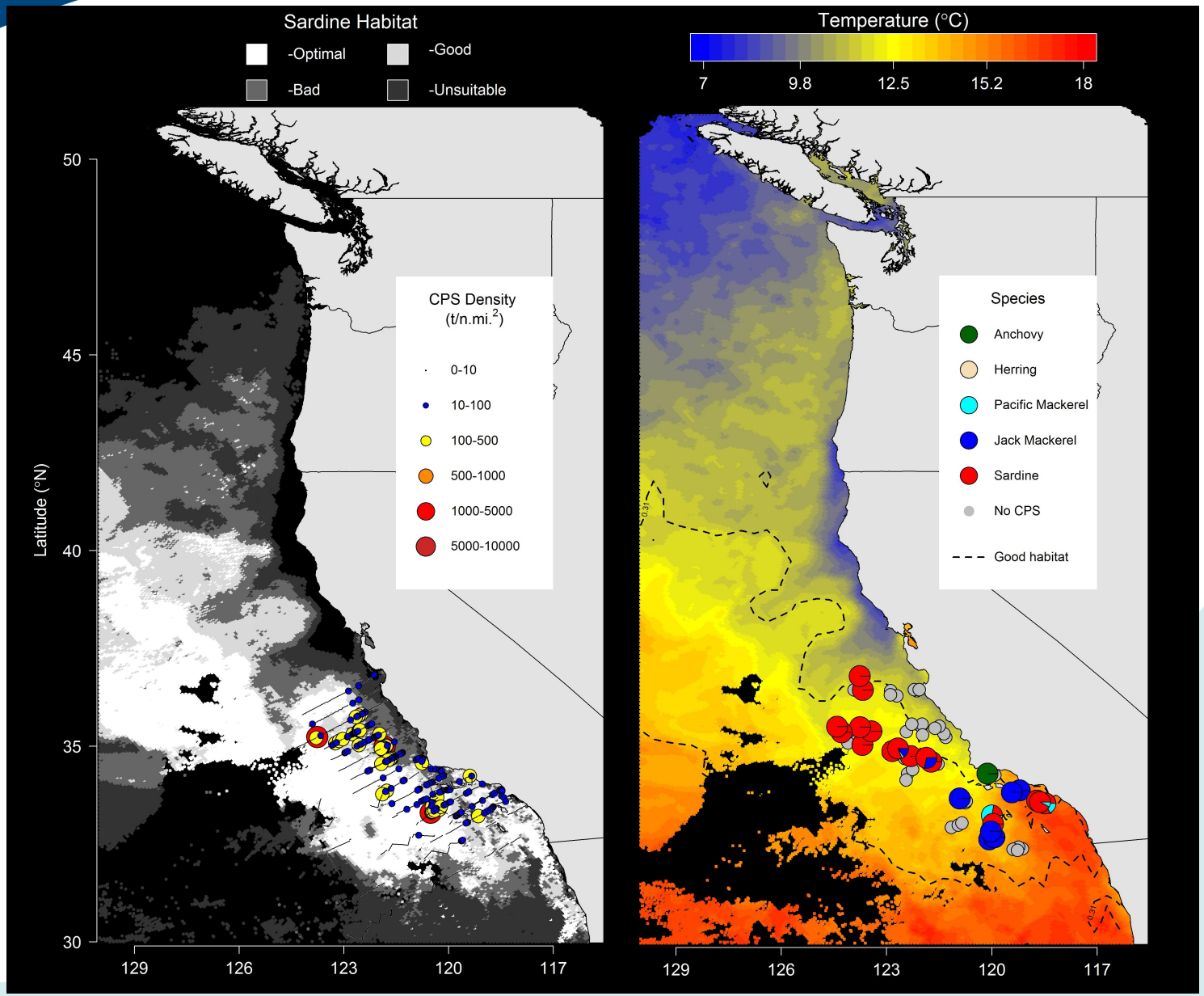
2013 Spring Sardine Survey

NOAA FISHERIES

- Few sardine in SCB
- Main distribution: Offshore from Pt. Conception to S.F.
- Cohort: 2009-2010
- No sign of new recruitment

Left panel:
ATM backscatter

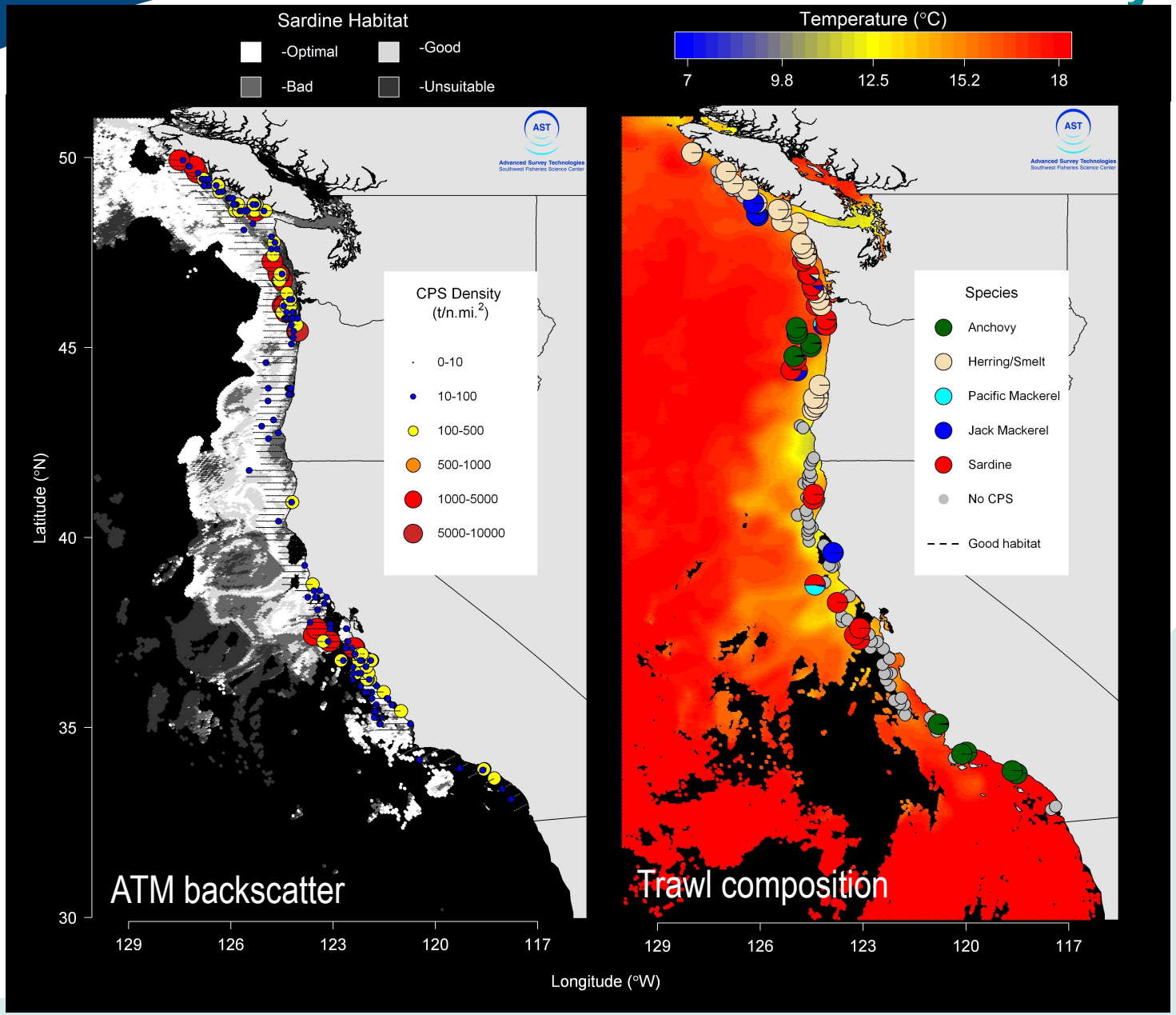
Right panel:
trawl composition



2013 Summer SaKe Survey

NOAA FISHERIES

- June 6 – Sept 6
- Few sardine, nearshore, S.F. to central WA
- None in S. California Bight
- None off Vancouver Island
- Cohort: 2009-2010
- No sign of new recruitment
- Five anchovy trawls in SCB



NOAA FISHERIES

1304 *Ocean Starr*: DEPM

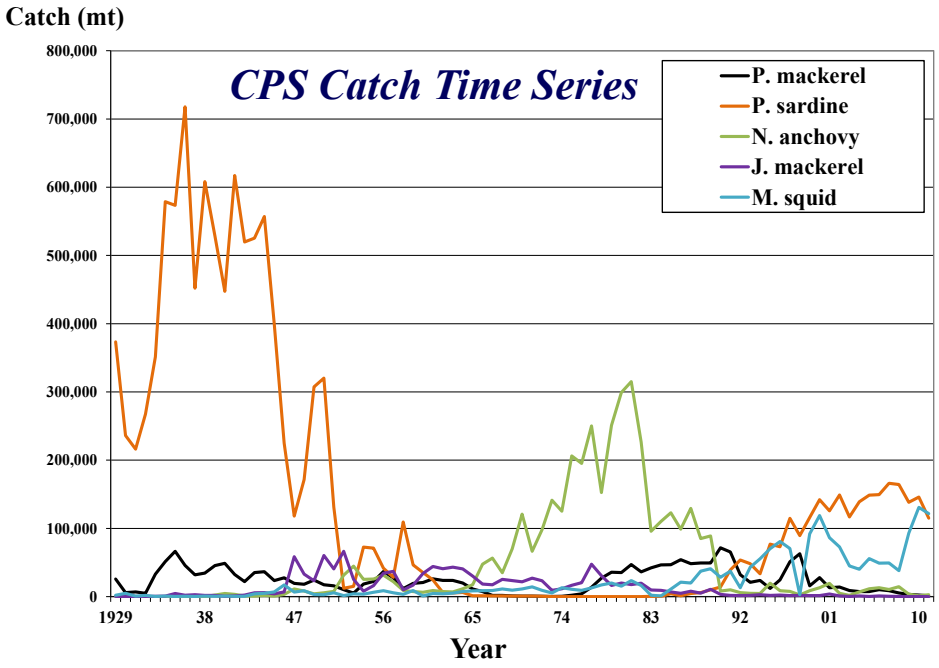
Laboratory Process	CUFES	PairoVET	Manta	Bongo
Sample Sorting	100%	100%	60%	8% (High density [Region 1] sardine spawning area)
Ichthyoplankton Identification	100%	100% (Sardine egg and larval identification & egg staging only)	60%	8% (Sardine only, Region 1)
Data Entry & Verification	100%	100% (Sardine egg & larval count data, egg stages)	0%	8% (Sardine only, Region 1)

1304 *Shimada*: CalCOFI + DEPM

Laboratory Process	CUFES	PairoVET	Manta	Bongo
Sample Sorting	100%	100%	NA	60% (100% of High density [Region 1] sardine spawning area)
Ichthyoplankton Identification	100%	100% (Sardine egg and larval identification & egg staging only)	NA	25% (Sardine only, Region 1)
Data Entry & Verification	100%	100% (Sardine egg & larval count data, egg stages)	NA	25% (Sardine only, Region 1)

- Laboratory sample processing of Spring Surveys delayed due to SaKe Cruise
- Gonad histology also delayed by SaKe cruise
- Processing will be completed for 2014 assessment

Coastal Pelagic Species (CPS): Assessment and Monitoring Schedule



- Primary goal is to develop similar assessments for all CPS
- Assessment models would emphasize indices of abundance from critical surveys (ATM and DEPM)
    - Consistent parameterization of stock parameters across assessments
    - Management strategies should be generally similar across species
- Management categories would be adaptive to changing species depending on population status and fishery operations

Potential schedule of CPS Stock Assessments

Species	Year					
	2014	2015	2016	2017	2018	2019
Pacific sardine	Full	Up	Full	Up	Full	Up
Other CPS (data preparation - STAR)	X	→		→	→	
Pacific mackerel		Full	→	Pro	→	Full
Northern anchovy - Northern sub		Full	→	Pro	→	Full
Northern anchovy - Central sub			Full	→	Pro	→
Jack mackerel			Full	→	Pro	→
Market Squid	C	C	C	C	C	C
Full CPS Assemblage including Krill					?	?

LEGEND

Full ≡ Full assessment

Up ≡ Update assessment

Pro ≡ Projection assessment

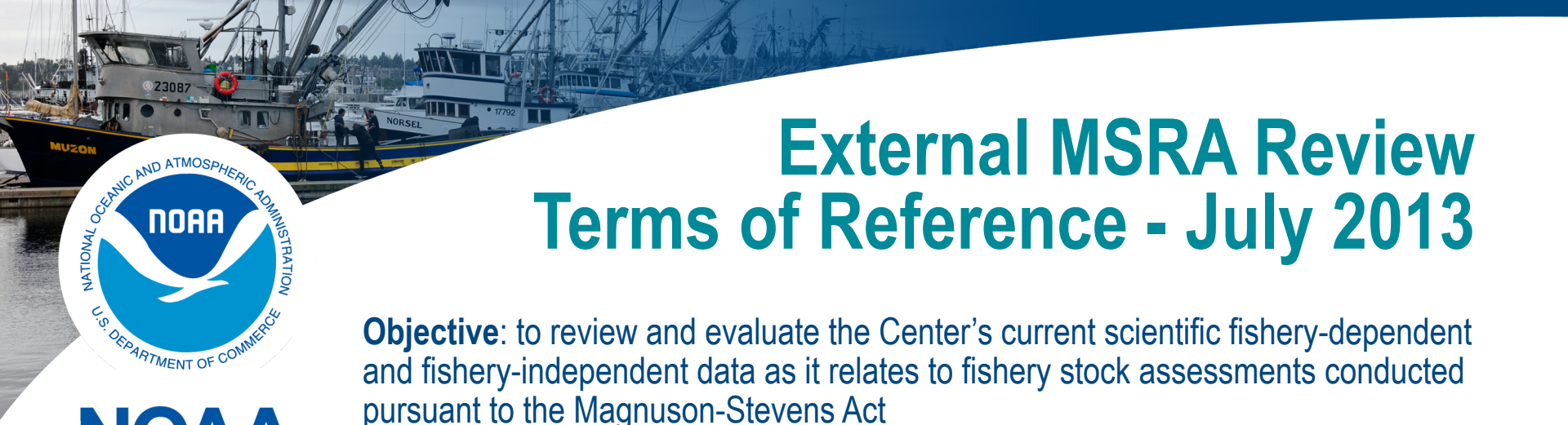
C ≡ Catch assessment (CDFW)

X ≡ To be conducted

→ ≡ Harvest advice based on previous assessment (Full, Up, or Pro)

CPS Assessment and Monitoring Schedule would result in…

- Actively managed species with limited landings for extended periods would be assessed according to a 4-year schedule
- Short-term projections would provide harvest advice for CPS as update assessments and would be less time consuming
- Assessments for monitored species would develop in phases, e.g., data preparation and literature review, model development, peer review, Council consideration, moving toward a full CPS assemblage assessment
- Monitoring of the stocks is conducted on an ongoing basis by two surveys (ATM and DEPM) which provide measures of stock status (abundance and productivity) in interim years between formal assessments

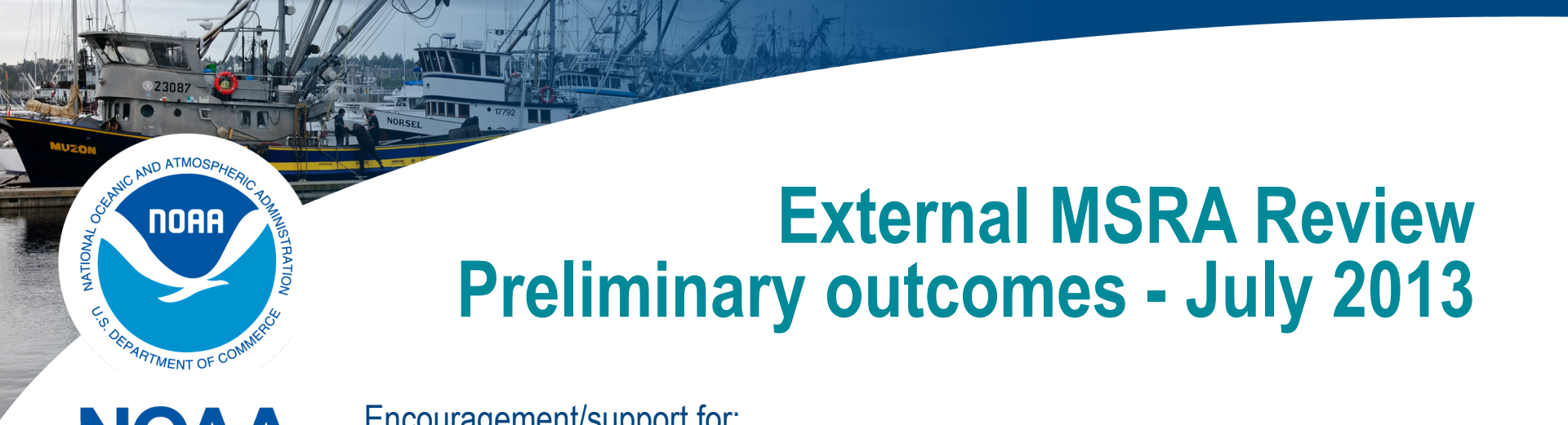


NOAA FISHERIES
Southwest Fisheries Science Center

External MSRA Review Terms of Reference - July 2013

Objective: to review and evaluate the Center's current scientific fishery-dependent and fishery-independent data as it relates to fishery stock assessments conducted pursuant to the Magnuson-Stevens Act

- **Relationship of current and planned fishery assessment data activities** to Center fishery assessments mandates and requirements – is the Center doing the right things?
- **Opportunities** – are there opportunities that the Center should be pursuing in collecting and compiling fishery assessment data, including shared approaches with partners?
- **Scientific/technical approach** – are the Center's fishery data objectives adequate, and is the Center using the best suite of techniques and approaches to meet those objectives?
- **Organization and priorities** – is the Center's fishery data system properly organized to meet its mandates and is the allocation of resources among program appropriate?
- **Scientific conduct** – are the Center's fishery data programs being conducted properly (survey design, integrity, peer review, transparency, confidentiality, …)?



External MSRA Review
Preliminary outcomes - July 2013

NOAA FISHERIES
Southwest Fisheries Science Center

Encouragement/support for:

- Proposal to change the frequency of CPS assessments and potentially surveys.
- Continued development of acoustic and ichthyoplankton efforts have potential to provide information on multiple coastal pelagic species; design of cruises should optimize benefits to as many species as possible.
- Research into understanding population dynamics and distributions that is critical for evaluating synergies and efficiencies when surveying multiple species.
- The expansion of a coordinated set of surveys between trawl, acoustics, and CALCOFI to allow NMFS to broaden its portfolio of species.

New resources: the La Jolla Lab

- Five-story, 120,000-square-foot laboratory (total cost ~US$75M, funded by the American Recovery and Reinvestment Act, ARRA)
- The facility has 35 laboratories, including: an experimental aquarium, a large animal necropsy lab, a photogrammetry lab, an ichthyoplankton lab, biotechnology laboratories, a laboratory for the design of ROVs and AUVs.
- The Lab also has a state-of-the-art Ocean Technology Development tech tank; archives containing more than 1.5 million specimens, samples, photographs and recordings; a main library and three additional reference collections; multimedia-equipped conference rooms; and office space for 275 scientists and support staff.

New labs for advanced technologies

- State-of-the-art tank unique facility:
  - 10 m D x 10 m W x 20 m L (2 M liters)
  - Thermohaline control (2 - 23°C; fresh to seawater)
- Saves valuable ship-time
- Development and Testing
  - Sensors: multi-frequency, and multibeam echosounders
  - Autonomous platforms: tags, landers, buoys, floats, moored arrays, and AUVs
- Science experiments
  - Mammals, turtles, fish, and invertebrates

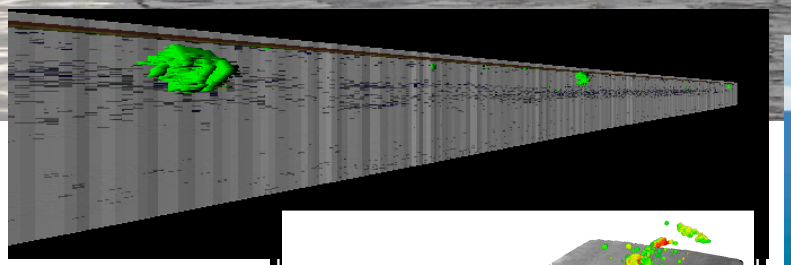
New FSV to address West Coast / California Current ecosystem questions

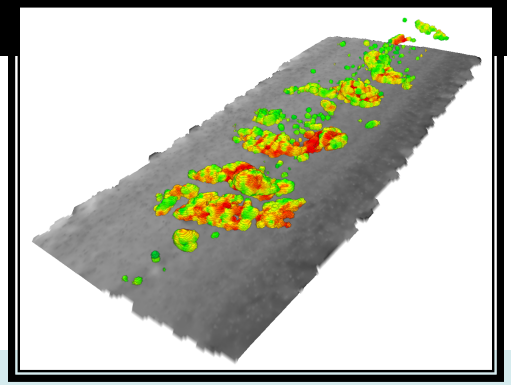
The Lasker is the fifth in a series of Dyson-class ships (208ft; 63m) due in San Diego (~Mar 2014)

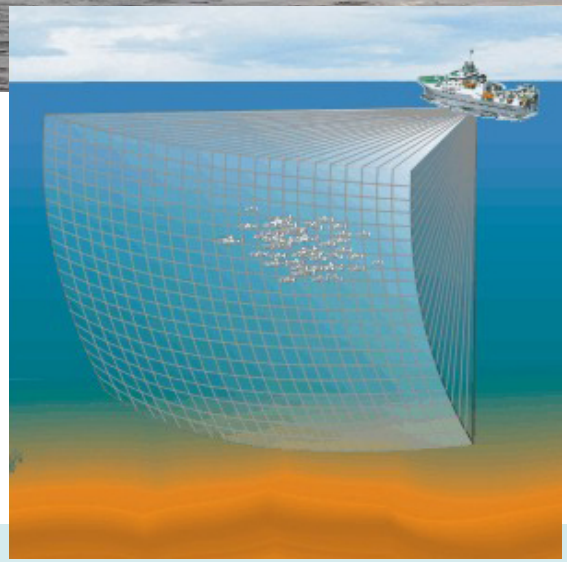
Equipped with technologies for fisheries and oceanographic research, including advanced navigation systems, acoustic sensors.

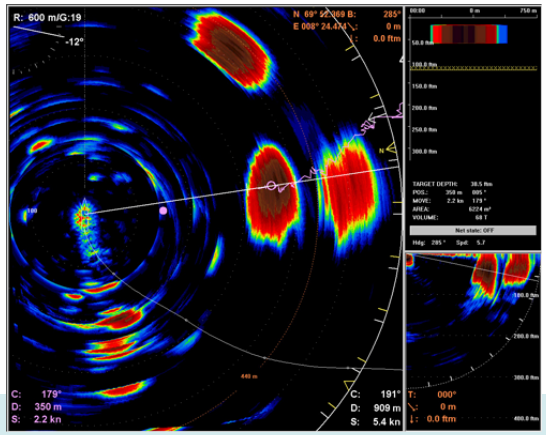
- Five-frequency split-beam echosounders
- Scanning, Multi-beam and Imaging Sonars

The ship is “quiet” (as per ICES standards)









NOAA FISHERIES

MexUS-Pacifico Bilateral Meeting Outcomes - August 2013

1. Both the US and Mexico recognized the importance of acoustic-trawl survey methods as a way of comprehensively studying a variety of coastal pelagic species such as sardine, anchovy and squid, and the value of this method to address questions of forage and ecosystem management.

2. NOAA and INAPESCA exchanged information on the two new research ships FSV Reuben Lasker and BIPO-INAPESCA, and agreed to future exchanges of scientific and collaborative joint research.

3. NOAA and INAPESCA agreed that key personnel for coastal pelagic species will attend the Tri-National Sardine Forum in Ensenada in December 2013, where cooperative planning will include: the acoustic-trawl methods, stock assessments and abundance estimation.

Instituto Nacional de Pesca

BUQUE DE INVESTIGACIÓN PESQUERA Y OCEANOGRÁFICA

CARACTERISTICAS PRINCIPALES

Eslora Total (aprox.)	59 m
Manga Máxima (aprox.)	13 m
Calado de diseño (aprox.)	5 m
Tripulación	18 personas
Personal Investigación	22 personas
Capacidad de Combustible (aprox.)	440 m3
Capacidad de agua dulce (aprox.)	50 m3
Potencia total de Gen. Principales (mínimo)	3000 kVA
Potencia de motores eléctricos propulsores (aprox.)	2 x 1000 kW
Capacidad de bodega () (aprox.)	120 m3
Velocidad máxima estimada (nudos)	13
Velocidad al 90% de potencia (aprox.)	12

NOAA FISHERIES
Southwest Fisheries Science Center

CPS calendar of activities (through to next Council meeting)

- Trinational Sardine Forum, Ensenada, MX (Dec 5-7, 2013)
  - Focus issue: “The coastwide structure, distribution and movements of the sardine population”
- CalCOFI Conference, SWFSC, La Jolla (Dec 9-11, 2013)
  - Symposium: “Forage Species and Assemblages in the California Current System”
- NWC/SWC SaKe Survey CIE Review (Jan/Feb 2014)
- Pacific sardine STAR and CPS Data Preparation Panel (3-6 March 2014)

2014 EXEMPTED FISHING PERMITS (EFP) NOTICE OF INTENT

The Coastal Pelagic Species (CPS) Fisheries Management Plan (FMP) allows for exempted fishing permit (EFP) activities to be conducted under a permit issued by the National Marine Fisheries Service (NMFS). Council Operating Procedure (COP) 23 was adopted in 2012, which outlines the process for proposing EFPs. In recent years, the Council has considered proposals to conduct EFP activities at the March and April meetings, but COP 23 calls for an initial notice of intent to be submitted in the November briefing book, with final action typically occurring at the March Council meeting.

One EFP proposal is included for consideration (Agenda Item E.2.a, Attachment 1), from the Northwest Aerial Survey, LLC, which has conducted sardine aerial survey work since 2008. Agenda Item E.2.a, Attachment 2 (*electronic only*) is the prior year's EFP proposal, including an addendum and supplemental tables.

At this meeting, the Council will consider adopting the proposal for public review.

Council Action:

1. **Adopt EFP proposal for public review.**
2. **Determine amount to be set aside for EFP research.**

Reference Materials:

1. Agenda Item E.2.a, Attachment 1: NWSS EFP proposal and request.
2. Agenda Item E.2.a, Attachment 2 ***Electronic only***: NWSS prior EFP proposal including addendum and supplemental tables.

Agenda Order:

a. Agenda Item Overview — Kerry Griffin
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Adopt Preliminary EFPs for Public Review

PFMC
10/10/13

Northwest Sardine Survey, LLC
c/o Astoria Holdings
12 Bellweather Way, Suite 209
Bellingham, WA 98225

Dr. Donald McIsaac
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220

October 2, 2013

Dear Dr. McIsaac:

As you know, the Northwest Sardine Survey, LLC has conducted an aerial sardine survey under exempted fishing permits (EFPs), approved by PFMC (Council) and granted by the National Marine Fisheries Service (NMFS), in recent years (2009, 2011, 2012, and 2013). This work has been conducted for the purpose of contributing to the stock assessment of Pacific sardine, to inform fisheries management.

Please consider this our letter of intent to request an EFP to conduct the aerial sardine survey again in 2014. The timing will be essentially the same as in 2012. The requested amount of fish is uncertain at this time.

Thank you for your consideration.

Sincerely,

Jerry Thon,
Principal, NWSS LLC

Agenda Item E.2.a
Attachment 2, *electronic only*
November 2012

Northwest Aerial Sardine Survey, LLC 2012 Exempted Fishing Permit proposal, including Addendum and supplemental tables

West Coast Aerial Sardine Survey

2012

Application for Exempted Fishing Permit

Applicant:

Northwest Sardine Survey, LLC
(Jerry Thon, Principal)

Science Advisor:

Tom Jagielo
Tom Jagielo, Consulting

Scientific Field Leader:

Ryan Howe

DRAFT

March 16, 2012

At the November 2012 Council meeting, the Northwest Sardine Survey (NWSS) submitted a letter of intent to apply again for an EFP to continue the aerial sardine survey in 2013. Subsequently, the SSC raised several concerns in its November 2012 statement. One recurring concern has been with regard to the spatial allocation of point sets with respect to the historical observations of sardine schools on the survey transects. This addendum was prepared in order to address this concern, by adding further detail to the experimental design in 2013, with respect to the spatial allocation of point sets.

The spatial distribution of schools observed on transects (2009-2012) is shown with an overlay of the locations of point sets sampled, in Figure 1. It is evident that improving the latitudinal distribution of point sets could help to ensure better spatial representation of sampling with respect to the distribution of sardine schools as observed on the aerial survey transects.

Examination of the number of schools, by latitude, (on transects spaced 15 nm apart) in the 2009-2012 surveys (Table 1) reveals that for all four surveys combined, 82% of the schools were found between 45 to 48 degrees North latitude (Table 2). A sizeable proportion of the schools observed were consistently found each year in each of the three bands delineated by 45-46, 46-47, and 47-48 degrees North latitude (Table 2; Figure 2).

To arrive at the spatial distribution of point sets proposed for the 2013 sampling plan, we distributed the 82 point sets (as called for in the 2012 EFP) across the three bands in proportion to the numbers of schools observed in each of the bands from the 2009-2012 surveys; this resulted in: 1) 32 point sets in the 45-46 band, and 2) 25 point sets in each of the 46-47 and 47-48 bands (Table 3; Figure 3). The sampling design also calls for apportioning point set sampling by school size; the school size allocations by area are shown in Tables 4 and 5.

In 2012, time constraints limited the collection of bona fide point sets to only 14 of the 82 proposed for the survey; the remaining landings were all sampled for biological characteristics but were either not photographed or they did not otherwise qualify as point sets that could be used for biomass estimation. In 2013, the total sardine HG is lower than it was in 2012; this should allow for more operational time and we will strive to get as many valid point sets as possible in the time window allocated for the survey (July 1 to September 15th).

Table 1. Spatial distribution of sardine schools observed in the Northwest Aerial Sardine Survey; numbers by latitude, 2009-2012, for transects spaced 15 nm apart only.

	Latitude (Deg N)					
	43-44	44-45	45-46	46-47	47-48	48-49
Year	Number of Schools					
2009	69	2	478	191	235	9
2010	0	2	128	143	186	50
2011	0	0	354	204	190	31
2012	99	581	571	632	595	0
2009-2012	168	585	1531	1170	1206	90

Table 2. Spatial distribution of sardine schools observed in the Northwest Aerial Sardine Survey; percent frequency by latitude, 2009-2012, for transects spaced 15 nm apart only.

	Latitude (Deg N)					
	43-44	44-45	45-46	46-47	47-48	48-49
Year	Percent Frequency of Schools					
2009	0.070	0.002	0.486	0.194	0.239	0.009
2010	0.000	0.004	0.251	0.281	0.365	0.098
2011	0.000	0.000	0.454	0.262	0.244	0.040
2012	0.040	0.234	0.230	0.255	0.240	0.000
2009-2012	0.035	0.123	0.322	0.246	0.254	0.019
				0.82		

Table 3. Proposed spatial distribution of point set sampling, by latitude, for the Northwest Aerial Sardine Survey in 2013.

Proposed Spatial Distribution - 2013 Survey		
Latitude	**%**	**Number**
45-46 deg N	0.39	32
46-47 deg N	0.30	25
47-48 deg N	0.31	25
	1.00	82

Table 4. Proposed school size distribution of point set sampling for the Northwest Aerial Sardine Survey in 2013, for the area between 45-46 degrees North latitude.

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets
100	4	15	4
500	11	53	5
1000	17	85	5
2000	27	133	5
4000	52	260	5
8000	71	282	4
10000	82	328	4
		1156	32

Table 5. Proposed school size distribution of point set sampling for the Northwest Aerial Sardine Survey in 2013, for: 1) the area between 46-47 degrees North latitude, and 2) the area between 47-48 degrees North latitude.

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets
100	4	11	3
500	11	42	4
1000	17	68	4
2000	27	106	4
4000	52	208	4
8000	71	212	3
10000	82	246	3
		893	25

Figure 1. Spatial distribution of sardine schools observed in the Northwest Aerial Sardine Survey; locations of: 1) point sets (blue triangles) and 2) fish school locations on transects (red circles) (2009-2012).

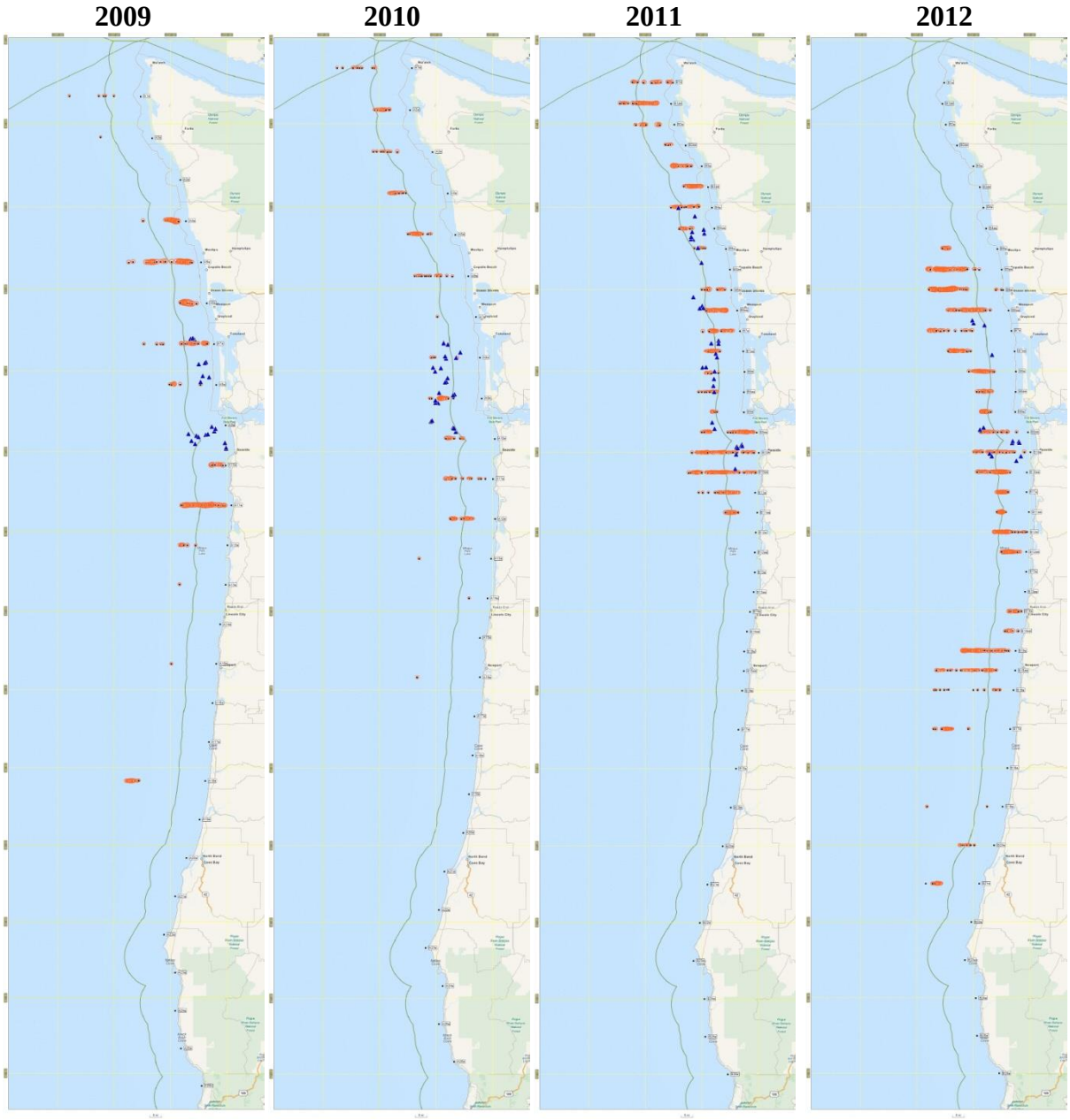


Figure 2. Spatial distribution of sardine schools observed in the Northwest Aerial Sardine Survey; percent frequency of schools by latitude (2009-2012).

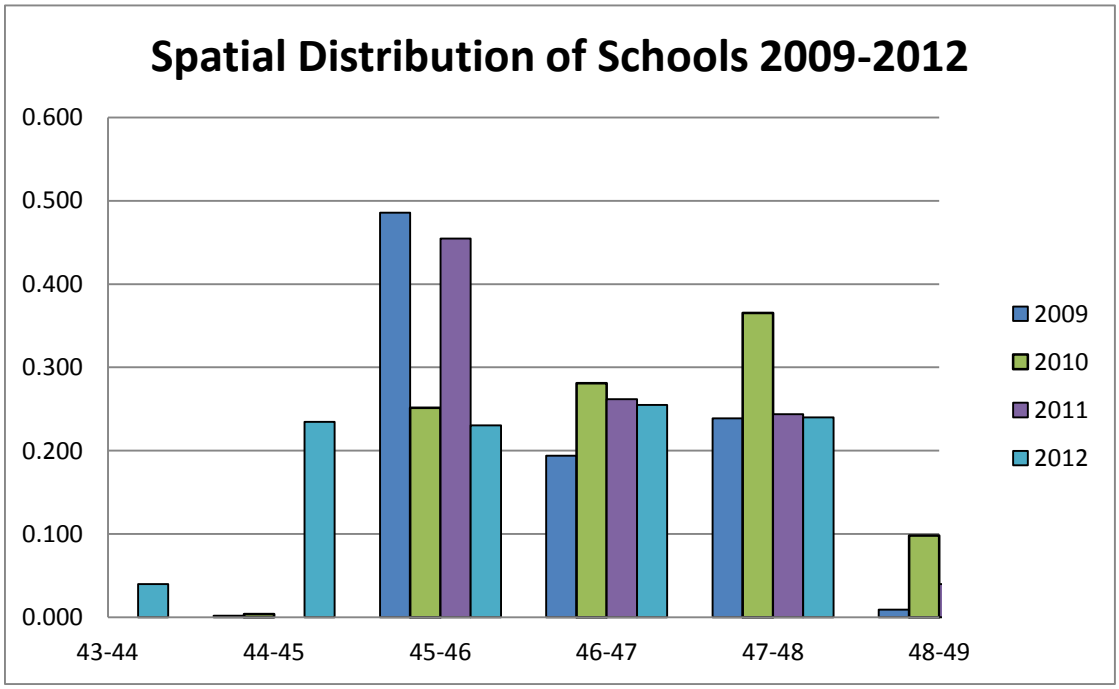


Table 6. Alternative summary of spatial distribution of sardine schools observed in the Northwest Aerial Sardine Survey; percent frequency by latitude, 2009-2012, for transects spaced 15 nm apart only.

	Latitude (Deg N)					
	43-44	44-45	45-46	46-47	47-48	48-49
Year	Percent Frequency of Schools					
2009		0.558		0.194	0.248	
2010		0.255		0.281	0.464	
2011		0.454		0.262	0.284	
2012		0.505		0.255	0.240	
2009-2012		**0.44**		**0.25**	**0.31**	

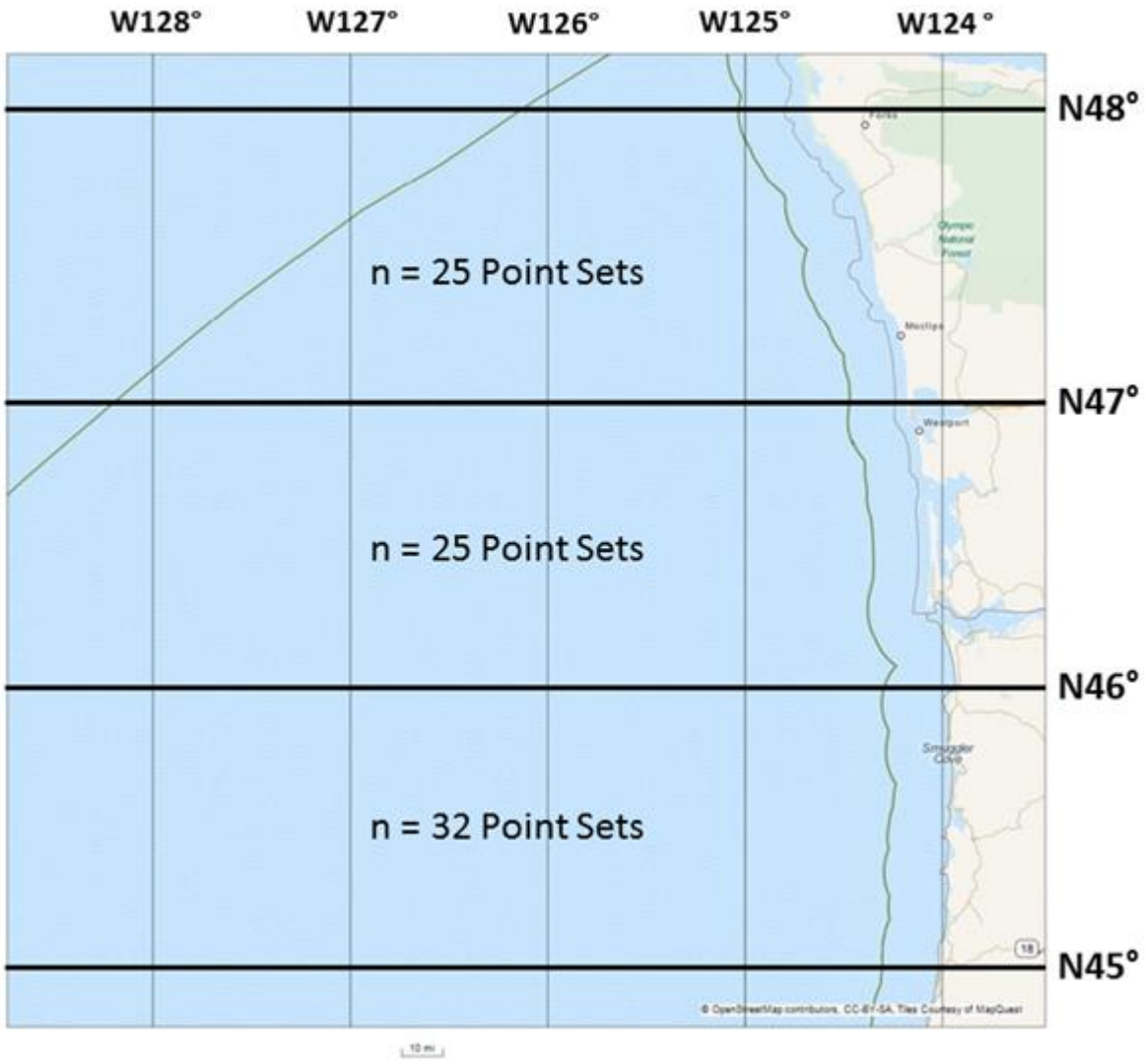
Table 7. Alternative school size distribution of point set sampling for the Northwest Aerial Sardine Survey in 2013, for: 1) the area south of 46 degrees North latitude (top), 2) the area between 46-47 degrees North latitude (middle) and 3) the area north of 47 degrees North latitude (bottom).

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets	
100	4	15	4	
500	11	64	6	
1000	17	102	6	
2000	27	159	6	
4000	52	311	6	
8000	71	282	4	
10000	82	328	4	
		1262	36	44%

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets	
100	4	11	3	
500	11	32	3	
1000	17	51	3	
2000	27	80	3	
4000	52	156	3	
8000	71	212	3	
10000	82	246	3	
		787	21	26%

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets	
100	4	11	3	
500	11	42	4	
1000	17	68	4	
2000	27	106	4	
4000	52	208	4	
8000	71	212	3	
10000	82	246	3	
		893	25	30%
	Total:	2942	82	

Figure 3. Proposed spatial distribution of point set sampling for the Northwest Aerial Sardine Survey in 2013.



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I. Introduction

Advisory bodies of the Pacific Fishery Management Council (PFMC), including the Coastal Pelagic Species Advisory Subpanel (CPSAS), Coastal Pelagic Species Management Team (CPSMT), and the Scientific and Statistical Committee (SSC), have recommended that additional fishery-independent indices of abundance be developed for the assessment of Pacific sardine.

To meet this need, an aerial survey methodology was developed and successfully tested in 2008 by the Northwest Sardine Survey (NWSS), an industry group based in the Pacific Northwest (Wespestad et al. 2009). A stock assessment review (STAR) panel approved the approach in May 2009, and an EFP application was submitted jointly by NWSS and the California Wetfish Producers Association (CWPA) to conduct a coastwide aerial sardine survey. Following approvals by PFMC and NMFS, work conducted under the 2009 sardine EFP resulted in a survey that extended from Cape Flattery, WA to Monterey Bay, CA (Jagielo et al. 2009). The results from that survey were reviewed by a STAR panel in September 2009 and were approved for use in the 2009 Pacific sardine stock assessment that was used for harvest management in 2010.

Subsequently, EFP applications were approved for aerial surveys conducted in 2010 (Cape Flattery through the California Bight – NWSS and CWPA) and in 2011 (Cape Flattery to the Oregon/California border - NWSS) (Jagielo et al 2010, 2011). Results from these surveys were approved by STAR panels and were used to inform the stock assessments used for management in 2011 and 2012.

The present EFP application is for survey work proposed by NWSS in 2012. As is 2011, the survey proposed for 2012 extends from Cape Flattery to the Oregon/California border and uses the same methodology employed by the previous aerial surveys (2009-2011). The purpose of this application is to document how the proposed survey meets the NMFS requirements for the approval of a Coastal Pelagic Species (CPS) EFP. Specifically, it provides: 1) the scientific study design, analytical methodologies, and a description of the overall logistics (in the main document that follows), 2) a detailed Field Operational Plan (Appendix I), and 3) a point by point discussion of how this EFP application follows the NMFS guidelines for preparation of an EFP application (Appendix II).

If approved by PFMC, this EFP application will be submitted to NMFS in order to obtain access to 3,000 mt of sardine which is requested to be withheld from the directed fishery management measures for the West Coast sardine OY for the purpose of funding and conducting the survey in 2012. The request of 3,000 mt of sardine in 2012 represents an increase of 300 mt over that requested by NWSS in 2011. The additional amount of EFP sardine will provide 1) increased funding to allow for a fourth survey airplane to conduct the aerial survey transects planned for 2012 in a timely manner, and 2) an increased sample size of point sets to help reduce the variance of the survey biomass estimate.

The NWSS-LLC will conduct aerial survey work and point sets from the Canadian border to the Oregon-California border (survey area). Additional aerial survey work may be conducted in Canada if approval is obtained from the Canadian government.

Scientific oversight for the Aerial Sardine Survey will be provided again by Mr. Tom Jagielo. Mr. Jagielo will have the primary responsibility to analyze the survey data and will report the results to Dr. Kevin Hill, National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SFSC), in a form suitable for input to the stock assessment model. Mr. Ryan Howe will be responsible for oversight of scientific sampling in the field. Mr. Jerry Thon (NWSS) will oversee the day to day logistic activities of the survey, including deployment of vessels and aircraft as needed to accomplish the projects objectives. Mr. Chris Cearns (NWSS) will serve as the West Coast Aerial Survey project Single Point of Contact (SPC), to comply with NMFS reporting requirements for the survey.

II. Survey Design

The aerial sardine survey employs a two-stage sampling design. Stage 1 consists of aerial transect sampling to estimate the surface area (and ultimately the biomass) of individual sardine schools from quantitative aerial photogrammetry. Stage 2 involves at-sea sampling to quantify the relationship between individual school surface area and biomass. Sampling will be conducted in July (following closure of the directed fishery), through August, and potentially into early September of 2012. Logistical details of the survey are provided in Appendix I (West Coast Aerial Sardine Survey - 2012 Field Operational Plan).

Stage 1: Aerial Transect Survey

Logistics

The 2012 aerial survey employs the belt transect method using a systematic random sampling design; with each transect comprising a single sampling unit (Elzinga et al. 2001). Parallel transects will be conducted in an east-west orientation, generally parallel to the onshore-offshore gradient of sardine schools distributed along the coast.

Sampling in 2012 will again be conducted with different transect spacing in two separate strata. In the northern portion of the survey area (From Cape Flattery, WA southward to approximately Tillamook, OR), 31 transects are spaced 7.5 nautical miles apart. For the southern portion of the survey area (southward to the Oregon-California border) an additional 10 transects are spaced 15 nautical miles apart. In previous years (2009-2010) we found that the southern area accounted for only 1% of the sardine surface area measured; and in 2011, we found no sardine schools on transects in the southern area. While it is possible that sampling only the northern stratum could result in improved efficiency, continued sampling of the southern stratum will aid in the documentation of inter-annual variability in the southward spatial distribution of sardine in the northwest.

Three alternative fixed starting points five miles apart were established, and from these points, three sets of 41 transects were delineated for the survey. The order of conducting the three replicate sets will be chosen by randomly picking one set at a time without replacement. The east and west endpoints of each transect and corresponding shoreline position are given in Appendix I, Tables 1a-f and are mapped in Appendix I, Figures 1a-c for each of the three replicates (Set A, Set B, and Set C, respectively). Transects start at 3 miles from shore and extend westward for 35 statute miles in length. In addition to the 35 statute mile transect, the 3 statute mile segment directly eastward of each transect to the shore will be flown and photographed. Survey biomass will be estimated from the 35 statute mile transect data. Photographs from the shoreward segment will be used primarily to evaluate the potential need for future modification of the survey design.

Details regarding the airplanes and pilots participating in the survey, a description of the order in which transects will be flown to avoid "double counting", and other operational specifics are described in Appendix I.

Data Collection and Reduction

Each survey plane will be equipped with the same photogrammetric aerial digital camera mounting and data acquisition system that was used from 2009-2011 in the previous aerial surveys (Aerial Imaging Solutions; Appendix I, Adjunct 1). This integrated system will again be used to acquire digital images and to log transect data. The system records altitude, GPS position, and spotter observations, which are directly linked to the time stamped quantitative digital imagery. At the nominal survey altitude of 4,000 feet, the approximate width-swept by the camera with a 24 mm lens is 1,829 m (1.13 mi). Digital images will be collected with 80% overlap to ensure seamless photogrammetric coverage along transects.

A Transect Flight Log Form will be kept during the sampling of each transect for the purpose of documenting the observations of the pilot (Appendix I, Adjunct 2). Key notations will include 1) observations of school species identified and 2) documentation of any special conditions that could have an influence on interpreting the photographs.

In order to provide ground truth information and a cross comparison between survey aircraft, digital imagery of certain land-based features of known size (e.g., an airplane hangar, a football field, or a set of tennis courts) will again be collected at a series of altitudes ranging from 1,000 ft. to 4,000 ft. The observed vs. actual sizes of the objects will subsequently be compared to validate camera performance and to evaluate photogrammetric error.

Digital images from the survey will be analyzed to determine the number, size, and shape of sardine schools on each transect. Adobe *Photoshop Lightroom 3.0* software will be used to make the sardine schools visible. Measurements of sardine school size (m^2) and shape (circularity) will be made using Adobe *Photoshop CS5-Extended* software.

Transect readability will be scored for each transect analyzed. In the event that we are able to collect more than one set of transects in 2012 (it was only possible to complete one set in 2011), this procedure will be used to determine which transect set reflects the best (most clearly readable) sampling of the survey area.

Transect width will be determined from the digital images using the basic photogrammetric relationship:

$$\frac{I}{F} = \frac{GCS}{A}$$

and solving for *GCS*:

$$GCS = \frac{I}{F} A$$

where I = Image width of the camera sensor (e.g. 36 mm), F = the focal length of the camera lens (e.g. 24mm), A = altitude, and *GCS* = "ground cover to the side" or width of the field of view of the digital image. Transect width will be obtained by taking the average of *GCS* for all images collected on transect. Transect length will be obtained from the distance between start and stop endpoints using the GPS data logged by the data acquisition system.

Data Analysis

Estimation of total sardine biomass for the survey area will be accomplished in a 3 step process, requiring: 1) measurement of individual school surface area on sampled transects, 2) estimation of individual school biomass (from measured school surface area and estimated school density), and 3) transect sampling design theory for estimation of a population total.

Individual school surface area (a_i) will be measured on the photo-documented transects using the measurement tool feature of *Adobe Photoshop,* employing the photogrammetric relationships described above. Individual school density (d_i) is specific to school size and will be determined from the empirical relationship between surface area and biomass obtained from Stage 2 (point-set) sampling (described below). Individual school biomass (b_i) is estimated as the product of school density and surface area ($b_i = d_i a_i$). The sum of individual school biomass (b_u) will then be determined for each transect (u). The mean sampled biomass for the study area ($\bar{b}$) is computed as:

$$\bar{b} = \sum_{u=1}^{n} b_u \ / \ n \ .$$

Total biomass for the study area $(\hat{B})$ will be estimated using the unbiased estimator for a population total (Stehman and Salzer 2000),

$$\hat{B} = N\bar{b} \ .$$

The school measurement process described above will be conducted by two independent readers; thus two estimates of total biomass will be obtained. The two separate estimates of biomass will be averaged to obtain the final biomass estimate.

Individual School Biomass

The biomass of individual schools observed on the transects (b_i) will be calculated using 1) measurements of school surface area, and 2) the relationship between school surface area and biomass, obtained from point sets. The three parameter Michaelis-Menten (MM) model assuming log-normal error will be used to describe the sardine surface area – biomass relationship:

$$d_i = (yz + xa_i)/(z + a_i)$$

where

d_i = school surface area density (mt/m^2)
a_i = school surface area (m^2)
y = y intercept
x = asymptote as x approaches infinity
x/z = slope at the origin.

As noted above, individual school biomass (b_i) is then estimated as the product of school surface area density and surface area ($b_i = d_i a_i$).

Total Biomass Coefficient of Variation (CV)

The CV of the total biomass estimate will again be obtained by employing a bootstrapping procedure implemented with the R statistical programming language (Jagielo et al. 2011). The intent of the procedure is to propagate error from the point of school density estimation forward -- to the ultimate goal of total biomass estimation from the transect data.

Stage 2: At-Sea Point Set Sampling

Logistics

Empirical measurements of biomass will be obtained by conducting research hauls or "point sets" at sea. Point sets are the means used to determine the relationship between individual school surface area (as documented with quantitative aerial photographs, described above) and the biomass of individual fish schools (Figure 1). Up to four purse seine vessels will participate in the survey under the direction of Mr. Thon. The identification and gear configuration of the participating vessels is given in Appendix I, Adjunct 3.

For the purposes of the aerial survey, a valid point set is defined as a sardine school that is: 1) first identified and quantitatively photographed by a survey pilot, and 2) subsequently captured in its entirety and landed by a survey purse seine vessel. The

criteria that will be used for determining the acceptability of point sets for the school density analysis are given in Appendix I, Adjunct 4.

The point set sampling design is stratified by school size, with the goals of obtaining 1) a range of sizes representative of schools photographed on the transects (keeping within a size range consistent with the safe operation of the vessels participating in the survey) and 2) a geographic distribution of schools that is representative of schools found on the transects (to the extent logistically possible given operational constraints). Point sets will generally not be attempted for schools larger than approximately 130 mt. Using the EFP set-aside amount of 3,000 mt, a total of n = 82 point sets are planned for 2012 (Appendix I; Table 2, page 12). Point sets will be distributed spatially throughout the area of sardine abundance, as observed on survey transects. In 2011 we improved the spatial distribution of point sets compared to previous surveys (Figure 2); however, we can do incrementally better by obtaining point sets further northward in 2012.

A new federal regulation restricts low altitude flights over specified zones within national marine sanctuaries. The Olympic Coast National Marine Sanctuary (OCNMS) is located within the proposed aerial sardine survey area. At the OCNMS, flights below 2000 feet are prohibited within one nautical mile of Flattery Rocks, Quillayute Needles, or Copalis National Wildlife Refuge, or within one nautical mile seaward from the coastal boundary of the sanctuary (Federal Register 2012). We do not anticipate the need to conduct point sets in these specified zones, so this minimum altitude restriction should not pose a constraint to survey operations.

For 2012 we propose to remove the constraint that point sets must be flown at the same altitude used for transect sampling. This constraint was originally recommended during an early STAR panel methodology review (PFMC 2009), as a means to validate species identification of schools photographed on transects. Subsequently, with three years of survey experience and 88 point sets completed at the nominal transect altitude of 4,000 ft, we have observed a point set species misidentification rate of zero. Unfavorable weather conditions have often resulted in ceiling altitudes well below 4,000 ft. during the brief time period allotted for the survey, and the number of workable days for conducting point sets has been negatively impacted. Relaxing the point set altitude constraint will enable us to better achieve other sampling objectives, including getting better (more representative) point set size and spatial distributions.

Data Collection and Reduction

For fully captured schools, the 1) total weight of the school, 2) numbers per unit weight, and 3) species composition will be determined from biological sampling of the point set hauls (see below). Additionally, school height in the water column will be recorded from vessel sonar and down-sounder equipment. Point set photographs will be analyzed to determine school surface area using the same procedure described above for analysis of sardine schools on survey transects.

Biological Sampling of Point Sets

Fishermen participating in the survey will keep the point set hauls in separate holds upon capture so that the tonnage of each aerially photographed and measured haul can be determined separately upon landing. Fish will be collected at fish processing plants upon landing. Samples will be collected from the unsorted catch while being pumped from the vessels. Fish will be taken systematically at the start, middle, and end of each set as it is pumped. The three samples will then be combined and a random subsample of fish (n = 50) will be taken from the pooled sample. Length, weight, sex, and maturity data will be collected for each sampled fish. Sardine weights will be taken using an electronic scale accurate to 0.5 gm; lengths will be taken using a millimeter length strip provided attached to a measuring board. Standard length is determined by measuring from sardine snout to the last vertebrae. Sardine maturity will be documented by referencing maturity codes (female- 4 point scale, male- 3 point scale) supplied by Beverly Macewicz NMFS, SWFSC (Appendix I, Table 3). Otoliths will be taken from a randomly selected 25 fish subsample for future age determination.

III. Survey Logistics

A description of: 1) the roles and responsibilities of project personnel, 2) EFP purse seine vessel selection, 3) the disposition of fish harvested under the EFP, and 4) the project budget, are provided below. Additionally, a detailed Field Operational Plan is presented in Appendix I, and a point by point discussion of NMFS EFP guidelines and requirements is presented in Appendix II.

Key Project Personnel: Roles and Responsibilities

Name: Mr. Jerry Thon
Affiliation: Principal, Northwest Sardine Survey, LLC
Address: 12 Bellwether Way, Suite 209, Bellingham, WA 98225
Email: jthon2@msn.com
Phone: (360) 201-8449

Role: Industry Coordinator; EFP Applicant: NWSS-LLC

Responsibilities: Oversee day to day logistic activities of the survey, including deployment of vessels and aircraft as needed to accomplish the projects objectives. Coordinatate sale of EFP sardine with participating processors. Administrate EFP funds; direct funds as required to accomplish the projects scientific objectives. Contract with scientists, vessels, pilots, and others as needed to execute the project with scientific oversight from Mr. Jagielo (Science Advisor).

Name: Mr. Tom Jagielo, MSc
Affiliation: Tom Jagielo, Consulting
Email: TomJagielo@msn.com
Phone: (360) 791-9089

Role: Science Advisor

Responsibilities: Develop survey design. Provide scientific guidance and oversight for project execution. Analyze survey data. Provide survey results in a form suitable for use by NMFS/SWFSC in the Pacific sardine stock assessment. Prepare final report. Represent the project in public fora (e.g., PFMC, STAR panels, and SSC) to present and interpret scientific results from the survey.

Name: Mr. Ryan Howe, BSc
Affiliation: Consultant
Email: ryanhowe9@yahoo.com

Role: Scientific Field Leader

Responsibilities: Under direction of Mr. Jagielo, coordinate field data collection and ensure scientific validity of field data from the survey. Compile data for analysis. Provide leadership of photogrammetric analysis staff. Assist with survey data analysis, preparation of final report, and presentation of project results as appropriate and/or required.

EFP Purse Seine Vessel Selection

Our priorities for selecting vessels to participate under this EFP include: 1) vessels having the ability to separate the point sets into different hatches, 2) vessels committing to follow scientific protocol as directed during this study period, and 3) vessels that have installed or have the capacity to install or carry any electronic equipment necessary.

With the narrow time window for sampling it is desirable to have a field of boats we can draw on, in order to maximize the number of point sets we can bring in during optimum weather and sea conditions. These boats will only be used for point sets. Some vessels do not have recording sounders, but all vessels do have sonar's that can measure school height and log it. Having a slate of potential vessels to draw from removes the possibility of losing operational days from problems like engine failure. Being able to pick vessels from the list of available boats, and reporting the vessels that will be operating at any given time to local enforcement will help to meet the EFP goals efficiently and cost-effectively. We request approval to deploy up to seven vessels per 24 hour period (See Appendix I, Adjunct 3). Participating vessels may make EFP landings in either one or both states (Washington or Oregon).

Disposition of fish harvested under the EFP

Fish harvested under this EFP will be sold to help fund the sardine research described above. Participating processors receiving point set EFP product from sardine quota set-

aside to NWSS-LLC will be identified prior to any fish deliveries made under this EFP, and they will process the fish by bid. Fish Tickets will be tabulated to verify that the sardine harvested under the EFP do not exceed the amount of harvest allocated for the research set-aside to the recipients, and that the amounts harvested correspond to the total of the amounts harvested while conducting the point set research.

Budget

An itemized budget is provided in Appendix II, Adjunct 2. The amount of funds that will be available to the project from the sale of sardine harvested and sold under the EFP is of necessity a rough estimate; this number will be refined as bids for processing are received and the amount of funds potentially available can be established. On the cost side, we have detailed components of the project that will be required to complete the work proposed. Field work always includes uncertainty (weather, fish availability, etc.) and contingency amounts have been included to attempt to address some of this uncertainty.

The financial structure of the project is as follows:

1. Funds derived from the capture and sale of the sardine research set-aside will be used to pay for the research to be conducted under this proposed EFP. The costs of the project will be the responsibility of the NWSS-LLC and will be paid for by the sale of the fish captured during the point sets.

2. Fishing vessels will be chartered by NWSS-LLC to catch the sardines during point sets and conduct echo soundings of fish schools with ES-60 or other suitable electronic equipment.

3. Participating processors will not profit on the sale of the EFP sardine quota; rather, they will process the fish at cost. The processor(s) for this project will be chosen after submitting bids. The lowest bid(s) will be accepted.

4. Airplanes conducting the photo surveys and assisting in point set captures will work under hourly rates or by contract to NWSS-LLC.

5. Equipment needs and operational costs, including scientific support, will be paid for by the NWSS-LLC from the sale of the 3,000 mt research quota. We anticipate the revenue from the fish sales will be sufficient to cover the costs to capture, process, and conduct the survey.

General Sampling Schedule

The survey fieldwork described above will most likely not commence until the second open fishery period (commencing on July 1, 2012) has concluded. In the past this has typically occurred prior to July 15th; however, the increased amount of the quota for 2012 (compared to recent years) could result in starting later for point set collection. It may be possible to commence transect sampling in early July (prior to the fishery closure),

airplane availability and weather conditions. Every effort will be made to complete the data analysis in time to submit the results to the Pacific sardine stock assessment author (Dr. Kevin Hill) two weeks prior to the stock assessment review. In past years this has been held the first week in October.

IV. Exempted Fishery Permit Application - Conclusion

In summary, the proposed EFP will contribute substantially toward improving the data available to assess the sardine stock for management on the Pacific Coast. Building on the successful survey work conducted and used in the 2009, 2010, and 2011 stock assessments, the EFP research study in 2012 will enable us to obtain a fourth biomass estimate. The research set-aside of OY under the EFP will provide a reliable source of funds and will allow us to conduct our work in a controlled, methodical manner, separate from the race for fish, which ensues during the directed fishery. This will enable us to obtain a larger and more representative sample of point sets, needed to more precisely and accurately estimate sardine biomass.

V. Literature Cited

Elzinga, C. L, D. W. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring Plant and Animal Populations. Blackwell Science, Inc., Maiden, MA.

Federal Register. 2012. Overflight Regulations for the Channel Islands, Monterey Bay, Gulf of the Farallones, and Olympic Coast National Marine Sanctuaries. 15 CFR Part 922. Vol. 77, No. 17, January 26, 2012.

Jagielo, T.H., Hanan, D., and R. Howe. 2009. West Coast Aerial Sardine Survey. Sampling Results in 2009. Prepared for California Wetfish Producers Association, and the Northwest Sardine Survey. Submitted to Pacific Fishery Management Council, Portland, OR, October 14, 2009.

Jagielo, 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. Submitted to Pacific Fishery Management Council, Portland, OR, October 15, 2010. 51p.

Jagielo, T. H., Howe, R., and M. Mikesell. 2011. Northwest Aerial Sardine Survey. Sampling Results in 2011. Prepared for Northwest Sardine Survey, LLC. Submitted to Pacific Fishery Management Council, Portland, OR, October 13, 2011. 44p.

PFMC. 2009. Aerial Survey Methods for Pacific Sardine. Report of STAR Panel Meeting. May 4-8, 2009. NOAA/SWFSC, La Jolla, CA. 14 p.

Stehman, S. and D. Salzer. 2000. Estimating Density from Surveys Employing Unequal-Area Belt Transects. Wetlands. Vol. 20, No. 3, pp. 512-519. The Society of Wetland Scientists, McLean, VA.

Wespestad, V., Jagielo, T. and R. Howe. 2008. The Feasibility Of Using An Aerial Survey To Determine Sardine Abundance Off The Washington-Oregon Coast In Conjunction With Fishing Vessel Observation Of Surveyed Schools And Shoals. Report Prepared For: Northwest Sardine Survey, LLC. 12 Bellwether Way, Suite 209, Bellingham, WA 98225.

Figure 1. Plot showing sardine point set surface area-biomass relationship (mt/m^2 vs m^2), 2008-2011. Red – 2008; Green – 2009; Blue – 2010; Black (open squares) – 2011.

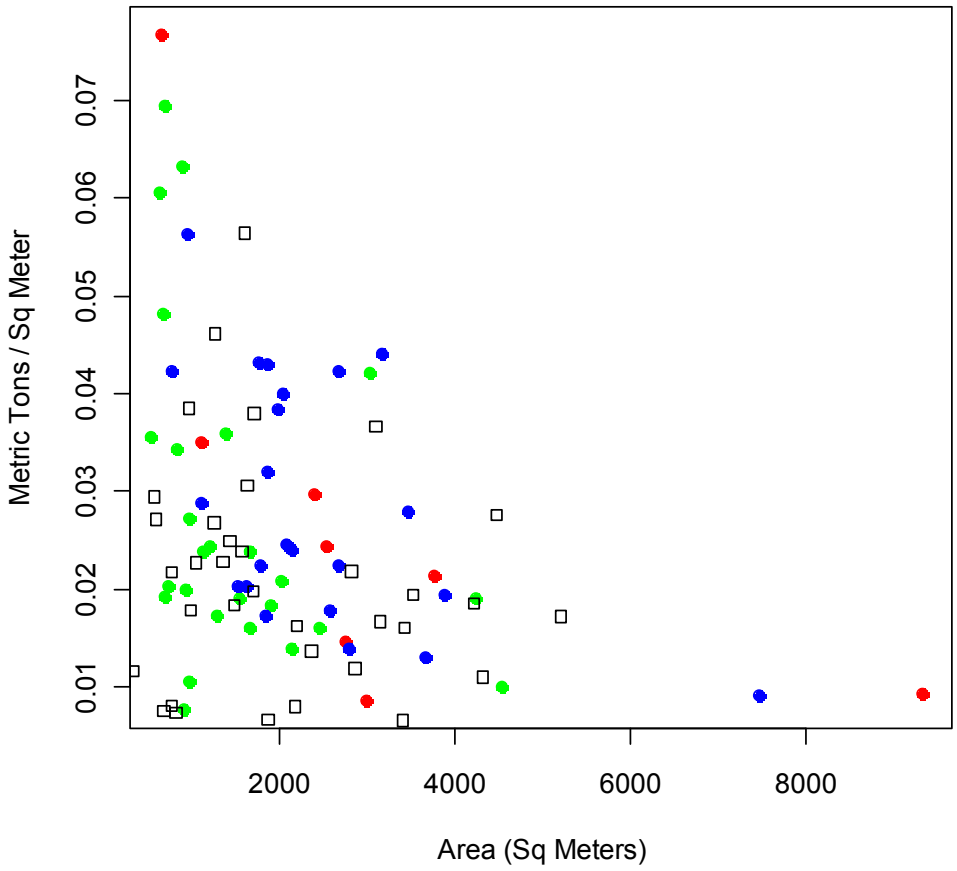
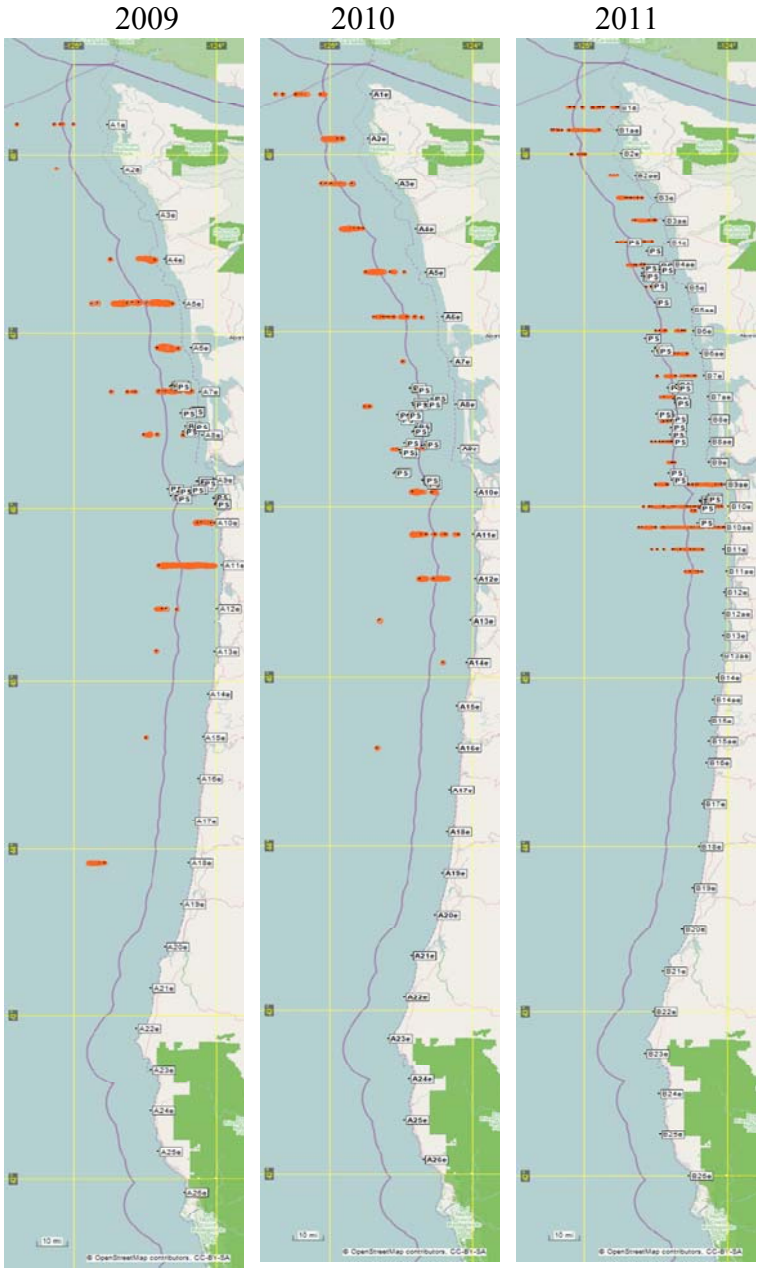


Figure 2. Map showing locations of point sets with respect to fish school locations on transects (2009-2011).



Appendix I

West Coast Aerial Sardine Survey

2012

Field Operational Plan

Industry Coordinator:

Northwest Sardine Survey, LLC
(Jerry Thon, Principal)

Science Advisor:

Tom Jagielo
Tom Jagielo, Consulting

Scientific Field Project Leader:

Ryan Howe

DRAFT

March 16, 2012

Aerial Transect Survey

Overall Aerial Survey Design

Mr. Jerry Thon will oversee the day to day logistic activities of the survey, including deployment of vessels and aircraft as needed to accomplish the projects objectives. To ensure clear communications among participants and other interested parties, the Single Point of Contact (SPC) person for 2012 survey field work will be Mr. Chris Cearns (NWSS), working under the direction of Mr. Thon.

Scientific field work will be conducted in Washington and Oregon by Mr. Ryan Howe with oversight from Mr. Tom Jagielo. Mr. Howe will lead the digital photograph analysis team and will archive all photographic and biological data.

Mr. Jagielo will be responsible for analyzing the survey data and will report the results to Dr. Kevin Hill, NMFS, SWFSC, in a form suitable for input to the stock assessment model. Mr. Howe will be available to help with data analysis as requested.

The 2012 aerial survey design consists of 41 transects spanning the area from Cape Flattery in the north to the Oregon-California border in the south (Table 1, Figure 1). Three replicate sets of transects have been identified for the survey in 2012; however, completion of at least one full set will be sufficient for biomass estimation. Sampling multiple sets will give us a better chance to get at least one full set under optimal sampling conditions. Survey coverage could potentially be extended northward into Canada -- if Canadian governmental approvals can be obtained.

Location of Transects

The east and west endpoints of each transect and corresponding shoreline position are given in Tables 1a-c and are mapped in Figures 1a-c for each of the three replicates (Set A, Set B, and Set C, respectively). Transects start at 3 miles from shore and extend westward for 35 statute miles in length. Transect spacing differs in the north (7.5 nautical miles) compared to the south (15 nautical miles) of the survey area. In addition to the 35 statute mile transect, the 3 statute mile segment directly eastward of each transect to the shore will be flown and photographed. Survey biomass will be estimated from the 35 statute mile transect data. Photographs from the shoreward segment will be used primarily to evaluate the need for future modification of the survey design.

Aerial Resources

Two Piper Super Cubs, one Cessna 337, and possibly a fourth (as yet unspecified) airplane will be used to conduct survey transects and point sets. Survey airplanes will be equipped with a Canon EOS 1Ds in an Aerial Imaging Solutions FMC mount system (Adjunct 1), installed inside the fuselage of the plane.

Use of Aerial Resources

Aerial resources will be coordinated by Mr. Thon (NWSS). To conduct a set, survey pilots will begin with transect number 1 at Cape Flattery in the north and will proceed to the southernmost transect off the southern Oregon coast. When operating together as a team, pilots will

communicate via radio or cell phone. They will take a "leap-frog" approach: for example -- plane 1 will fly transects 1-5 while plane 2 is flying transects 6-10; then plane 1 will fly transects 11-15 while plane 2 flies Transects 16-20, and so on. The actual number of transects flown in a day by each plane will be determined jointly by the survey pilots and Mr. Thon and may be more or less than the example of five per plane given above.

Conditions Acceptable for Surveying

At the beginning of each potential survey day, the survey pilots will confer with Mr. Thon and will jointly judge if conditions will permit safe and successful surveying that day. Considering local conditions, they will also jointly determine the optimal time of day for surveying the area slated for coverage that day. Factors will include sea condition, sardine visibility, presence of cloud or fog cover, and other relevant criteria.

Transect Sampling

Prior to beginning a survey flight, the Pre-Flight Survey Checklist (Adjunct 2) will be completed for each aircraft. This will ensure that the camera system settings are fully operational for data collection. For example, it is crucial to have accurate GPS information in the log file. It is also crucial that the photograph number series is re-set to zero. Transects flown without the necessary survey data are not valid and cannot be analyzed.

The decision of when to start a new set of transects will be determined by Mr. Thon with input from Mr. Jagielo and/or others as requested. Transects will be flown at the nominal survey altitude of 4,000 ft. Transects may be flown starting at either the east end or the west end.

A Transect Flight Log Form (Adjunct 2) will be kept during the sampling of each transect for the purpose of documenting the observations of the pilot and/or onboard observers. Key notations will include observations of school species ID and documentation of any special conditions that could have an influence on interpreting photographs taken during transects.

Sardine are believed to migrate northward from California during the summer. Thus, to avoid the possibility of "double counting", it is important that transects are conducted in a North-to-South progression. Once a transect (or a portion of a transect) has been flown, neither that transect, nor any transects to the north of that transect, may be flown again during that transect set in progress. It will be acceptable to skip transects or portions of transects if conditions require it (e.g. if better weather is available to the south of an area), but transects may not be "made up" once skipped during the sampling of a transect set. Once begun, the goal is to cover the full 41-transect set in as few days as possible.

Data Transfer

Photographs and FMC log files will be downloaded and forwarded for analysis and archival at the end of each survey day. At the end of each flight, the Scientific Field Project Leader (Mr. Howe) will verify that the camera and data collection system operated properly and that images collected are acceptable for analysis. Mr. Howe will collect data from the pilots and will coordinate the transfer and archival of all aerial survey data.

I. Point Set Sampling

Location, Number, and Size of Point Sets
Point sets are fully captured sardine schools landed by purse seiners approved and permitted for this research. Each set by a purse seiner will be directed by one of the survey pilots. Point sets will be made over as wide an area as feasible within the survey area, in order to distribute the sampling effort spatially. We anticipate that point sets could be landed into both Washington and Oregon ports in 2012.

Point sets will also be collected over a range of sizes, as set out in Table 2. The goal is to obtain 82 valid point sets in 2012.

Aerial Photography of Point Sets
The detailed protocol for point set sampling is given in Adjunct 4. Sardine schools to be captured for point sets will be first selected and identified by the survey pilot at the nominal survey altitude of 4,000 ft. When deemed necessary, and at the sole discretion of Mr. Jerry Thon in communication with the survey pilot, schools may (on occasion) be first selected and identified at altitudes lower than 4,000 ft. Following a discrete school selection, the pilot will descend to a lower altitude to better photograph the approach of the seiner to the school and set the seiner for capture of the school. Photographs will be taken before and during the vessels approach to the school for the point set capture. Each school selected by the pilot and photographed for a potential point set will be logged on the survey pilot's Point Set Flight Log Form (Adjunct 2). The species identification of the selected school will be verified by the captain of the purse seine vessel conducting the point set and will be logged on the Fisherman's Log Form (Adjunct 2). These records will be used to determine the rate of school mis-identification by spotter pilots in the field and by analysts viewing photographs.

Vessel Point Set Capture
The purse seine vessel will encircle (wrap) and fully capture the school selected by the survey pilot for the point set. Any school not "fully" captured will not be considered a valid point set for analysis. If a school is judged to be "nearly completely" captured (i.e., over 90% captured), it will be noted as such and will be included for analysis. Both the survey pilot and the purse seine captain will independently make note of the "percent captured" on their survey log forms for this purpose. Upon capture, sardine point sets will be held in separate holds for separate weighing and biological sampling of each set after landing.

Biological Sampling
Biological samples of individual point sets will be collected at the landing docks or at the fish processing plants upon landing. Fish will be systematically taken at the start, middle, and end of a delivered set. The three samples will then be combined and a random subsample of fish will be taken. The sample size will be n = 50 fish for each point set haul.

Length, weight, maturity, and otoliths will be sampled for each point set haul and will be documented on the Biological Sampling Form (Adjunct 2). Sardine weights will be taken using an electronic scale accurate to 0.5 gm. Sardine lengths will be taken using a millimeter length strip attached to a measuring board. Standard length will be determined by measuring from

sardine snout to the last vertebrae. Sardine maturity will be established by referencing maturity codes (female- 4 point scale, male- 3 point scale) supplied by Beverly Macewicz NMFS, SWFSC. A subsample of 25 fish from each point set sample will be individually bagged, identified with sample number and frozen with other fish in the subsample, clearly identified as to point set number, vessel, and location captured and retained for collection of otoliths.

Hydroacoustic Sounding of School Height

School height will be measured for each point set. This may be obtained by using either the purse seine or other participating research vessels' hydroacoustic gear. The school height measurements to be recorded on the Fisherman's Log Form are: 1) depth in the water column of the top of the school, and 2) depth in the water column of the bottom of the school. Simrad ES-60 sounders will be installed on two purse seine vessels. Data collected by the ES-60 sounders will be backed-up daily and archived onshore.

Number and Size of Point Sets to be Captured

Point sets will be conducted for a range of school sizes (Table 2). Point sets will be targeted working in general from the smallest size category to the largest. Each day, spotter pilots will operate with an updated list of remaining school sizes needed for analysis. Each spotter pilot will use his experience to judge the biomass of sardine schools from the air, and will direct the purse seine vessel to capture schools of appropriate size. Following landing of the point sets at the dock, the actual school weights will be determined. Every effort will be made to ensure, as soon as possible, that successfully landed point sets were also successfully photographed. This will in general occur before the end of each fishing day. After verification of point set acceptability, the list of remaining school sizes needed from Table 2 will be updated accordingly for ongoing fishing. If schools are not available in the designated size range, point sets will be conducted on schools as close to the designated range as possible. Pumping large sets onto more than one vessel should be avoided, and should only be done in the accidental event that school size was grossly underestimated. Mr. Howe will oversee the gathering of point set landing data and will update the list daily. The total landed weight of point sets sampled will not exceed 3,000 mt.

Spatial Distribution of Point Sets

In order to distribute point sets spatially, sampling will occur both north and south of the Columbia River, and offshore vs. nearshore, as well. This could be facilitated by landing point sets in both Washington and Oregon ports in 2012. Quadrants have been established to facilitate spatial distribution of the point sets (Figure 2).

Landing Reporting Requirements

Cumulative point set landings will be updated by Mr. Chris Cearns (NWSS), who will report the running total daily to NMFS, as per the terms of the Exempted Fishing Permit. Also included in this daily report will be an estimate of the weight of all by-catch by species.

Other EFP Reporting Requirements

To ensure clear communications among participants and other interested parties, the single point of contact (SPC) person during 2012 survey field work will be Mr. Chris Cearns.

Mr. Cearns (under the direction of Mr. Thon) will also be responsible for providing other required reporting elements (as specified in the EFP permit) to NMFS. For example, a daily notice will be provided for enforcement giving 24 hour notice of vessels to be conducting point sets on any given day and will include vessel name, area to be fished, estimated departure time, estimated return time.

II. Calibration and Validation

Aerial Measurement Calibration
Each survey year, routine calibration is conducted to verify aerial measurements. A series of photographs will again be collected of a feature of known size (e.g. airplane hangars the Astoria, OR airport), from the altitudes of 1,000 ft, 2,000 ft, 3,000 ft, and 4,000 ft. For each altitude series, an aerial pass will be made to place the target onto the right, middle, and left portions of the photographic image.

Aerial Photographs and Sampling for Species Validation
The collection of reference photographs is updated each survey year, for the purpose of species identification. These photographs are used by the team of photograph analysts to continue to learn how to discern between sardine and other species as they appear on the aerial transect photographs.

Reference photographs will be taken at the nominal survey altitude of 4,000 ft for the purpose of species identification. The spotter pilots will find and photograph schooling fish other than sardine (e.g. mackerel, herring, smelt, anchovy, etc). For the actual schools photographed, a vessel at sea (typically a small, relatively fast boat) will collect a jig sample to document the species identification. This sampling will most likely occur in June, prior to commencement of the summer fishery opening.

Tables 1a -1f. Transect Sets A, B, and C.

Table 1a. Set A

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Washington	N	A1	48	20.000	125	29.30	A1w	124	43.71	A1e	124	39.81	A1s
Washington	N	A1a	48	12.500	125	30.98	A1aw	124	45.51	A1ae	124	41.61	A1as
Washington	N	A2	48	5.000	125	30.99	A2w	124	45.63	A2e	124	41.74	A2s
Washington	N	A2a	47	57.500	125	29.48	A2aw	124	44.24	A2ae	124	40.36	A2as
Washington	N	A3	47	50.000	125	21.05	A3w	124	35.91	A3e	124	32.04	A3s
Washington	N	A3a	47	42.500	125	13.82	A3aw	124	28.79	A3ae	124	24.93	A3as
Washington	N	A4	47	35.000	125	10.89	A4w	124	25.96	A4e	124	22.11	A4s
Washington	N	A4a	47	27.500	125	9.13	A4aw	124	24.30	A4ae	124	20.46	A4as
Washington	N	A5	47	20.000	125	5.89	A5w	124	21.17	A5e	124	17.33	A5s
Washington	N	A5a	47	12.500	125	0.98	A5aw	124	16.37	A5ae	124	12.54	A5as
Washington	N	A6	47	5.000	124	59.07	A6w	124	14.57	A6e	124	10.76	A6s
Washington	N	A6a	46	57.500	124	58.70	A6aw	124	14.30	A6ae	124	10.50	A6as
Washington	N	A7	46	50.000	124	54.58	A7w	124	10.28	A7e	124	6.49	A7s
Washington	N	A7a	46	42.500	124	52.93	A7aw	124	8.73	A7ae	124	4.95	A7as
Washington	N	A8	46	35.000	124	51.75	A8w	124	7.66	A8e	124	3.88	A8s
Washington	N	A8a	46	27.500	124	51.41	A8aw	124	7.42	A8ae	124	3.65	A8as
Washington	N	A9	46	20.000	124	51.77	A9w	124	7.87	A9e	124	4.11	A9s
Washington	N	A9a	46	12.500	124	47.63	A9aw	124	3.83	A9ae	124	0.08	A9as
Oregon	N	A10	46	5.000	124	43.80	A10w	124	0.10	A10e	123	56.36	A10s
Oregon	N	A10a	45	57.500	124	45.71	A10aw	124	2.11	A10ae	123	58.38	A10as
Oregon	N	A11	45	50.000	124	44.99	A11w	124	1.50	A11e	123	57.77	A11s
Oregon	N	A11a	45	42.500	124	43.65	A11aw	124	0.25	A11ae	123	56.53	A11as
Oregon	N	A12	45	35.000	124	44.22	A12w	124	0.91	A12e	123	57.20	A12s
Oregon	N	A12a	45	27.500	124	45.16	A12aw	124	1.95	A12ae	123	58.25	A12as
Oregon	N	A13	45	20.000	124	45.10	A13w	124	1.99	A13e	123	58.29	A13s
Oregon	N	A13a	45	12.500	124	44.94	A13aw	124	1.92	A13ae	123	58.23	A13as
Oregon	N	A14	45	5.000	124	46.96	A14w	124	4.03	A14e	124	0.36	A14s
Oregon	N	A14a	44	57.500	124	47.76	A14aw	124	4.93	A14ae	124	1.26	A14as
Oregon	N	A15	44	50.000	124	49.86	A15w	124	7.12	A15e	124	3.45	A15s
Oregon	N	A15a	44	42.500	124	49.95	A15aw	124	7.31	A15ae	124	3.65	A15as
Oregon	N	A16	44	35.000	124	50.38	A16w	124	7.83	A16e	124	4.18	A16s
Oregon	N	A17	44	20.000	124	52.00	A17w	124	9.63	A17e	124	6.00	A17s
Oregon	N	A18	44	5.000	124	53.44	A18w	124	11.25	A18e	124	7.63	A18s
Oregon	N	A19	43	50.000	124	55.46	A19w	124	13.45	A19e	124	9.84	A19s
Oregon	N	A20	43	35.000	124	58.98	A20w	124	17.14	A20e	124	13.55	A20s
Oregon	N	A21	43	20.000	125	7.59	A21w	124	25.92	A21e	124	22.35	A21s
Oregon	N	A22	43	5.000	125	11.18	A22w	124	29.67	A22e	124	26.12	A22s
Oregon	N	A23	42	50.000	125	18.75	A23w	124	37.41	A23e	124	33.87	A23s
Oregon	N	A24	42	35.000	125	8.28	A24w	124	27.11	A24e	124	23.59	A24s
Oregon	N	A25	42	20.000	125	10.20	A25w	124	29.20	A25e	124	25.68	A25s
Oregon	N	A26	42	5.000	125	3.86	A26w	124	23.02	A26e	124	19.52	A26s

Table 1b. Set B

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Washington	N	B1	48	15.000	125	30.91	B1w	124	45.40	B1e	124	41.50	B1s
Washington	N	B1a	48	7.500	125	31.79	B1aw	124	46.39	B1ae	124	42.50	B1as
Washington	N	B2	48	0.000	125	29.92	B2w	124	44.64	B2e	124	40.75	B2s
Washington	N	B2a	47	52.500	125	23.80	B2aw	124	38.62	B2ae	124	34.75	B2as
Washington	N	B3	47	45.000	125	15.09	B3w	124	30.02	B3e	124	26.16	B3s
Washington	N	B3a	47	37.500	125	11.56	B3aw	124	26.60	B3ae	124	22.74	B3as
Washington	N	B4	47	30.000	125	9.43	B4w	124	24.58	B4e	124	20.73	B4s
Washington	N	B4a	47	22.500	125	7.95	B4aw	124	23.20	B4ae	124	19.37	B4as
Washington	N	B5	47	15.000	125	1.78	B5w	124	17.13	B5e	124	13.31	B5s
Washington	N	B5a	47	7.500	124	59.49	B5aw	124	14.95	B5ae	124	11.13	B5as
Washington	N	B6	47	0.000	124	58.62	B6w	124	14.19	B6e	124	10.38	B6s
Washington	N	B6a	46	52.500	124	55.48	B6aw	124	11.15	B6ae	124	7.35	B6as
Washington	N	B7	46	45.000	124	53.93	B7w	124	9.70	B7e	124	5.91	B7s
Washington	N	B7a	46	37.500	124	52.05	B7aw	124	7.92	B7ae	124	4.14	B7as
Washington	N	B8	46	30.000	124	51.33	B8w	124	7.31	B8e	124	3.54	B8s
Washington	N	B8a	46	22.500	124	51.46	B8aw	124	7.53	B8ae	124	3.77	B8as
Washington	N	B9	46	15.000	124	51.41	B9w	124	7.59	B9e	124	3.83	B9s
Washington	N	B9a	46	7.500	124	44.62	B9aw	124	0.89	B9ae	123	57.14	B9as
Oregon	N	B10	46	0.000	124	43.24	B10w	123	59.61	B10e	123	55.87	B10s
Oregon	N	B10a	45	52.500	124	45.05	B10aw	124	1.51	B10ae	123	57.78	B10as
Oregon	N	B11	45	45.000	124	45.10	B11w	124	1.67	B11e	123	57.94	B11s
Oregon	N	B11a	45	37.500	124	43.78	B11aw	124	0.44	B11ae	123	56.73	B11as
Oregon	N	B12	45	30.000	124	44.58	B12w	124	1.34	B12e	123	57.63	B12s
Oregon	N	B12a	45	22.500	124	44.90	B12aw	124	1.76	B12ae	123	58.06	B12as
Oregon	N	B13	45	15.000	124	44.81	B13w	124	1.76	B13e	123	58.07	B13s
Oregon	N	B13a	45	7.500	124	45.43	B13aw	124	2.48	B13ae	123	58.79	B13as
Oregon	N	B14	45	0.000	124	47.23	B14w	124	4.36	B14e	124	0.69	B14s
Oregon	N	B14a	44	52.500	124	48.78	B14aw	124	6.01	B14ae	124	2.34	B14as
Oregon	N	B15	44	45.000	124	50.13	B15w	124	7.46	B15e	124	3.80	B15s
Oregon	N	B15a	44	37.500	124	50.24	B15aw	124	7.66	B15ae	124	4.01	B15as
Oregon	N	B16	44	30.000	124	51.11	B16w	124	8.62	B16e	124	4.97	B16s
Oregon	N	B17	44	15.000	124	52.78	B17w	124	10.47	B17e	124	6.84	B17s
Oregon	N	B18	44	0.000	124	54.02	B18w	124	11.88	B18e	124	8.27	B18s
Oregon	N	B19	43	45.000	124	56.45	B19w	124	14.49	B19e	124	10.90	B19s
Oregon	N	B20	43	30.000	125	0.71	B20w	124	18.92	B20e	124	15.34	B20s
Oregon	N	B21	43	15.000	125	8.59	B21w	124	26.92	B21e	124	23.35	B21s
Oregon	N	B22	43	0.000	125	12.51	B22w	124	31.07	B22e	124	27.52	B22s
Oregon	N	B23	42	45.000	125	15.75	B23w	124	34.46	B23e	124	30.93	B23s
Oregon	N	B24	42	30.000	125	9.74	B24w	124	28.63	B24e	124	25.11	B24s
Oregon	N	B25	42	15.000	125	9.03	B25w	124	28.08	B25e	124	24.57	B25s
Oregon	N	B26	42	0.000	124	56.96	B26w	124	16.17	B26e	124	12.67	B26s

Table 1c. Set C

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Washington	N	C1	48	10.000	125	33.23	C1w	124	47.80	C1e	124	43.91	C1s
Washington	N	C1a	48	2.500	125	30.14	C1aw	124	44.81	C1ae	124	40.93	C1as
Washington	N	C2	47	55.000	125	27.35	C2w	124	42.14	C2e	124	38.27	C2s
Washington	N	C2a	47	47.500	125	17.80	C2aw	124	32.70	C2ae	124	28.83	C2as
Washington	N	C3	47	40.000	125	12.56	C3w	124	27.57	C3e	124	23.71	C3s
Washington	N	C3a	47	32.500	125	10.08	C3aw	124	25.18	C3ae	124	21.34	C3as
Washington	N	C4	47	25.000	125	8.72	C4w	124	23.94	C4e	124	20.10	C4s
Washington	N	C4a	47	17.500	125	2.94	C4aw	124	18.26	C4ae	124	14.43	C4as
Washington	N	C5	47	10.000	125	0.13	C5w	124	15.56	C5e	124	11.73	C5s
Washington	N	C5a	47	2.500	124	58.74	C5aw	124	14.26	C5ae	124	10.45	C5as
Washington	N	C6	46	55.000	124	57.35	C6w	124	12.98	C6e	124	9.18	C6s
Washington	N	C6a	46	47.500	124	53.97	C6aw	124	9.71	C6ae	124	5.91	C6as
Washington	N	C7	46	40.000	124	52.16	C7w	124	8.00	C7e	124	4.21	C7s
Washington	N	C7a	46	32.500	124	51.45	C7aw	124	7.39	C7ae	124	3.61	C7as
Washington	N	C8	46	25.000	124	51.33	C8w	124	7.37	C8e	124	3.60	C8s
Washington	N	C8a	46	17.500	124	52.19	C8aw	124	8.33	C8ae	124	4.57	C8as
Washington	N	C9	46	10.000	124	45.89	C9w	124	2.13	C9e	123	58.38	C9s
Washington	N	C9a	46	2.500	124	43.18	C9aw	123	59.52	C9ae	123	55.78	C9as
Oregon	N	C10	45	55.000	124	45.64	C10w	124	2.08	C10e	123	58.35	C10s
Oregon	N	C10a	45	47.500	124	45.21	C10aw	124	1.74	C10ae	123	58.02	C10as
Oregon	N	C11	45	40.000	124	43.51	C11w	124	0.14	C11e	123	56.43	C11s
Oregon	N	C11a	45	32.500	124	44.06	C11aw	124	0.79	C11ae	123	57.08	C11as
Oregon	N	C12	45	25.000	124	44.58	C12w	124	1.40	C12e	123	57.70	C12s
Oregon	N	C12a	45	17.500	124	44.67	C12aw	124	1.59	C12ae	123	57.90	C12as
Oregon	N	C13	45	10.000	124	44.93	C13w	124	1.94	C13e	123	58.26	C13s
Oregon	N	C13a	45	2.500	124	46.84	C13aw	124	3.94	C13ae	124	0.27	C13as
Oregon	N	C14	44	55.000	124	48.17	C14w	124	5.37	C14e	124	1.70	C14s
Oregon	N	C14a	44	47.500	124	50.64	C14aw	124	7.93	C14ae	124	4.27	C14as
Oregon	N	C15	44	40.000	124	49.91	C15w	124	7.30	C15e	124	3.65	C15s
Oregon	N	C15a	44	32.500	124	50.65	C15aw	124	8.12	C15ae	124	4.48	C15as
Oregon	N	C16	44	25.000	124	51.18	C16w	124	8.74	C16e	124	5.11	C16s
Oregon	N	C17	44	10.000	124	52.90	C17w	124	10.64	C17e	124	7.02	C17s
Oregon	N	C18	43	55.000	124	54.64	C18w	124	12.56	C18e	124	8.95	C18s
Oregon	N	C19	43	40.000	124	57.85	C19w	124	15.95	C19e	124	12.35	C19s
Oregon	N	C20	43	25.000	125	3.13	C20w	124	21.40	C20e	124	17.82	C20s
Oregon	N	C21	43	10.000	125	9.61	C21w	124	28.05	C21e	124	24.48	C21s
Oregon	N	C22	42	55.000	125	14.93	C22w	124	33.55	C22e	124	30.00	C22s
Oregon	N	C23	42	40.000	125	10.57	C23w	124	29.34	C23e	124	25.81	C23s
Oregon	N	C24	42	25.000	125	10.24	C24w	124	29.18	C24e	124	25.66	C24s
Oregon	N	C25	42	10.000	125	6.07	C25w	124	25.18	C25e	124	21.67	C25s
Oregon	N	C26	41	55.000	124	56.53	C26w	124	15.80	C26e	124	12.31	C26s

Table 1d. Set A Canadian Transects

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Canada	CN	cnA1	48	35.000	125	30.02	cnA1w	124	44.22	cnA1e	124	40.29	cnA1s
Canada	CN	cnA2	48	50.000	126	9.18	cnA2w	125	23.15	cnA2e	125	19.20	cnA2s
Canada	CN	cnA3	49	5.000	126	42.25	cnA3w	125	55.98	cnA3e	125	52.02	cnA3s
Canada	CN	cnA4	49	20.000	127	4.75	cnA4w	126	18.25	cnA4e	126	14.26	cnA4s
Canada	CN	cnA5	49	35.000	127	31.47	cnA5w	126	44.73	cnA5e	126	40.73	cnA5s
Canada	CN	cnA6	49	50.000	127	54.49	cnA6w	127	7.51	cnA6e	127	3.48	cnA6s
Canada	CN	cnA7	50	5.000	128	40.48	cnA7w	127	53.26	cnA7e	127	49.21	cnA7s
Canada	CN	cnA8	50	20.000	128	50.05	cnA8w	128	2.58	cnA8e	127	58.51	cnA8s
Canada	CN	cnA9	50	35.000	129	5.73	cnA9w	128	18.01	cnA9e	128	13.92	cnA9s
Canada	CN	cnA10	50	50.000	129	4.71	cnA10w	128	16.74	cnA10e	128	12.63	cnA10s
Canada	CN	cnA11	51	5.000	128	31.37	cnA11w	127	43.13	cnA11e	127	39.00	cnA11s
Canada	CN	cnA12	51	20.000	128	39.13	cnA12w	127	50.63	cnA12e	127	46.48	cnA12s
Canada	CN	cnA13	51	35.000	129	0.41	cnA13w	128	11.65	cnA13e	128	7.47	cnA13s
Canada	CN	cnA14	51	50.000	129	9.27	cnA14w	128	20.24	cnA14e	128	16.03	cnA14s
Canada	CN	cnA15	52	5.000	129	15.18	cnA15w	128	25.88	cnA15e	128	21.66	cnA15s
Canada	CN	cnA16	52	20.000	129	38.12	cnA16w	128	48.54	cnA16e	128	44.29	cnA16s
Canada	CN	cnA17	52	35.000	130	2.84	cnA17w	129	12.98	cnA17e	129	8.71	cnA17s
Canada	CN	cnA18	52	50.000	130	16.03	cnA18w	129	25.88	cnA18e	129	21.58	cnA18s
Canada	CN	cnA19	53	5.000	130	38.77	cnA19w	129	48.34	cnA19e	129	44.01	cnA19s
Canada	CN	cnA20	53	20.000	131	4.57	cnA20w	130	13.84	cnA20e	130	9.49	cnA20s
Canada	CN	cnA21	53	35.000	131	28.20	cnA21w	130	37.17	cnA21e	130	32.80	cnA21s
Canada	CN	cnA22	53	50.000	131	36.53	cnA22w	130	45.20	cnA22e	130	40.80	cnA22s
Canada	CN	cnA23	54	5.000	131	33.54	cnA23w	130	41.90	cnA23e	130	37.48	cnA23s
Canada	CN	cnA24	54	20.000	131	26.95	cnA24w	130	35.00	cnA24e	130	30.55	cnA24s
Canada	CN	cnA25	54	35.000	132	2.78	cnA25w	131	10.51	cnA25e	131	6.03	cnA25s

Table 1e. Set B Canadian Transects

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Canada	CN	cnB1	48	30.000	125	33.41	cnB1w	124	47.68	cnB1e	124	43.76	cnB1s
Canada	CN	cnB2	48	45.000	125	57.61	cnB2w	125	11.65	cnB2e	125	7.71	cnB2s
Canada	CN	cnB3	49	0.000	126	30.47	cnB3w	125	44.28	cnB3e	125	40.32	cnB3s
Canada	CN	cnB4	49	15.000	126	56.32	cnB4w	126	9.90	cnB4e	126	5.92	cnB4s
Canada	CN	cnB5	49	30.000	127	24.28	cnB5w	126	37.62	cnB5e	126	33.62	cnB5s
Canada	CN	cnB6	49	45.000	127	49.17	cnB6w	127	2.27	cnB6e	126	58.25	cnB6s
Canada	CN	cnB7	50	0.000	128	10.98	cnB7w	127	23.84	cnB7e	127	19.80	cnB7s
Canada	CN	cnB8	50	15.000	128	39.58	cnB8w	127	52.20	cnB8e	127	48.14	cnB8s
Canada	CN	cnB9	50	30.000	129	0.01	cnB9w	128	12.38	cnB9e	128	8.29	cnB9s
Canada	CN	cnB10	50	45.000	129	15.83	cnB10w	128	27.94	cnB10e	128	23.84	cnB10s
Canada	CN	cnB11	51	0.000	128	24.13	cnB11w	127	35.99	cnB11e	127	31.86	cnB11s
Canada	CN	cnB12	51	15.000	128	38.03	cnB12w	127	49.62	cnB12e	127	45.47	cnB12s
Canada	CN	cnB13	51	30.000	128	58.26	cnB13w	128	9.59	cnB13e	128	5.42	cnB13s
Canada	CN	cnB14	51	45.000	129	0.72	cnB14w	128	11.78	cnB14e	128	7.59	cnB14s
Canada	CN	cnB15	52	0.000	129	7.13	cnB15w	128	17.92	cnB15e	128	13.70	cnB15s
Canada	CN	cnB16	52	15.000	129	18.98	cnB16w	128	29.49	cnB16e	128	25.25	cnB16s
Canada	CN	cnB17	52	30.000	129	53.92	cnB17w	129	4.15	cnB17e	128	59.89	cnB17s
Canada	CN	cnB18	52	45.000	130	11.91	cnB18w	129	21.86	cnB18e	129	17.57	cnB18s
Canada	CN	cnB19	53	0.000	130	35.44	cnB19w	129	45.10	cnB19e	129	40.79	cnB19s
Canada	CN	cnB20	53	15.000	130	58.66	cnB20w	130	8.02	cnB20e	130	3.68	cnB20s
Canada	CN	cnB21	53	30.000	131	21.16	cnB21w	130	30.23	cnB21e	130	25.86	cnB21s
Canada	CN	cnB22	53	45.000	131	22.07	cnB22w	130	30.84	cnB22e	130	26.45	cnB22s
Canada	CN	cnB23	54	0.000	131	36.01	cnB23w	130	44.47	cnB23e	130	40.05	cnB23s
Canada	CN	cnB24	54	15.000	131	21.17	cnB24w	130	29.32	cnB24e	130	24.88	cnB24s
Canada	CN	cnB25	54	30.000	131	55.50	cnB25w	131	3.34	cnB25e	130	58.87	cnB25s

Table 1f. Set C Canadian Transects

	Survey	Transect	Transect Latitude		West End			East End			Shoreline		
Location	Area	Number	Lat Deg	Lat Min	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #	Long Deg	Long Min	Way Point #
Canada	CN	cnC1	48	25.000	125	33.09	cnC1w	124	47.44	cnC1e	124	43.52	cnC1s
Canada	CN	cnC2	48	40.000	125	40.56	cnC2w	124	54.67	cnC2e	124	50.74	cnC2s
Canada	CN	cnC3	48	55.000	126	18.86	cnC3w	125	32.75	cnC3e	125	28.80	cnC3s
Canada	CN	cnC4	49	10.000	126	51.29	cnC4w	126	4.95	cnC4e	126	0.97	cnC4s
Canada	CN	cnC5	49	25.000	127	25.40	cnC5w	126	38.82	cnC5e	126	34.83	cnC5s
Canada	CN	cnC6	49	40.000	127	43.17	cnC6w	126	56.35	cnC6e	126	52.34	cnC6s
Canada	CN	cnC7	49	55.000	128	3.03	cnC7w	127	15.97	cnC7e	127	11.94	cnC7s
Canada	CN	cnC8	50	10.000	128	42.20	cnC8w	127	54.90	cnC8e	127	50.84	cnC8s
Canada	CN	cnC9	50	25.000	128	48.14	cnC9w	128	0.59	cnC9e	127	56.51	cnC9s
Canada	CN	cnC10	50	40.000	129	12.56	cnC10w	128	24.76	cnC10e	128	20.66	cnC10s
Canada	CN	cnC11	50	55.000	128	52.06	cnC11w	128	4.00	cnC11e	127	59.88	cnC11s
Canada	CN	cnC12	51	10.000	128	39.54	cnC12w	127	51.22	cnC12e	127	47.08	cnC12s
Canada	CN	cnC13	51	25.000	128	48.18	cnC13w	127	59.60	cnC13e	127	55.43	cnC13s
Canada	CN	cnC14	51	40.000	129	2.29	cnC14w	128	13.44	cnC14e	128	9.26	cnC14s
Canada	CN	cnC15	51	55.000	129	8.30	cnC15w	128	19.18	cnC15e	128	14.97	cnC15s
Canada	CN	cnC16	52	10.000	129	24.51	cnC16w	128	35.11	cnC16e	128	30.88	cnC16s
Canada	CN	cnC17	52	25.000	129	40.03	cnC17w	128	50.36	cnC17e	128	46.10	cnC17s
Canada	CN	cnC18	52	40.000	130	8.07	cnC18w	129	18.11	cnC18e	129	13.83	cnC18s
Canada	CN	cnC19	52	55.000	130	26.33	cnC19w	129	36.09	cnC19e	129	31.78	cnC19s
Canada	CN	cnC20	53	10.000	130	52.13	cnC20w	130	1.60	cnC20e	129	57.27	cnC20s
Canada	CN	cnC21	53	25.000	131	15.43	cnC21w	130	24.60	cnC21e	130	20.24	cnC21s
Canada	CN	cnC22	53	40.000	131	18.96	cnC22w	130	27.83	cnC22e	130	23.45	cnC22s
Canada	CN	cnC23	53	55.000	131	39.54	cnC23w	130	48.10	cnC23e	130	43.69	cnC23s
Canada	CN	cnC24	54	10.000	131	45.12	cnC24w	130	53.38	cnC24e	130	48.94	cnC24s
Canada	CN	cnC25	54	25.000	131	44.31	cnC25w	130	52.25	cnC25e	130	47.79	cnC25s

Table 2. Distribution of point set sizes proposed for the 2012 Aerial Sardine Survey. Total weight is in metric tons.

Size (m^2)	Weight (mt)	Total Weight (mt)	Number of point sets
100	**3.8**	**45.6**	**12**
500	**10.6**	**127.2**	**12**
1000	**17**	**204**	**12**
2000	**26.5**	**318**	**12**
4000	**51.9**	**622.8**	**12**
8000	**70.5**	**775.5**	**11**
10000	**82.1**	**903.1**	**11**
		2996.2	**82**

Table 3. Sardine maturity codes. Source: Beverly Macewicz NMFS, SWFSC.

Female maturity codes	Male maturity codes
1. Clearly immature- ovary is very small; no oocytes present	1. Clearly immature- testis is very small thin, knifed-shaped with flat edge
2. Intermediate- individual oocytes not visible but ovary is not clearly immature; includes maturing and regressed ovaries	2. Intermediate- no milt evident and is not a clear immature; includes maturing or regressed testis
3. Active- yolked oocytes visible; any size or amount as long as you can see them with the unaided eye in ovaries	3. Active- milt is present; either oozing from pore, in the duct, or when testis is cut with knife.
4. Hydrated oocytes present; yolked oocytes may be present	

Figure 1a. Maps showing locations of transects comprising Replicate Set A

Set A: Transects 1-8

Set A: Transects 9-16

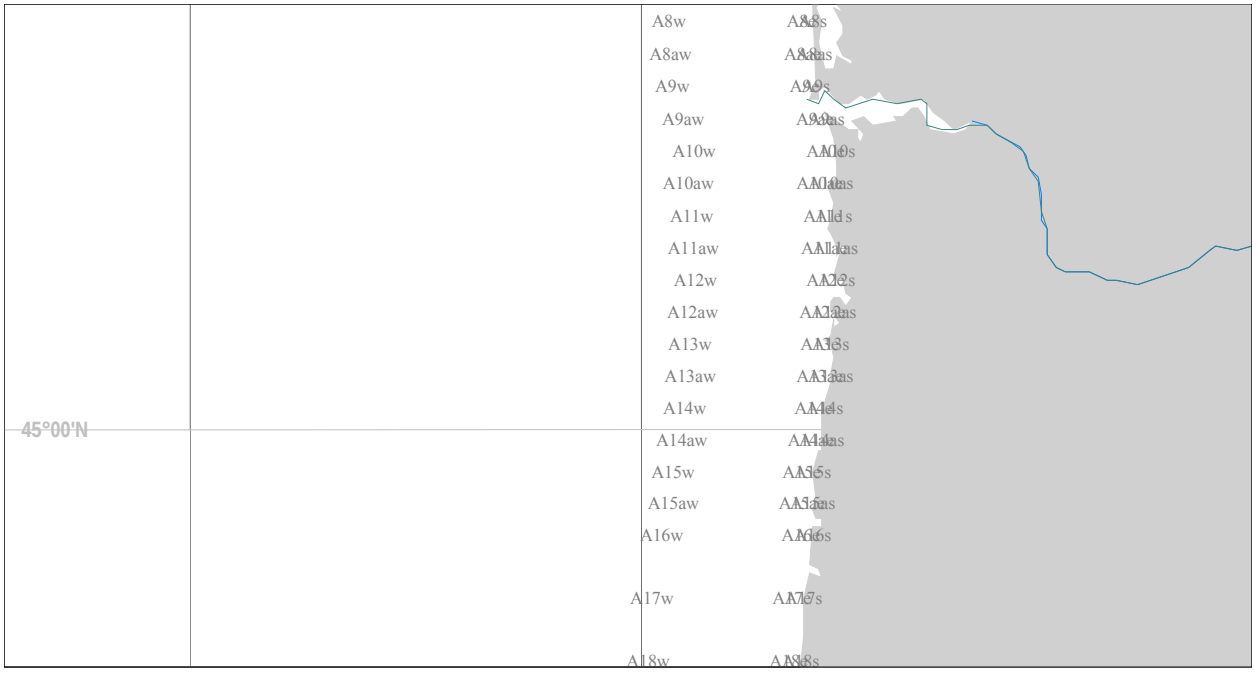


Figure 1a, Continued. Maps showing locations of transects comprising Replicate SET A

Set A: Transects 17-26

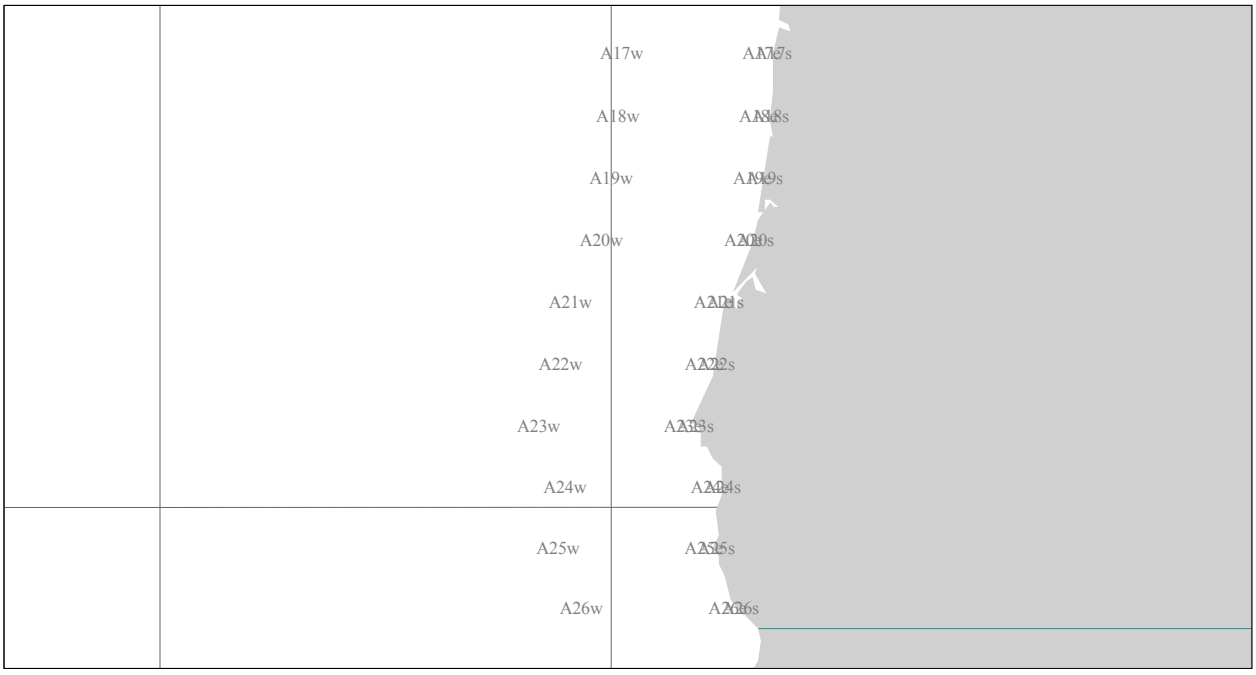


Figure 1b. Maps showing locations of transects comprising Replicate Set B

Set B: Transects 1-8

Set B: Transects 9-16

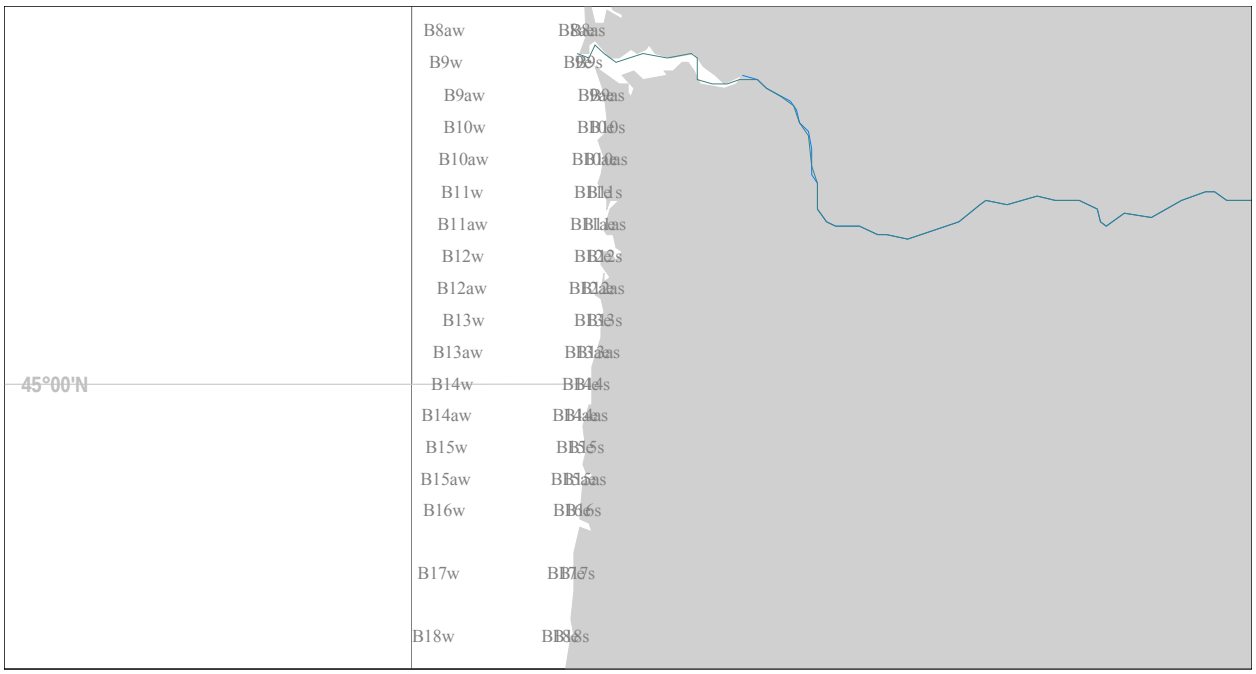


Figure 1b, Continued. Maps showing locations of transects comprising Replicate Set B

Set B: Transects 17-26

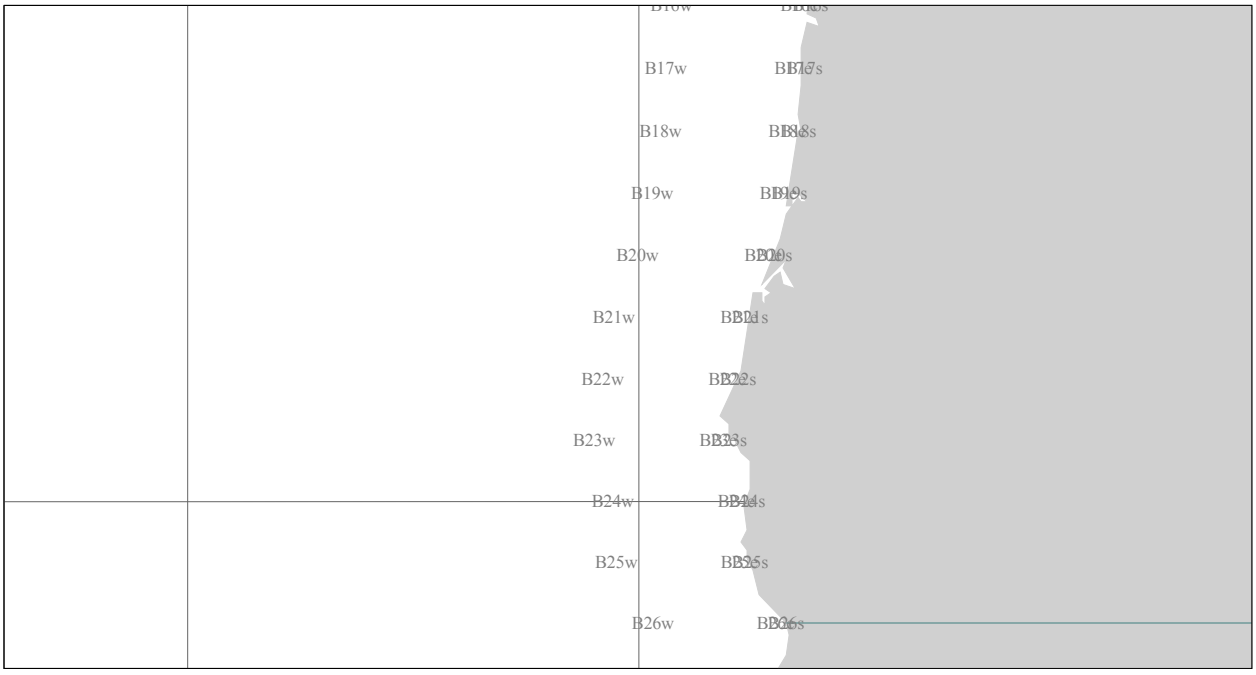
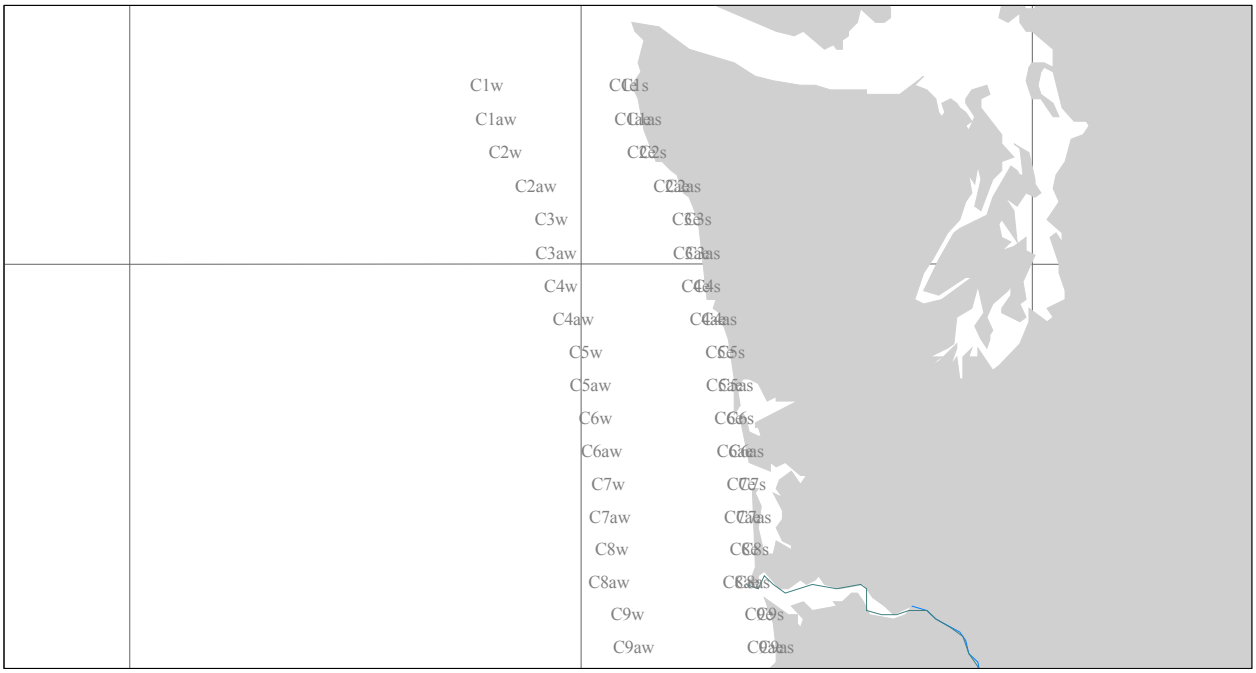


Figure 1c. Maps showing locations of transects comprising Replicate Set C

Set C: Transects 1-8



Set C: Transects 9-16

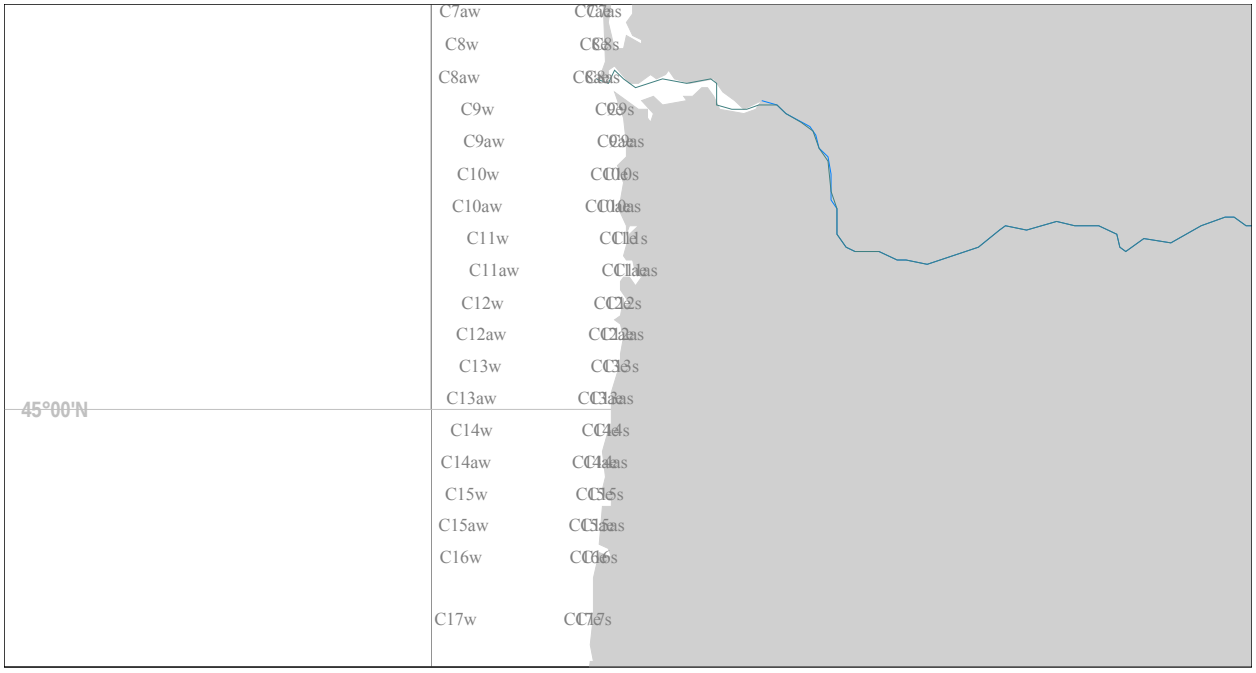


Figure 1c, Continued. Maps showing locations of transects comprising Replicate Set C

Set C: Transects 17-26

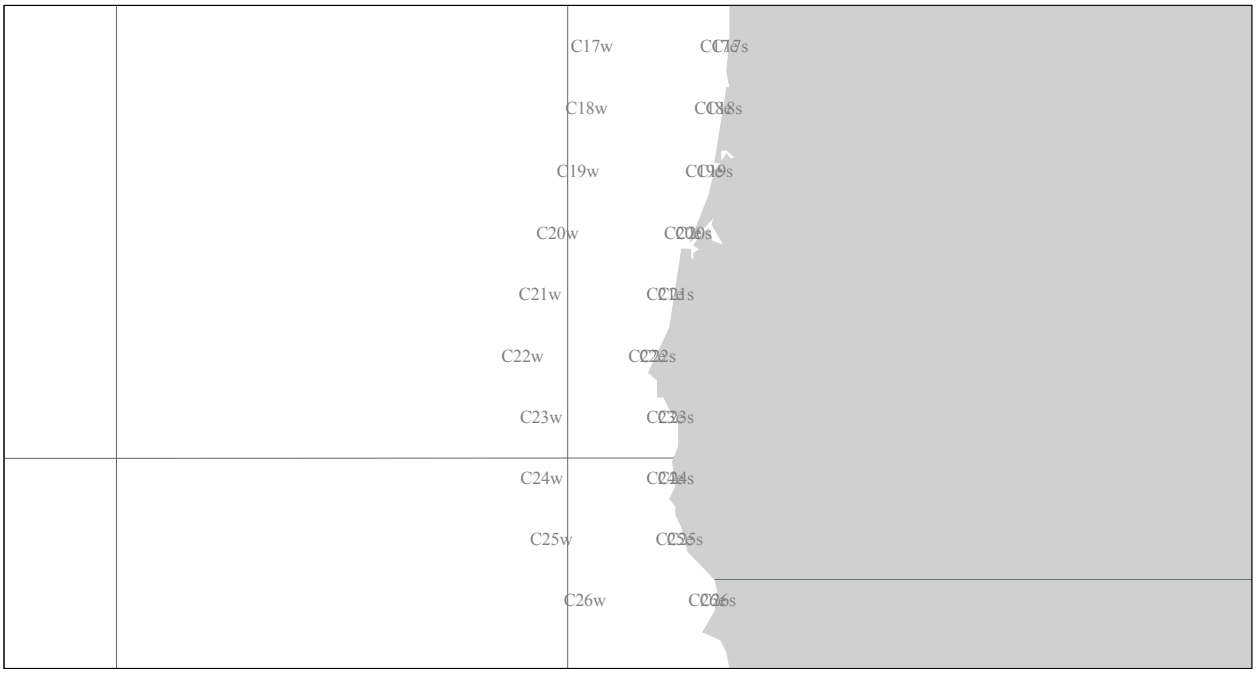
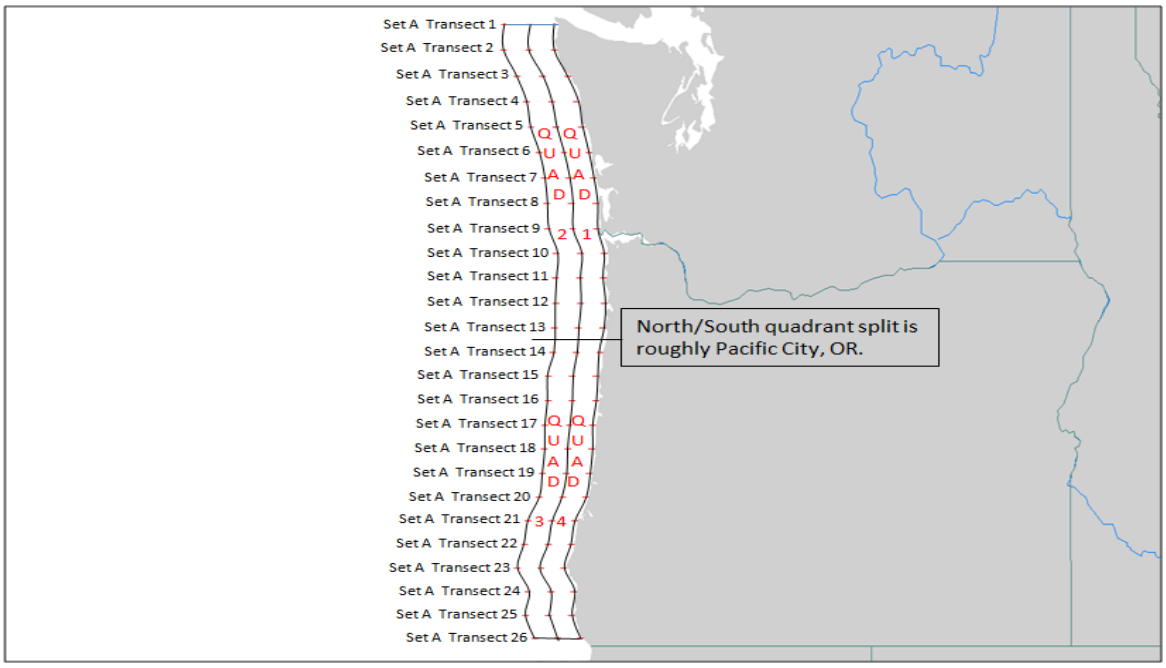
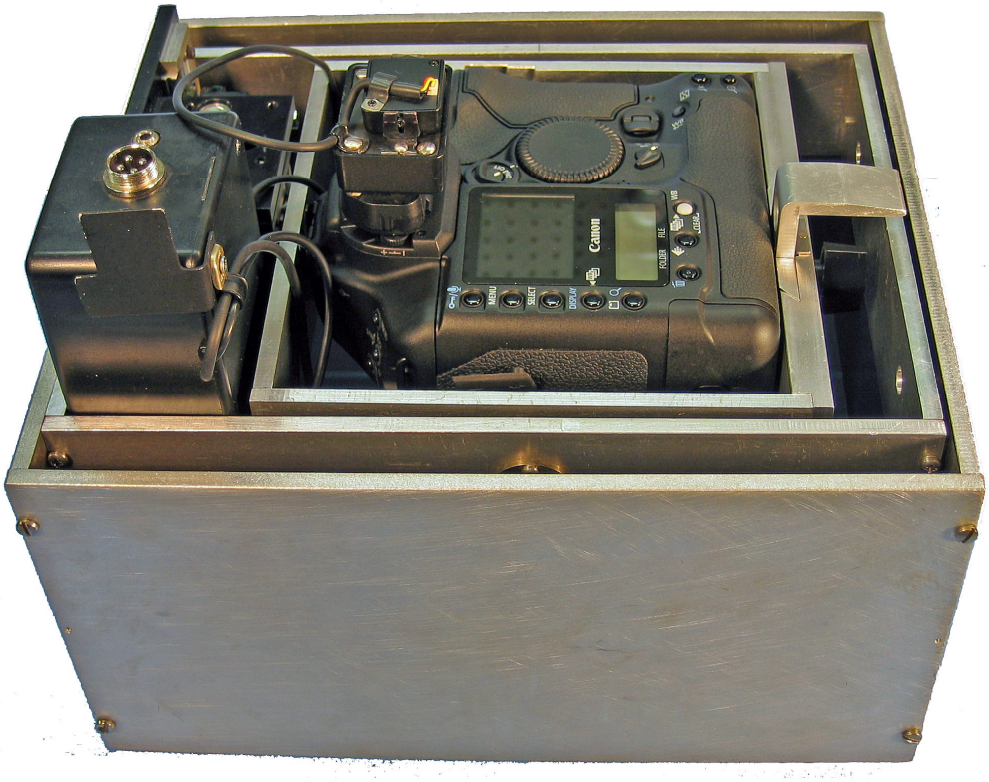


Figure 2. Maps showing quadrants for spatial distribution of point sets.



AERIAL IMAGING SOLUTIONS
FMC MOUNT SYSTEM



DESCRIPTION

An aerial mount system for digital cameras that reduces image blur caused by the forward motion of the aircraft while the shutter is open. The mount and camera are connected to, and remotely controlled by, a program running on a customer-supplied (Windows-based) computer. Flight and camera parameters entered by the computer's operator determine the required forward motion compensation (FMC) and camera firing interval. The system also takes inputs from the customer-supplied GPS and radar altimeter and will, optionally, use these data to automatically determine the required FMC and firing interval. The system includes a remote viewfinder that displays the image seen through the camera's eyepiece on a small monitor to permit the computer operator to observe camera operation to ensure successful coverage of sites. It also includes a data acquisition system that interfaces with the camera, GPS, radar altimeter, and computer to record position and altitude readings as each frame is collected.

Appendix I, Adjunct 2. Field Data Forms

West Coast Sardine Survey

Camera Settings for 1Ds Mark III (Bigger Camera)

1. Press the MENU button located in the upper left corner of the camera, just above the LCD monitor.

    a. Turn the dial on the top right of the camera, near the shutter button, to scroll left though the menu tabs at the top of the monitor.

    b. Under the Shooting 1 tab, ensure that the White balance is set to "AWB" and that the Picture style is set to "Standard."

    c. Scroll right and select the Shooting 2 tab. Under the Shooting 2 tab, set the image size to "L."

    d. Scroll right and select the Set-up 1 tab. Set Auto power off to "Off".

    e. Set File numbering to "Auto Reset".

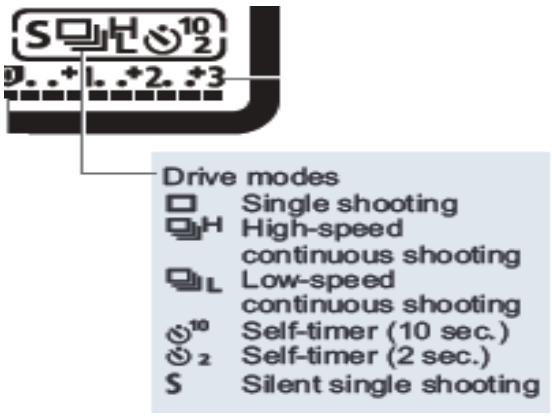
    f. Select Record Function+media/folder sel. and set the camera to "Auto switch media." Set the camera to record first to the CF memory card (card number 1).

    g. Select Live View function settings. Select Live View shoot. Select "Disable".

    h. Finally, select File name setting and change the User 1 setting to read "SP3_" for survey pilot 3, "SP4_ " for survey pilot 4, and so forth. Photos will now be numbered SPx_001, SPx_002, and so on.

2. Set the lens focus mode switch located on the side of the lens to "M" and move the focusing ring toward the camera to engage it.

3. Press the AF DRIVE button located on the top left corner of the camera. Turn the scroll wheel to set the camera to "Single Shot". The icon is a single rectangle, not "S". "S" is silent mode, which will ruin your day! See below:



4. Press the MODE button located above the AF DRIVE button and rotate the scroll wheel to set the camera to "M." Wait for the AF drive display to time out, then turn the scroll wheel to set the Aperture to "4.0." Turn the dial to set the Shutter speed to "2000."

5. Press the ISO button located adjacent to the dial and turn the scroll wheel to set the ISO Speed to "400."

6. Ensure that the 3 cables plugged into the side of the camera are securely connected. The 3 connectors are: flash sync, remote, and mini USB.

   - The flash sync connector screws in. Make sure that it is screwed in all the way. It is ok to use long nosed pliers to tighten it if your fingers are too stubby. Just be gentle.

   - The remote connector is a push-pull locking connector. Press on the top rubber part to engage it. Pull on the silver outer ring to disengage it.

   - The mini USB simply plugs in.

West Coast Sardine Survey

Camera Settings for 5D Mark II (Smaller Camera)

1. Press the MENU button located in the upper left corner of the camera, just above the LCD monitor.

    a. Turn the dial on the top right of the camera, near the shutter button, to scroll left though the menu tabs at the top of the monitor.

    b. Ensure that the White balance is set to “AWB” and that the Picture style is set to “Standard.”

    c. Set the image size to “L.”

    d. Set Auto power off to “Off”.

    e. Set File numbering to “Auto Reset”.

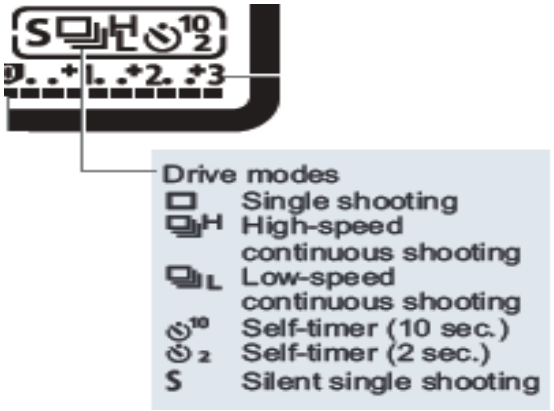
    f. Select Record Function+media/folder sel. and set the camera to “Auto switch media.” Set the camera to record first to the CF memory card (card number 1).

    g. Select Live View function settings. Select Live View shoot. Select “Disable”.

    h. Disable “Silent Mode” shooting.

2. Set the lens focus mode switch located on the side of the lens to “M” and move the focusing ring toward the camera to engage it.

3. Press the AF DRIVE button located on the top left corner of the camera. Turn the scroll wheel to set the camera to “Single Shot”. The icon is a single rectangle, not “S”. “S” is silent mode, which will ruin your day! See below:



4. Press the MODE button located above the AF DRIVE button and rotate the scroll wheel to set the camera to "M." Wait for the AF drive display to time out, then turn the scroll wheel to set the Aperture to "4.0." Turn the dial to set the Shutter speed to "2000."
5. Press the ISO button located adjacent to the dial and turn the scroll wheel to set the ISO Speed to "400."

6. Ensure that the 3 cables plugged into the side of the camera are securely connected. The 3 connectors are: flash sync, remote, and mini USB.

    - The flash sync connector screws in. Make sure that it is screwed in all the way. It is ok to use long nosed pliers to tighten it if your fingers are too stubby. Just be gentle.

    - The remote connector is a push-pull locking connector. Press on the top rubber part to engage it. Pull on the silver outer ring to disengage it.

    - The mini USB simply plugs in.

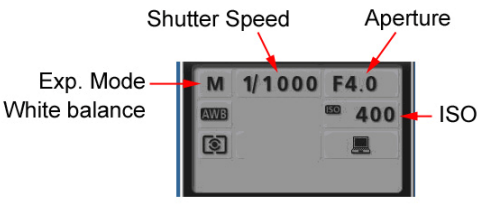
Pilot Checklist

Pre-Flight

1. Check/clean the camera window
2. Check that batteries are fully charged.
3. Ensure that memory cards are installed and have sufficient space.
4. Ensure that a copy of the transect waypoint document is aboard aircraft.
5. Check GPS reading and enter waypoints if necessary.
6. Ensure that all mount system cables are properly connected.
7. Turn on camera, notebook computer, power inverter, and control unit.
8. Ensure the laptop sleep setting is set to "never."
9. Start FMC Mount, Remote Viewfinder, and EOS Utility programs on notebook computer.

   Note: make sure only one window is open for each of the previous programs, having more than one of any program open will cause problems with the camera system.
10. Adjust FMC Mount program settings, as necessary:
    - Altitude: TBD
    - Speed: TBD
    - Overlap: 80%
    - FMC: On
    - Frame count: 0 (Admin->Frame Count->ENTER "0")
11. Ensure that GPS/IMU is functioning.

    Note: the first time the GPS is used in a new location, it may take up to 25 minutes for the GPS to initialize.
12. Ensure that the camera viewfinder is displayed in the Remote Viewfinder window.
13. Check the camera settings using the EOS Utility. See below:



- Look for the rectangle for Drive mode and "MANUAL" for the Focus mode, to verify that the camera is in "Single Shot" mode and is set to manual focus.

- Verify that the Exp. Mode is "M" for manual exposure control and that the Shutter Speed, Aperture and ISO are set for proper exposure - normally, 1/2000, F4.0, and 400, respectively.

- Press "F9" in the FMC Mount program and verify that the camera fires. The frame counter in the FMC program should advance and that the Shots left indicator in the EOS Utility should subtract.

  WARNING: If the Shots left indicator in EOS Utility doesn't change when the camera fires, it indicates that the images are not being saved to the memory card in the camera. Go to "Preferences -> Remote Shooting", in EOS Utility and check the box "Save also on camera's memory card".

14. *The following may be unnecessary:*

    i. *Power OFF the mount system so that power does not spike when the airplane is started.*
    ii. *Start the airplane.*
    iii. *Power ON the mount system.*
    iv. *Verify that the on-screen GPS positions approximately match the pilot's GPS.*
    v. *Press "F9" to take a single photo and verify that all systems are working properly.*

Mid-Flight

Upon approaching the beginning of a transect/point set, press "F5" (AUTO) to begin recording. Occasionally compare the Mount System GPS positions with the pilot's GPS. Also, remember to adjust the Mount System altitude and speed settings as necessary.

Post-Flight

After landing, the survey photos and FMC datalog will need to be downloaded. Please contact Mr. Ryan Howe to coordinate the download and archive for each survey day.

West Coast Aerial Sardine Survey

Transect Flight Log Form

Date:___________ **Set:**__________ **Pilot:**_________________**Observer:**____________________ **Plane:**_________________

Transect No.	Time	Start Photo No.	Latitude/Longitude	Altitude (ft)	Species Observed	Est. Tonnage (mt)	End Photo No.

Cloud Cover code	Glare code	Beaufort Wind Scale

Comments: ____

____

Transect No.	Time	Start Photo No.	Latitude/Longitude	Altitude (ft)	Species Observed	Est. Tonnage (mt)	End Photo No.

Cloud Cover code	Glare code	Beaufort Wind Scale

Comments: ____

____

Transect No.	Time	Start Photo No.	Latitude/Longitude	Altitude (ft)	Species Observed	Est. Tonnage (mt)	End Photo No.

Cloud Cover code	Glare code	Beaufort Wind Scale

Comments: ____

____

Transect No.	Time	Start Photo No.	Latitude/Longitude	Altitude (ft)	Species Observed	Est. Tonnage (mt)	End Photo No.

Cloud Cover code	Glare code	Beaufort Wind Scale

Comments: ____

____

____

Cloud Cover code: **1**- Clear, **2**- Cloud Coverage <50%, **3**- Cloud Coverage >50%, **4**- No Visibility

Glare code: **1** - No glare, **2**- glare <50%, **3**- glare >50%, **4**- Cloud shadows <50%, **5**- Cloud shadows >50%, **6**- No visibility

Beaufort Wind Scale: Refer to attached Beaufort Wind Scale (0-12) to quantify sea state

West Coast Aerial Sardine Survey

Biological Sampling Form

Date Landed:_____ Vessel:_____ Sample No._____ Point Set No._____

Date Sampled:_____ Sampler:_____Processor:_____ Sample Wt (kg):_____

Fish No.	Weight (g)	Std. Length (mm)	Sex (M/F)	Maturity Code	Otolith Vial No.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Fish No.	Weight (g)	Std. Length (mm)	Sex (M/F)	Maturity Code	Otolith Vial No.
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					

Comments:

West Coast Aerial Sardine Survey

Point Set Flight Log Form

Date:________________ Pilot:________________________ Plane:_________________________

Processor:________________________ Observer:______________________

Point Set No.	Time	Photo No.	Latitude/Longitude	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments:

Point Set No.	Time	Photo No.	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments:

Point Set No.	Time	Photo No.	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments

Point Set No.	Time	Photo No.	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments:

Point Set No.	Time	Photo No.	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments:

Point Set No.	Time	Photo No.	Position (Lat/Long)	Altitude (ft)	Vessel	Species Observed	% of School Captured	Est. school Tonnage (mt)

Comments:

West Coast Aerial Sardine Survey

Vessel Point Set Log

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	Est. School Tonnage (mt)	Fish Hold (FP, FS, MP, MS, AP, AS)	Other Vessel utilized: Name, est. weight, fish hold	*Delivered Weight (mt)	*Fish Ticket Number

Comments:

West Coast Aerial Sardine Survey
Survey Data Form Overview

The purpose of this document is to help guide us through each of the sardine survey data forms. If you are still unclear of what a field within a form is asking, please contact Mr. Ryan Howe for further clarification. Please have all survey forms completed and submitted to Mr. Howe by the end of each survey day.

Transect Flight Log Form

Aerial survey pilots will complete the Transect Flight Log Forms for each transect flown for each survey day. The information recorded on this form will help the photo analyst identify fish schools during the transect survey photo processing period, so be as detailed as possible while recording notes. *If a transect is skipped or aborted due to poor visibility or some other factor, please make a note of it on the Transect Flight Log Form and also let Mr. Howe know as early as possible.

Heading Information

- **Date** – Record the date that the transect is flown
- **Set** – Record which replicate SET is being flown
- **Pilot** – Name of pilot flying the transect
- **Observer** – Name of observer on board if any
- **Plane** – Type of aircraft flying the transect

Transect Data

- **Transect No.** – Record the transect number that is flown
- **Time** – Pilots are asked to log the time a fish school is observed along the survey transect
- **Start Photo No.** – Pilots are asked to log the photo number that corresponds with the school identified on that transect.
- **Latitude/Longitude** – Record the latitude and longitude of the school observed while flying the survey transect.
- **Altitude (ft)** – Record the altitude of the plane as it passes over the school observed
- **Species Observed –** Record the species observed on each transect. Use comments section for additional writing space as needed.
- **Estimated Tonnage (mt)** – Pilots are to estimate the observed tonnage of fish schools identified along the survey transect. If there are too many schools to estimate tonnage for each individual school, estimate the schools as a whole.
- **End Photo No**. – Pilots are asked to log the photo number that corresponds with the last school observed on that transect.

- **Cloud Cover code –** Pilots are asked to record the current cloud cover conditions while flying transects, using the following cloud cover scale: **1**- Clear, **2**- Cloud Coverage <50%, **3**- Cloud Coverage >50%, **4**- No Visibility
- **Glare code –** Pilots are asked to record the current glare conditions on the surface of the water using the following glare scale: **1**- No glare, **2**- glare <50%, **3**- glare >50%, **4**- Cloud shadows <50%, **5**- Cloud shadows >50%, **6**- No visibility
- **Beaufort Wind Scale**: Pilots are asked to refer to the Beaufort Wind Scale (0-12) to quantify sea state conditions during transect flights.
- **Comments –** Please write any additional information or notes in this section

Biological Sampling Form

Biological samples will be taken from landed point sets to collect individual fish data. This form is to be filled out by the person/s working up the biological sample. Please contact Mr. Howe with any questions or for further clarification.

Heading Information

- **Date Landed–** Record the date the point set was landed at the processing plant
- **Vessel –** Record the vessel name that delivered the point set catch
- **Sample No. –** Record the sample number consecutively as they occur during the 2011 season
- **Point Set No. –** Record the point set number that the biological sample corresponds to
- **Date Sampled –** Record the date the biological sample was worked up
- **Sampler –** Record the name of the person/s processing the biological sample
- **Processor –** Name of the fish processing plant the sample was collected at
- **Sample Wt. (kg) –** Record the total biological sample weight in kilograms

Biological Data

- **Weight (g) –** Record the individual fish weights using an electronic scale accurate to 0.5 gm
- **Standard (Std.) Length (mm) –** Record the length of each individual fish. Standard length is measured from the tip of fish snout to last vertebrae in millimeters.
- **Sex –** Record the sex of each individual fish (M = male ; F = female)
- **Maturity Code –** Record the maturity code that closely matches the maturity of the fish. Refer to Table. 3 of the Operational Plan for detailed sardine maturity codes.
- **Otolith vial No.** - The otolith vial number is determined by the following information: the point set number, fish number and the year date the otolith was collected. This information allows for easy reference to the individual fish information as needed.
  Example: Point set number 23 is being offloaded. You collect your biological sample from the processing plant. You have already determined which fish will be the otolith fish. It is a good idea to pre-label the capsules before working up the sample. So our otolith capsule would read **PS23F37-11** which again refers to **P**oint **S**et **23** and **F**ish number **37** of 50 collected in 20**11**.

- **Comments –** Please write any additional information or notes in this section.

Point Set Flight Log Form

During the survey, pilots are asked to record important point set information that will be used in the photo enhancement process. Each pilot is asked to fill out a new Point Set Flight Log Form each day point sets are attempted. The Point Set Flight Log Form allows for six point sets to be recorded on each form. Use additional Point Set Flight Log Forms as needed. Also on the form is a comments section for the pilot to include any other important details or notes.

Heading Information

- **Date** – Record the date the point sets are completed
- **Pilot** – Name of pilot setting the vessel for point sets
- **Plane –** Type of aircraft flying for point sets
- **Processor** – Name of the fish processing plant that the catch will be delivered to
- **Observer** – Name of observer onboard airplane if any

Point Set Flight Log Data

- **Point Set No. –** Number the point sets consecutively as they occur during the 2011 season
- **Time** – Record the time when the point set is attempted
- **Photo No.** - Pilots are asked to log the photo number that corresponds with the point set school that is identified and being targeted
- **Latitude/Longitude** - Record the latitude and longitude of the school being targeted for the point set
- **Altitude(ft) –** Record the altitude of the airplane for which species identification was made
- **Vessel –** Record the name of the vessel being set during each point set
- **Species Observed –** Record the species observed for each point set. Use comment section for additional writing space
- **% of School Captured –** Pilots are to estimate a percentage of point set school capture. Pilots estimated percent capture should be independent of captain's vessel estimate.
- **Estimated School Tonnage (mt) –** Pilots are to estimate the tonnage of the targeted fish school prior to setting on it.
- **Comments –** Please write any additional information or notes in this section.

Vessel Point Set Log Form

During the survey, vessel captains participating in the capture of point sets are asked to record important fish school data, ocean data, catch estimates and delivery information. Additional vessels may be utilized during point set operations, so be sure to include this information in the '**Other Vessel utilized**' field under the Captains Estimate and Delivery Information heading. If additional vessels are used to land a point set, please contact Mr. Howe.

*Heading Informati*on

- **Date** – Record the date the point set is completed
- **Vessel** – Name of the vessel participating in the point set operations (also include any additional vessels that were utilized during a point set landing)
- **Captain** – Name of the person operating the vessel
- **Processor** –Name of the processing plant the point set catch will be delivered to

Vessel Log Data

Hydro acoustic Gear

- **Manufacturer –** Record the manufacturer name of the sounder and sonar being used during point set operations
- **Model –** Record the model number or series number of the sounder and sonar being used during point set operations
- **Frequency –** Record the frequency used for both the sounder and sonar during point-set operations

Net Dimensions

- **Net Length –** Record the length of the net (in fathoms) being used during point set operations
- **Net Depth –** Record the depth of the net (in fathoms) being used during point set operations
- **Mesh size –** Record the size of the net mesh (in inches) being used during point set operations

School and Ocean Data

- **Point Set No. –** Number the point sets consecutively as they occur during the 2011 season
- **Time –** Record the time the skiff was deployed from the vessel for point set capture
- **Latitude/Longitude –**Record the positional information related to the targeted point set school
- **Depth to Top of School (fm) –** Record the distance from the water surface to the top of the targeted point set school
- **Depth to Bottom of School (fm) –** Record the distance from the water surface to the bottom of the targeted point set school
- **Ocean Depth (fm) –** Record the ocean depth at which the point set occurred
- **Temperature –** Record the temperature of the water that the point set occurred in

- **Weather Condition –** Refer to the key at the bottom of the Vessel Point Set Log form for weather codes: **1**- calm, clear, **2** - light wind, good visibility, **3** - moderate wind, fair visibility, **4 -** poor fishing conditions.

Captains Estimate and Delivery Information

- **Species Observed** – Record the species observed for each point set
- **% of School captured** – Record the percentage of school captured. The captain's estimate will be independent of the pilot's estimated percent capture.
- **Estimated School Tonnage (mt)** – Record the estimated landed weight (mt)of the targeted point set
- **Fish Hold** – Record the fish hold that the point set is being held in for delivery. Below are abbreviations to be used for identifying which hold a specific point set is being held. Of course not all vessels will have six fish holds, use the fish hold code that best represents your vessels.

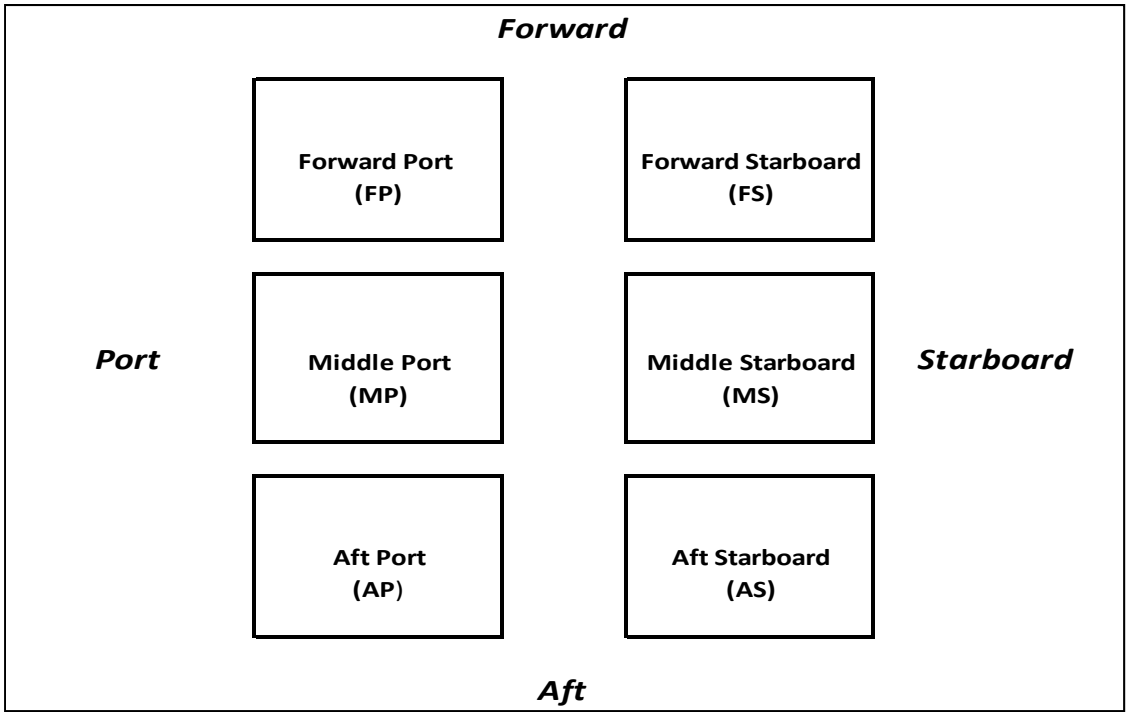


Diagram of fish hold abbreviations to be used on Fisherman's Log Form

- **Other Vessel utilized** – If an additional vessel is utilized to land a point set school, record the vessels name, estimated weight (mt) and in what holds the fish are being held. Use the comments section at the bottom of the form to report any additional information.
- ***Delivered Weight** (Office Use Only) – Leave this field blank. After the delivery is completed, the regional field coordinators will acquire this information from the processing plant manager.
- ***Fish Ticket Number** (Office Use Only) – Leave this field blank. The regional field coordinator will acquire this information from the processing plant manager.
- **Comments** – Please write any additional information or notes in this section.

Appendix I, Adjunct 3. Identification and gear configuration of participating vessels

Vessel Name	Skipper	Owner	USGS/OR Reg#	CPS/Sardine Permit #	Length	GRT	Holds	Capacity (Tons)
Pacific Pursuit	Keith Omey	Pacific Pursuit, LLC	OR873ABY	30920	73'	86	4	80
Lauren L. Kapp	Ryan Kapp	Mt. Hood Holdings LLC	OR072ACX	57008	72'	74	4	70
Pacific Raider	Nick Jerkovich	Nick Jerkovich	972638	57010	58'	75	2	55
Pacific Journey	Leaf Nelson	Stan Nelson	OR661ZK	36106	71'	98	4	78
Evermore	Arnold Burke	Gulf Vessel Management	248555	57009	82'	120	4	50
Sunrise	Roger Smith	Sunrise Fishing, Inc.	238918	57013	80.2'	129	2	65
Delta Dawn	<information to be included in final draft>							

Appendix I, Adjunct 3a. Identification of participating sardine processors

Participating fish processors will be established by a bid process using the same procedure as in previous years.

Appendix I, Adjunct 4. Aerial Survey Point Set Protocol

1) Sardine schools to be captured for point sets will first be selected by the spotter pilot and photographed at the nominal survey altitude of 4,000 ft. If deemed necessary, and with the approval of Mr. Thon, the altitude for selection may be less than 4,000 ft. After selection, the pilot may descend to a lower altitude to continue photographing the school and setting the fishing vessel.
2) It is essential that any school selected for a point set is a discrete school and is of a size that can be captured in its entirety by the purse seine vessel; point set schools may not be a portion of a larger aggregation of fish.
3) To ensure standardization of methodology, the first set of point sets taken by each participating pilot will be reviewed to ascertain that they meet specified requirements. From that point forward, point set photos will be reviewed routinely to ensure that requirements are met.
4) A continuous series of photographs will be taken before and during the vessels approach to the school to document changes in school surface area before and during the process of point set capture. The photographs will be collected automatically by the camera set at 80% overlap.
5) Each school selected by the spotter pilot and photographed for a potential point set will be logged on the spotter pilots' Point Set Flight Log Form. The species identification of the selected school will be verified by the Captain of the purse seine vessel conducting the point set, and will be logged on the Fishermans' Log Form. These records will be used to determine the rate of school mis-identification by spotter pilots in the field. The purse seine vessel will wrap and fully capture the school selected by the spotter pilot for the point set. Any schools not "fully" captured will not be considered a valid point set for analysis.
6) If a school is judged to be "nearly completely" captured (i.e. over 90% captured), it will be noted as such and will be included for analysis. Both the spotter pilot and the purse seine vessel captain will independently make note of the "percent captured" on their survey log forms for this purpose.
7) Upon capture, sardine point sets will be held in separate holds for separate weighing and biological sampling at the dock.
8) Biological samples of individual point sets will be collected at fish processing plants upon landing. Samples will be collected from the unsorted catch while being pumped from the vessels. Fish will be systematically taken at the start, middle, and end of a delivery as it is pumped. The three samples will then be combined and a random subsample of fish will be taken. The sample size will be n = 50 fish for each point set haul.
9) Length, weight, maturity, and age structures will be sampled for each point set haul and will be documented on the Biological Sampling Form. Sardine weights will be taken using an electronic scale accurate to 0.5 gm. Sardine lengths will be taken using a millimeter length strip provided attached to a measuring board. Standard length will be determined by measuring from sardine snout to the last vertebrae. Sardine maturity will be established by referencing maturity codes (female- 4 point scale, male- 3 point scale). Otolith samples will be collected from n = 25 fish selected at random from each n = 50 fish point set sample for future age reading analysis. Alternatively, the 25 fish subsample

may be frozen (with individual fish identified as to sample number, point set, vessel and location captured, to link back to biological data) and sampled for otoliths at a later date.

10) School height will be measured for each point set. This may be obtained by using either the purse seine or other participating research vessels' hydroacoustic gear. The school height measurements to be recorded on the Fishermans' Log Form are: 1) depth in the water column of the top of the school, and 2) depth in the water column of the bottom of the school. Simrad ES-60 sounders will be installed on two purse seine vessels. Data collected by the ES-60 sounders will be backed-up daily and archived onshore.
11) Point sets will be conducted for a range of school sizes. Point sets will be targeted working in general from the smallest size category to the largest. The field director will oversee the gathering of point set landing data and will update the list of point sets needed (by size) daily for use by the spotter pilot. Each day, the spotter pilot will operate with an updated list of remaining school sizes needed for analysis. The spotter pilot will use his experience to judge the surface area of sardine schools from the air, and will direct the purse seine vessel to capture schools of the appropriate size. Following landing of the point sets at the dock, the actual school weights will be determined and the list of remaining school sizes needed will be updated accordingly for the next day of fishing. If schools are not available in the designated size range, point sets will be conducted on schools as close to the designated range as possible. Pumping large sets onto more than one vessel should be avoided, and should only be done in the accidental event that school size was grossly underestimated.
12) The Scientific Field Project Leader will also oversee the spatial distribution of point set sampling, to ensure adequate dispersal of point set data collection.
13) Photographs and FMCdatalogs of point sets will be forwarded from the field to Mr. Howe daily.
14) The total landed weight of point sets taken will not exceed the EFP allotment.
15) The following criteria will be used to exclude point sets from the density analysis (reasons used to deem a point set "unacceptable"). Mr. Howe will make the final determination of point set acceptability in the lab. A preliminary judgment will be made in the field, generally at the end of each day (or sooner), to ensure ongoing sampling is being properly accomplished.

1	Percent captured	School is judged to be less than 90% captured
2	No photograph -1	No photograph of vessel was documented (camera off)
3	No photograph -2	No photograph of vessel was documented (camera on)
4	No photograph -3	Photograph available, but late (vessel is already pursing the catch)
5	School not discrete	Sardine captured was only a portion of a larger school ("cookie cutter")
6	Mixed hauls	Multiple point sets were mixed in one hold

Appendix II

NMFS Guidelines: Coastal Pelagic Species Exempted Fishing Permit (EFP)

Aerial Sardine Survey

Application/Proposal Contents:

1. EFP application must contain sufficient information to determine that:

a. There is adequate justification for an exemption to the regulations;

Under this EFP, the West Coast Sardine Survey (a consortium of sardine industry participants) will perform a synoptic survey of the sardine biomass off the U.S. West Coast using aerial survey data in conjunction with fishing vessel observation data. This survey will continue the time series of data collection started in 2009 that provided information used in the PFMC Pacific sardine stock assessment. The PFMC has indicated support for the further development of this work, and has voted to set-aside a research allocation for the project.

b. The potential impacts of the exempted activity have been adequately identified;

Because the fishing, fishing locations, and quantities of fish requested in this EFP are addressed as part of the 2012 sardine harvest guideline as provided for in the CPS FMP, no additional unforeseen impacts are expected from this activity.

c. The exempted activity would be expected to provide information useful to management and use of CPS fishery resources.

<See: Introduction section of the Main Document>

2. Applicants must submit a completed application in writing that includes, but is not limited to, the following information:

a. Date of application;

[TBD]

b. Applicant's names, mailing addresses, and telephone numbers;

<See: Survey Logistics; Project Personnel: Roles and Responsibilities (Page 9 of Main Document) >

c. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP;

<See Introduction (Page 2 of Main Document); Survey Logistics; Disposition of fish harvested under the EFP (Page 9 of Main Document)>

d. Identify a single project manager (the point of contact person responsible for overall coordination of the project from beginning to end), and other staff or organizations necessary to complete the project, including specific responsibilities related to technical, analytical, and management roles. Provide evidence that the work proposed is appropriate for the experience of the investigators.

To ensure clear communications among participants and other interested parties, the single point of contact person during 2012 survey field work will be Mr. Chris Cearns (NWSS).

<See also: 1) Survey Logistics; Project Personnel: Roles and Responsibilities (Page 7 and 8 of Main Document) and 2) Appendix II, Adjunct 2; Scientific Advisors: Resumes and Curriculums Vitae>

e. Valid justification explaining why issuance of an EFP is warranted;

In 2008, pilot work began in the Northwest to evaluate the quantitative aerial survey method with point sets collected during the summer period of open fishing. It was very difficult to collect the data in a deliberate, methodical manner during the frenetic pace that typically accompanies a derby-style fishery opening. The issuance of an EFP allows for a more controlled sampling process with the focus on research and data quality, and will help to ensure better and more complete study results while using industry resources. This approach worked well in 2009, 2010, and 2011.

f. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals;

The research to be conducted under this EFP will further continue the time series of a new, scientifically rigorous survey of the Pacific sardine resource, and will again provide valuable Pacific sardine stock assessment data to the Council and to NOAA Fisheries. This information is considered a high priority research and data need by NOAA Fisheries. This survey methodology has been recommended by the Council and its sub-panels for use as an index of abundance in the PFMC Pacific sardine stock assessment.

g. An expected total duration of the EFP;

This EFP will be valid for one year, allowing for catching of Pacific sardine during the closed period between the second and third allocation periods in the 2012 season.

h. Number of vessels covered under the EFP as well as vessel names, skipper names, and vessel ID numbers and permit numbers;

<See: Appendix I, Adjunct 3; Identification and Gear Configuration of Participating EFP Vessels>

i. A description of the species (target and incidental) to be harvested under the EFP and quantitative justification for the amount(s) of such harvest necessary to conduct the experiment; this description should include harvest estimates of overfished species and protected species;

Under this EFP, participating vessels will target Pacific sardine exclusively. NWSS is proposing to the PFMC that 3,000 mt of Pacific sardine be deducted from the 2012 Harvest Guideline prior to allocation and set aside for the dedicated sardine research to be conducted under this EFP. If approved, the harvested quantity under this EFP will be limited to this Council recommended 3,000 mt set-aside.

Bycatch is generally low in CPS fisheries because most CPS vessels fish with roundhaul gear, which encircles schools of fish with nets. This gear targets specific schools, which usually contain only one species. The most common incidental catches in the CPS fishery are other CPS species; Pacific mackerel, jack mackerel, market squid, and northern anchovy, may be encountered in small numbers and will be retained if captured. Quantities of these other coastal pelagics species are expected to be nominal, and within the harvest guidelines for those species. Few other species are expected to be encountered or harvested under this EFP.

A quantitative analysis of sample size requirements was conducted in 2010 to justify the amount of sardine needed to accomplish the survey objectives (See: Sardine EFP Application for 2010 (WCSS 2010): Pages 11, and Appendix III.

j. A description of a mechanism, such as at-sea or dockside fishery monitoring, to ensure that the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for, and reported;

Under this EFP, participating vessels will deliver all species harvested to participating processing/freezing facilities within the survey area. Each participating vessel and participating processing/freezing facility will be responsible for collecting and recording catch data for each species delivered. Each participant will be responsible for the issuing and reporting of fish tickets to State authorities, as required by law.

Each participant will also be required to report all catch and fish ticket data to the survey Scientific Field Project Leader on a daily basis. Daily reporting is necessary to achieve the project objectives as specified in the Survey Design section of the main document. Individual point set catches will be kept in separate vessel holds and will be individually weighed at the dock upon landing. These individual point set catch weights will be tallied by the Scientific Field Project Leader to monitor the attainment of the project sample size goals, which specify that point sets are to be collected in specific size categories (small and large) required under the survey design . This detailed accounting of daily catch will

allow for a likewise detailed reporting to NMFS authorities and will ensure that the total sardine set aside amount of 3,000 mt will not be exceeded.

Any bycatch of other CPS species will be retained and a tally of the catch by species will be maintained by the Scientific Field Project Leader and reported to NMFS authorities on a daily basis to ensure that the harvest guidelines of incidental species taken are not exceeded. We do not expect more than a nominal amount of incidental species to be taken.

The PFMC website notes that, according to NMFS Biological Opinion, "… fishing activities conducted under the CPS FMP are not likely to jeopardize the continued existence of any endangered or threatened species." It is not expected that any fishing under this EFP would have any effect on any endangered or threatened species.

k. A description of the proposed data collection methods including procedures to ensure and evaluate data quality during the experiment and data analysis methodology and time line of stages through completion;

<See: 1) Survey Design and Survey Logistics sections of the Main Document, and 2) Appendix I: Field Operational Plan>

l. A description of how vessels were chosen to participate in the EFP;

<See: Page 8 of Main Document; EFP Purse Seine Vessel Selection>

m. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used;

Participating vessels will have the option to operate throughout the entire range of the survey region (from Cape Flattery, WA to the Oregon/California border).

<See: Appendix I, Adjunct 3: Identification and configuration of participating vessels>

n. Identify potential benefits to fisheries management and coastal communities;

Sardine industry participants assert, based on the observations of fishing vessels and spotter pilots, that the survey to be conducted under this EFP will show a significantly greater Pacific sardine biomass than has been estimated under previous stock assessment models. If this assertion is proven to be true, the Pacific sardine HG may be expected to increase over that called for under the current stock assessment model. In any event this survey methodology has been demonstrated to be a valuable second index of abundance to expand understanding of the Pacific sardine resource.

A greater HG would provide benefits to all Pacific sardine and other CPS fisheries industry participants, including the fishermen, processers, spotter pilots, and all those

employed by them, as well as to the coastal communities that support these industries. Due to the reduced HG in 2008, fishing was limited to 135 days in the first seasonal allocation period, 38 days in the second seasonal allocation period, and 7 days in the third seasonal allocation period, resulting in 185 lost fishing days. Fishing seasons were further limited in 2009, [50 fishing days in the first period, 17 days in the second period, 8 days in the third period, and total prohibition on sardine retention on December 23, virtually eliminating fishing on the CPS complex including market squid]. Fishing was further limited in 2010. These closures precipitated even greater socio-economic impacts on communities. These lost fishing days mean reduced employment for fishing vessel and processing plant crews, and reduced income for coastal communities.

o. Discuss compatibility with existing seasons and other test fisheries, potential difficulties with processors or dealers, additional enforcement requirements, and potential negative impacts of the study (e.g., species listed under the Endangered Species Act, allocation shifts, shortened allocation periods, etc.);

The research set-aside for the aerial sardine survey is supported enthusiastically by the west coast sardine industry. Processors and dealers are supportive of this EFP; they are contributing a significant in-kind contribution to the research by processing the fish at cost and contributing the profit from the fish to the research. This EFP research set aside is part of the harvest guideline, and daily reports will be supplied to NMFS detailing the vessels fishing, their landing port(s) and amount of fish caught; no additional enforcement costs should be accrued.

p. Discuss ability to conduct proposed research - Identify the total costs (including collection of samples, data analysis, etc) associated with the research and sources of funding; identify any existing commitments for participation in, or funding of the project;

<See: Appendix II, Adjunct 2; Estimated Project Budget>

q. The signature of the applicant(s);

<See cover page>

Thomas H. Jagielo

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Employment

[2008-Present] Tom Jagielo, Consulting — Seattle, WA

Fisheries Science Consultant *Recent Projects include:*

- Design an aerial survey to estimate menhaden abundance on the east coast of the U.S. for Virginia Institute of Marine Science.
- Design and execution of an aerial survey to estimate Pacific sardine abundance (Washington-Oregon–California) *for the* Pacific Fishery Management Council.
- Represent Oregon Department of Fish and Wildlife on the Scientific and Statistical Committee of the Pacific Fishery Management Council.
- Review and Evaluation of Annual Catch Limits and Accountability Measures proposed by Western Pacific Fishery Management Council *for the* NMFS Pacific Islands Regional Office, Honolulu, Hawaii.
- Literature review and evaluation of West Coast Spatial groundfish management *for the* Environmental Defense Fund.
- Marine Stewardship Council: Peer reviewer of Pacific Whiting certification; Literature search for West Coast Groundfish certification.

[1984-2008] Washington Dept. of Fish and Wildlife — Olympia, WA

Senior Research Scientist

- Developed stock assessments and rebuilding analyses used by Pacific Fishery Management Council; Designed surveys and conducted undersea manned submersible research; Investigated groundfish movement, survival, and abundance.

[1979-1984] University of Washington Fish. Res. Institute — Seattle, WA

Biologist

- Projects included: Foreign Fisheries Observer; *Limnology of Lake Roosevelt*; *Toutle River salmon survival; Seahurst Outfall Study.*

Education

[1988-1992] University of Washington — Seattle, WA

Post MS Graduate Study

- Fishery Population Dynamics, Statistical Sampling and Estimation

[1986-1988] University of Washington — Seattle, WA

Master of Science

- MS in Fisheries – Limnology of Lake Roosevelt, WA.

[1974-1977] Pennsylvania State University — University Park, PA

Bachelor of Science

- BS in Biology and Marine Science

Selected Scientific Committees

- Pacific Fishery Management Council Scientific and Statistical Committee: Chairman (2002-2003); Vice Chairman (2000-2001); Member: (1992-2008) and (2009-2011).
- US/Canada Groundfish Technical Subcommittee: Chairman (2003, 1987-1988); Member 1986-2008.
- PaCOOS – Pacific Coast Ocean Observation System: WDFW representative (2006-2008).

Selected Publications

Jagielo, T.H. 1988. The spatial, temporal, and bathymetric distribution of coastal lingcod trawl landings and effort in 1986. State of Wa. Dept. of Fish. Prog. Rept. No. 268. June 1988. 46 pp.

Jagielo, T.H. 1990. Movement of tagged lingcod, (*Ophiodon elongatus*), at Neah Bay, Washington. Fish. Bull. 88:815-820.

Jagielo, T.H. 1991. Synthesis of mark-recapture and fishery data to estimate open population parameters. *In* Creel and Angler Surveys in Fisheries Management, American Fisheries Society Symposium 12:492-506.

Jagielo, T.H. 1994. Assessment of lingcod (*Ophiodon elongatus*) in the area north of Cape Falcon (45^0 46' N.) and south of 49^0 N. in 1994. *In* Pacific Fishery Management Council, 1994. Status of the Pacific Coast Groundfish Fishery Through 1994 and Recommended Acceptable Biological Catches for 1995. Appendix I. Pacific Fishery Management Council, Portland, Oregon.

Jagielo, T.H. 1995. Abundance and survival of lingcod (*Ophiodon elongatus*) at Cape Flattery, Washington. Trans. Amer. Fish. Soc. 124(2).

Jagielo, T. H., LeClair, L.L., and B.A. Vorderstrasse. 1996. Genetic variation and population structure of lingcod. Trans Amer. Fish Soc. 125(3).

Jagielo, T.H., Adams, P., Peoples, M., Rosenfield, S., Silberberg, K, and T. Laidig. 1997. Assessment of lingcod (Ophiodon elongatus) for the Pacific Fishery Management Council in 1997. SAFE, 1998. Pacific Fishery Management Council, Portland, Oregon.

Jagielo, T.H. 1999. Rebuilding analysis for lingcod. Report prepared for the Pacific Fishery Management Council, Portland, OR.

Jagielo, T.H. 1999. Movement, mortality, and size selectivity of sport and trawl caught lingcod (*Ophiodon elongatus*) off Washington. Trans. Amer. Fish. Soc. 128:31-48.

Jagielo, T.H., Vandenberg, D.V., Sneva, J., Rosenfield, and F. Wallace. 2000. Assessment of lingcod (Ophiodon elongatus) for the

Pacific Fishery Management Council in 2000. SAFE, 2001. Pacific Fishery Management Council, Portland, Oregon.

Kocak, D.M., Caimi, F.M., **Jagielo, T.H.** and J. Kloske. 2002. Laser Projection Photogrammetry and Video System for Quantification and Mensuration. Oceans 2002, Marine Technology Society. Biloxi MS.

Jagielo, T.H., Hoffmann, A, Tagart, J., and Zimmermann, M. 2003. Demersal groundfish densities in trawlable and untrawlable habitats off Washington: implications for the estimation of habitat bias in trawl surveys. Fish Bull. 101:545–565.

Jagielo, T.H. and F. R. Wallace. 2005. Assessment of Lingcod (*Ophiodon elongatus*) for the *Pacific Fishery Management Council* in 2005. *In* Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council 2130 SW Fifth Ave. Suite 224, Portland, Ore. 97210.

Wallace, F., Tsou, T., **Jagielo, T**., and Cheng, Y.W. 2006. Status of Yelloweye Rockfish off the U.S. West Coast in 2006. *In* Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council 2130 SW Fifth Ave. Suite 224, Portland, Ore. 97210

Jagielo, T.H., Hanan, D., and R. Howe. 2009. West Coast Aerial Sardine Survey. Sampling Results in 2009. Prepared for Northwest Sardine Survey and the California Wetfish Producers Association. Submitted to the Pacific Fishery Management Council, Portland, OR, October 14, 2009. 14p.

Jagielo, 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. Submitted to Pacific Fishery Management Council, Portland, OR, October 15, 2010. 51p.

Jagielo, T. H., Howe, R., and M. Mikesell. 2011.West Coast Aerial Sardine Survey. Sampling Results in 2011. Prepared for Northwest Sardine Survey. Submitted to Pacific Fishery Management Council, Portland, OR, October 13, 2011. 91p.

Ryan A. Howe

Email: Ryanhowe9@yahoo.com · (989) 941-2241 · 4025 NE 64th Ave., Portland, OR 97232

Objective: To further my experience in the fisheries field while working with government agencies as well as public and private stakeholders.

Education:

University of Alaska: Anchorage, AK
North Pacific Groundfish Observer Program
Level 1 Observer (October 2006)
Level 2 Observer (March 2008)

Michigan State University: East Lansing, MI
Bachelor of Science Degree (August 2006): Fisheries and Wildlife

Work Experience:

Scientific Field Lead
West Coast Aerial Sardine Survey: WA and OR *July 2008 – Present*

- Coordinate data collection of aerial sardine survey
- Interaction with state and federal agencies as well as public and private stakeholders
- Collect biological information routinely of Pacific sardine (*Sardinops sagax*)
- Enhancement and analysis of digital photos using Adobe Photoshop CS5 and Adobe Lightroom 3
- Oversee the aerial sardine survey photo analyst staff
- Experience with Canon EOS 1Ds camera in an Aerial Imaging Solutions FMC mount system

Fisheries Technician
Pacific Whiting Conservation Cooperative: Seattle, WA *May 2008 – May 2009*

- Collect biological information daily of Pacific Whiting (*Merluccius productus*) and other species (i.e. species I.D., length/weight, species retention and storage)
- Record raw data on deck forms and enter in Microsoft Excel daily
- Assist in Seabird CTD operations (conductivity, temperature, depth)
- Work with vessel operator and crew to accomplish project tasks

North Pacific Groundfish Observer
TechSea International Inc.: Seattle, WA *September 2006 – March 2008*

- Collect biological samples for species composition, sex, and weight for catch and bycatch for vessels fishing in the Bering Sea and Gulf of Alaska
- Collect and record fishing effort, location, gear type, and incidental take of prohibited species
- Record fishery interactions with marine mammals and seabirds.
- Interaction with state and federal agencies as well as public and private stakeholders

Fisheries Technician
Michigan State University: East Lansing, MI *June 2006 – August 2006*

- Electro-shocked streams in northwest and southwest Ontario, Canada for a Sea Lamprey (*Petromyzon marinus*) recruitment and population research project
- Maintained electro-shocking equipment and USGS vehicle provided for project.
- Recorded biological, positional and catch information of sampled transects.

Fisheries Technician
Michigan State University: East Lansing, MI *Fall 2005*

- Gained communication skills through interaction with hatchery biologists of the Michigan Department of Natural Resources.
- Collect biological samples of Chinook salmon (*Oncorhynchus tshawytscha*) for future genetic analysis and to check for the presence of bacterial kidney disease (BKD).

Appendix II, Adjunct 2. Estimated Project Budget

Estimated NWSS EFP Project Budget - 2012				Draft 1-31-2012				
REVENUES:								Extension
Estimated Revenue/mt (FOB container yard):		$ 675.00						
Estimated EFP sardine available (mt):		3,000						
Estimated project revenue:								$ 2,025,000
EXPENSES:						Weather		
Aerial Transects	# Transects	Hrs/transect	$/hr	Total/Set	Replicates	contingency	Total	
Flying the transects	41	3	$500	$61,500	3	1.25	$230,625	
Processing transect images	41	12	$25	$12,300	3		$36,900	
Point Sets	# Point sets	#Sets/V Day	$/V Day	# V Days				
Fishing Point sets on schools	82	2	$12,500	41			$512,500	
	Hours		$/Hr					
Flying the point sets	112		$300				$33,600	($813,625)
Scientific support costs:								
Science Oversight and Staff - compensation							$220,000	
Science Oversight and Staff - expenses							$40,000	
								($260,000)
Supplies and Equipment							$7,000	
								($7,000)
Accounting/bookkeeping							$5,000	
								($5,000)
10% contingency on operations							$108,063	
								($108,063)
PROJECT SUBTOTAL								**$831,313**
Estimated Processing Costs								
Estimated processing Cost/mt:	$ 300.00							**($900,000)**
NET Proceeds								**($68,688)**

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL REPORT ON 2014 EXEMPTED FISHING PERMIT NOTICE OF INTENT

The Coastal Pelagic Species Advisory Subpanel (CPSAS) and the Coastal Pelagic Species Management Team (CPSMT) received an informal presentation from the Northwest Sardine Survey, LLC, and considered a notice of intent for a 2014 Exempted Fishing Permit (EFP).

Although the aerial survey data was intended to be used to augment data from stock assessments, the survey also provides valuable stand-alone information on the distribution of the sardine stock. The CPSAS unanimously supports adopting the Pacific Northwest aerial survey Exempted Fishing Permit (EFP) proposal for public review.

The amount of set aside for the EFP was not discussed, and will be presumably provided prior to the April 2014, Council meeting. The CPSAS recommends modifying Council Operating Procedure 23 as appropriate in order to align the submission and review of EFP applications with the new fishery start date. EFP participants noted that due to the change in the start date for the sardine fishery, the cost of analyzing the aerial photos will be reduced and the time available to analyze data from the survey has increased.

PFMC
11/02/13

COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON 2014 EXEMPTED FISHING PERMIT (EFP) NOTICE OF INTENT

The Coastal Pelagic Species Management Team (CPSMT) reviewed the Letter of Intent submitted by the Northwest Sardine Survey for an Exempted Fishing Permit (EFP) in 2014. The proponent, Mr. Jerry Thon, representing the Northwest Sardine Survey LLC, was present to discuss progress and problems encountered during their summer 2013 survey. The survey conducted in summer 2013 encountered significant delays due to fog and was not completed.

The CPSMT supports Council adoption of this survey for public review. The CPSMT notes that a specific EFP tonnage has not yet been specified by the requestor, we expect the amount to be presented when setting harvest specifications in April 2014.

Finally, the CPSMT notes that Council Operating Procedure 23 for EFP requests may need to be revised to accommodate the new sardine management cycle.

PFMC
11/02/13

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON 2014 EXEMPTED FISHING PERMIT (EFP) FOR NOTICE OF INTENT

The Scientific and Statistical Committee (SSC) reviewed the notice of intent to conduct another Pacific Northwest aerial sardine survey under the Council's exempted fishing permit process. No written report on the 2013 Northwest Aerial Sardine Survey was provided to the SSC. Due to extensive fog, the 2013 survey was unable to proceed as planned, and returned half of the 3,000 ton harvest quantity originally allocated for the survey. The SSC expects to see a full report of the 2013 survey at our March 2014 Pacific Council meeting, and we will provide a more detailed review then. A broader review of this survey approach should be conducted next year, perhaps in conjunction with a review of the southern California survey.

PFMC
11/01/13

ESTABLISH MAXIMUM SUSTAINABLE YIELD (MSY) REFERENCE POINT FOR NORTHERN ANCHOVY

At its June 2013 meeting, the Pacific Fishery Management Council (Council) considered a recommendation from the National Marine Fisheries Service (NMFS) to establish maximum sustainable yield (MSY), or a reasonable proxy, for the northern subpopulation of northern anchovy (NSNA). The need to establish MSY stems from the U.S. District Court for the Northern District of California order issued on April 14, 2013. A 2012 complaint filed by the conservation organization Oceana argued that NMFS, in approving the Council's Amendment 13 to the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP), violated the Magnuson-Stevens Act, National Environmental Policy Act, and the Endangered Species Act. The Court ruled in favor of NMFS on all counts except for the failure to establish MSY for NSNA.

The Council considered MSY for NSNA during development of the CPS FMP (approved in 1998), but did not establish MSY, citing lack of information about the stock's biomass, variability over time, and the proportion of the stock in U.S. (vs. Canadian) waters. The stock was categorized as Monitored (and remains in that category), meaning it was not subject to active management, and was not considered to be facing any conservation concern. Monitored stocks do not have periodic stock assessments or periodic adjustments to target harvest levels, although they may be subject to management measures.

Amendment 13 established mechanisms to determine annual catch limits, overfishing limits (OFL), and acceptable biological catches (ABC) for the species managed under the CPS FMP, including NSNA. These revisions to the FMP were based on biological benchmarks already established in the CPS FMP, including MSY (or a reasonable proxy). However, the original FMP did not specify MSY for NSNA, citing a lack of reliable information available at the time. For the same reason, the Council did not adopt an MSY of Amendment 13 either.

During the development of Amendment 13 to the CPS FMP, the CPS Management Team (CPSMT) investigated many potential sources of stock information for NSNA. This included an acoustic survey estimate, egg and larval surveys from the 1970s, a 1999-2009 relative abundance estimate based on the 1970s egg and larval surveys, landings data, and other sources of information. However, the CPSMT was not able to produce a single recommendation for establishing MSY, and instead provided two options for the SSC and the Council to consider.

Also during development of Amendment 13, the Scientific and Statistical Committee (SSC) considered OFLs and ABCs for CPS monitored stocks, and stated that the reference points for monitored CPS stocks are difficult to determine due to limited data for estimating biomass and productivity. Recognizing that the NSNA stock was lightly fished and had inconsistent fishery-dependent data on which to base estimates of stock status, the SSC recommended that the OFL be set by multiplying the best biomass estimate (130,000 mt) by 0.3. The 0.3 figure is the default fishing mortality rate (F_{msy}) value for Pacific mackerel, and the SSC determined that it was appropriate to use, because NSNA are likely at least as productive as Pacific mackerel. The Council adopted an OFL of 39,000 mt and an ABC of 9,750 mt, which incorporated a buffer of

75 percent. The Council did not take final action on establishing MSY for NSNA, and neither the CPSMT nor the SSC made explicit recommendations to do so. However, the SSC did make a clear recommendation regarding an appropriate F_{msy}.

NMFS will provide a report regarding whether Council action would require an FMP amendment and any other necessities for the Council prior to taking Council action.

Council Action:

Consider MSY for the Northern Subpopulation of Northern Anchovy

Reference Materials:

1. Agenda Item E.3.a, Supplemental Attachment 1: NMFS Report.
2. Agenda Item E.3.c, Public Comment.

Agenda Order:

a. Agenda Item Overview — Kerry Griffin
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Adopt MSY for the Northern Subpopulation of Northern Anchovy

PFMC
10/10/13

POTENTIAL ALTERNATIVES FOR ESTABLISHING AN ESTIMATE OF MSY FOR THE NORTHERN SUBPOPULATION OF NORTHERN ANCHOVY

Background

The Pacific Fishery Management Council developed Amendment 13 to the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP) to comply with the 2007 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Act), using the associated advisory guidelines for National Standard One. In 2011, NOAA Fisheries reviewed and approved Amendment 13.

In an amended complaint filed with the U.S. District Court for the Northern District of California in February 2012, the environmental advocacy organization Oceana alleged that the CPS Plan, as amended by Amendment 13, violated the Magnuson Act by failing to describe optimum yield or maximum sustainable yield (MSY) for several species, failing to appropriately account for scientific uncertainty, and failing to use the best available science; violated the National Environmental Policy Act for failure to prepare a new environmental impact statement; and violated the Endangered Species Act for failure to engage in a Section 7 consultation. On April 14, 2013, the District Court issued an order granting summary judgment in favor of federal defendants on all allegations except for failure to describe MSY for the northern subpopulation of northern anchovy; this decision was remanded back to the Secretary for action consistent with the Court's order. On April 17, the Court entered a final judgment in this case.

The central feature of Amendment 13 was to establish mechanisms and control rules for setting annual catch limits and other associated harvest limits for the stocks in the CPS FMP. Most of these mechanisms were built on biological benchmarks already included in the Plan through Amendment 8 (establishment of the CPS FMP) and Amendment 10, including a description of MSY or a reasonable proxy thereof. Citing a lack of information, the original FMP did not specify MSY for the northern subpopulation of northern anchovy. In developing Amendment 13, the Council considered an alternative for adding MSY for the northern subpopulation of northern anchovy to the CPS Plan (MSY is described for all other stocks, excluding krill, in the plan). However, at the time of Council action on Amendment 13 (June 2010), an appropriate MSY had not been determined and the Council added language to the FMP that explicitly deferred this decision to the specification process for monitored stocks.

In November 2010, although harvest specifications for the monitored stocks were adopted, including an OFL, ABC, ACL and ACT for the northern subpopulation of northern anchovy, an MSY for the northern subpopulation was not formally adopted.

Proposed Action— Establish an Estimate of MSY

The proposed action is to formally establish a reasonable estimate of MSY or MSY proxy for this stock by the Council. As noted by the Scientific and Statistical Committee (SSC) in a November 2010 statement, reference points such as MSY for monitored CPS stocks are difficult to determine due to limited data to estimate biomass and productivity.

Potential Alternatives for Estimating MSY

During the Amendment 13 development process, the CPS Management Team (CPSMT) compiled what limited information on the subpopulation existed, including estimates of biomass, catch over time, stock productivity and other available scientific information. Based on the available information, the CPSMT provided two alternative methods for developing an OFL, that could also be considered as MSY alternatives. Although the MT recognized that both of the alternatives had inherent issues, it was determined that based on the biology of the species, results of the vulnerability analysis for CPS stocks in the California Current ecosystem (Patrick et al. 2009) and the relatively low recent catch and expected continued low catch for this subpopulation, they provided reasonable approaches given the lack of available information.

Additionally, the SSC reviewed and discussed the information compiled by the MT at their November 2010 meeting. They also provided a potential alternative for the proposed action, based on the default fishing mortality rate (F_{MSY}) value used for Pacific mackerel.

1. **MSY Alternative: Biomass based**

Included in the information assembled by the CPSMT were two estimates of biomass: (1) a selected midpoint from a range of egg and larval production estimates from the 1970s (Richardson 1981) and (2) an estimate from an acoustic survey conducted by researchers at the Southwest Fisheries Science Center (Zwolinski et al, unpublished). This alternative would use this information to estimate a reasonable MSY value.

The approach previously proposed by the CPSMT using this method averaged these two estimates and then reduced this value to account for the uncertainty in the estimates. Specifically, they took the average of the estimates from the biomass estimates in the 1970s (102,000 mt) and 2008 (159,800 mt), which is approximately 130,000 mt and applied an 80 percent reduction (similar to other CPS stocks). This approach equates to a MSY of 26,000 mt.

2. **MSY Alternative: Catch-based**

Under this alternative, a MSY would be based on recent and average catch of the stock over time. The approach proposed by the MT using this method was to first develop a reasonable acceptable biological catch (ABC)/annual catch level (ACL) based recent catch levels and then calculate a MSY value from the previously determined ACL level. For example, under this approach, using an ABC/ACL of 3,000 mt (a value three times higher than the highest recent catch to allow for some modest increase in landings) and

the default harvest control rule for monitored stocks in reverse, equates to an MSY of 12,000 mt. The default harvest control for monitored stocks sets the ABC/ACL at only 25 percent the MSY/Overfishing level.

However, because the northern subpopulation of northern anchovy has been very lightly fished in recent times (average catch over last ten years is 230 mt) with inconsistent effort and landings, the MT noted that the time series of catch is likely a highly uncertain indicator of stock status.

3. F_{MSY} alternative:

Although not formally adopted at the November 2010 Council meeting, the Council received a recommendation from the SSC regarding a potential F_{MSY} for the northern subpopulation of northern anchovy. This was a F_{MSY} of 0.3, which was ultimately used in the calculation of the adopted OFL. This value (the default fishing mortality rate for Pacific mackerel) was considered appropriate by the SSC because they suggested northern anchovy are likely to be as productive as Pacific mackerel for which there is much greater understanding of productivity and biology.

Conclusion

The National Marine Fisheries Service believes that adopting the SSC's recommendation above is a prudent way forward for the establishment of an estimate of MSY. The best available information appears to indicate that an F_{MSY} of 0.3 for the northern subpopulation of northern anchovy when applied over the long term is a reasonably proxy for maintaining MSY. However we also recommend that as new information becomes available that this value be reevaluated.

References

Patrick, S. W., p. Spencer, O. Ormseth, J. cope, J. Field, D. Kobayashi, T. Gedamke, E.Cortes, K. Bigelow, W. Overhotz, J. Link, and P. Lawson.. 2009. Use of productivity and susceptibility indices to determine the vulnerability of a stock: with example applications to six U.S. fisheries. NOAA Tech. Memo. NMFS-F/SPO-101. 117 p.

Richardson, S. L. 1981. Spawning biomass and early life of northern anchovy, *Engraulis mordax*, in the northern subpopulation off Oregon and Washington. Fish. Bull. 78:855-876.

Zwolinski et al, Southwest Fisheries Science Center. 2010. Unpublished data from acoustic-trawl survey.

THE PEW CHARITABLE TRUSTS

4189 SE Division St.
Portland, OR 97202

October 9, 2013

Dorothy Lowman, Chair
Pacific Fishery Management Council
1100 NE Ambassador Place, #101
Portland, OR 97220

RE: Data, Assessment and Management of Northern Anchovy

Dear Mrs. Lowman and Council Members,

We write to request that the Pacific Fishery Management Council (Council) act with precaution in establishing maximum sustainable yield (MSY) and corresponding status determination criteria (SDCs) for the northern subpopulation of northern anchovy. Additionally, we request that the Council and National Marine Fisheries Service (NMFS) conduct a full benchmark stock assessment for both the northern and central subpopulations of northern anchovy, and to shift northern anchovy from the "Monitored" to the "Actively Managed" category in the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP).

Northern anchovy is a keystone forage species in the California Current Ecosystem and is preyed upon by a wide variety of marine wildlife including commercially and recreationally valuable fish, mammals and sea birds.[1] Furthermore, while the northern subpopulation of northern anchovy is considered "lightly fished,[2]" catches of both subpopulations[3] have ranged roughly between 2000 – 20,000mt per year over the last 15 years (behind only market squid and Pacific sardine in catch in the CPS FMP), not including catches from Mexico.[4] As harvest guidelines for Pacific sardine have decreased and appear to be continuing to decrease, fishing effort is likely to shift toward northern anchovy. Unfortunately, information on the status of this stock is outdated and highly uncertain. For these reasons the Council should be proactive and begin to focus more attention on data collection, assessment, and management of northern anchovy.

Specifically, we request that the Council:

- Take action now to establish precautionary reference points for northern anchovy, starting with MSY for the northern subpopulation.
- Request NMFS collect all fishery dependent and independent data needed to conduct a stock assessment for both subpopulations and conduct such assessments.
- Reassign northern anchovy to the Actively Managed category within the CPS FMP.

Below we discuss these recommendations in more detail.

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[1] PFMC. February 2013. Pacific Coast Fishery Ecosystem Plan. Public Review Draft of Ecosystem Initiatives Appendix. Page A-10.
[2] PFMC. November 2010. Supplemental SSC Report. Agenda Item I.2.c
[3] There are two subpopulations of northern anchovy in U.S. waters. The northern subpopulation ranges from San Francisco to Southeast Alaska and the central subpopulations ranges from San Francisco to Baja, Mexico.
[4] PFMC. June 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches; Stock Assessment and Fishery Evaluation 2011. SAFE Tables, Appendix A.

MSY for Northern Subpopulation of Northern Anchovy

At the November meeting, the Council must take action to establish MSY, or an MSY proxy, for the northern subpopulation of northern anchovy. While we support taking this action, we request that the Council act with a high level of precaution in doing so for the following reasons detailed below:

- Estimates of abundance for this stock are outdated and highly uncertain.
- Fmsy for this stock is based upon the qualitative assumption that northern anchovy is as productive as Pacific mackerel.
- Coastwide catches have fluctuated widely between 2000 – 20,000mt per year over the last 15 years.
- The portion of the northern subpopulation that resides in U.S. waters is unknown.[5]
- Northern anchovy are a critical forage species in the California Current.

In a supplemental report from November 2010, the Council's Scientific and Statistical Committee (SSC) states that the northern subpopulation of northern anchovy is "lightly fished" and, citing limited data on the species, recommends establishing a biomass estimate by averaging the only two available estimates of abundance. One estimate is from an egg and larval production survey conducted in the 1970's and the other is from a recent acoustic survey intended to assess Pacific sardine. The average of these two estimates is 130,000mt. From there, the SSC recommended that reference points be established using the Fmsy value for Pacific mackerel (.3) because northern anchovy can reasonably be expected to be as productive.[6] While this may be the case, the assumption should be scientifically verified and reconciled with the fact that recruitment for Pacific mackerel (like other CPS) is highly variable and unrelated to spawning biomass.[7] Under these two assumptions and the existing control rule for monitored species, the overfishing limit (OFL) for the northern subpopulation of northern anchovy would be 39,000mt. With the SSC established uncertainty buffer of 75%, the resulting annual acceptable biological catch (ABC) would be 9,750mt.

During the process of developing Amendment 13 to the CPS FMP, the Council chose not to establish the above biological reference points (BRPs) for the northern subpopulation of northern anchovy and instead added language to the FMP that deferred this action to the annual specification process for monitored CPS stocks.[8] However, due to a recent court order,[9] the Council and NMFS must now take action to establish MSY (a biological reference point) for this stock and finds itself in a position where it must rely on this outdated and uncertain information.

We find this scenario to be highly problematic. Because of the critical ecological role that northern anchovy plays in the California Current Ecosystem, and the varying levels of regulation

[5] PFMC. September 2011. Coastal Pelagic Species Fishery Management Plan as amended through Amendment 13. P. 41
[6] PFMC. November 2010. Supplemental SSC Report. Agenda Item I.2.c
[7] Parrish, R.H. 1974. Exploitation and recruitment of Pacific Mackerel, *Scomber japonicas*, in the northeastern Pacific. Calif. Coop. Oceanic Fish. Invest. Rep. 17:136-140-101.
[8] PFMC. September 2011. Coastal Pelagic Species Fishery Management Plan as amended through Amendment 13. P. 41
[9] See Oceana, Inc. v. Bryson, No. C-11-6257 (N.D. Cal. Apr. 12, 2013) (summary judgment order).

for commercial catch throughout the coast,[10] it is essential that the Council begin to focus more attention on northern anchovy. Having current and reliable information on northern anchovy is necessary to establishing SDCs with certainty and consequently to ensuring the sustainability of the fishery, maintaining its role in the ecosystem and achieving the CPS FMP's objective of maintaining adequate forage for dependent predators.[11]

Stock Assessment

In order to manage CPS such as northern anchovy with a higher degree of certainty and a reduced level of precaution, the Council must obtain sufficient information on stock status and ecosystem role. As discussed above, there is no reliable information on the abundance of either subpopulation of northern anchovy. The biomass estimate for the northern subpopulation is based on outdated and uncertain information. The central subpopulation was last assessed in 1995 and according to recent Council documents is currently assumed to be roughly 333,000mt.[12]

According to the most recent CPS Stock Assessment and Fishery Evaluation document, landings of northern anchovy have fluctuated between roughly 2000 – 20,000mt per year over the last 15 years, with coastwide catch exceeding 15,000mt as recently as 2008.[13] Compounding current uncertainty due to lack of recent data is the fact that while productivity is assumed to be similar to that of Pacific mackerel (a higher trophic-level species), northern anchovy experiences high natural mortality, with between 45 – 55% of the stock dying of natural causes (including predation) each year.[14] As stated above, this assumption should be scientifically verified.

Perhaps most alarming is the fact that the most recent survey cruise conducted by the Southwest Fishery Science Center (SWFSC) detected a complete absence of northern anchovy eggs in the spring of 2013.[15] The area surveyed by the SWFSC cruise comprises much of the range of the central subpopulation, which the Council assumes to be the larger of the two and thus assigns it a larger ABC. The fact that there were no northern anchovy eggs found in the survey of the central subpopulation – the larger supposed population – reinforces the critical need to set precautionary catch levels for the northern subpopulation.

For a fishery with a combined ABC of 34,750mt (should the Council adopt the proposed BRPs for the northern subpopulation), much more reliable assessment data is needed. This includes not just acoustic-trawl survey data, but fishery dependent data such as length-age compositions. In this regard, we agree with and support the following CPS Management Team statement from April 2011:

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[10] For example, Washington restricts the catch of northern anchovy to 5mt daily/10mt weekly for bait purposes only, while Oregon maintains an open access commercial fishery for northern anchovy.
[11] PFMC. September 2011. Coastal Pelagic Species Fishery Management Plan as amended through Amendment 13. P. 12
[12] PFMC. June 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches; Stock Assessment and Fishery Evaluation 2011. P. 58
[13] PFMC. June 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches; Stock Assessment and Fishery Evaluation 2011. SAFE Tables, Appendix A.
[14] NOAA/NMFS. June 2013. Fishwatch. U.S. Seafood Facts: Northern Anchovy.
[15] NOAA/NMFS. August 2013. Southwest Fishery Science Center. Egg Distribution Maps for Sardine, Anchovy and Jack Mackerel.

> *Biomass estimates for northern anchovy cannot be derived from the acoustic-trawl surveys conducted to date. However, the Panel concluded that acoustic-trawl methods could provide biomass estimates for northern anchovy if surveys were designed for that purpose. The CPSMT believes that acoustic-trawl surveys that provide biomass estimates for the northern and central subpopulation stocks would be valuable because the most recent biomass estimates for these stocks date from the mid-1970s and mid-1990s, respectively.*[16]

In sum, having newer and better information on northern anchovy, as described above, will allow the Council to set BRPs and catch levels for this stock with a much higher degree of certainty, to better understand the cyclical nature of this stock and its relationship to Pacific sardine, to better manage the entire CPS assemblage, to maintain the role of northern anchovy in the ecosystem and ultimately to manage all the Council's FMPs with an ecosystem-based approach.

Active Management

Consistent with the need to conduct a stock assessment for northern anchovy discussed above is our request that the stock be reassigned to the Actively Managed category. According to the CPS FMP, this action is necessary for the stock to be given the priority attention it deserves:

> *The purpose of Active and Monitored management is to use available agency resources in the most efficient and effective manner while satisfying goals and objectives of the FMP. The distinction enables managers and scientists to concentrate efforts on stocks and segments of the CPS fishery that need the greatest attention or where the most significant benefits might be expected.*[17]

Both Actively Managed and Monitored species require SDCs and ACLs. However, data collection, stock assessments and other scientific products are prioritized for those species that are Actively Managed relative to those that are Monitored. This prioritization and the science that comes with it would allow the Council to act with more certainty and better manage northern anchovy.

We also note that Pacific mackerel remains in the Actively Managed category, and northern anchovy in the Monitored category, despite the fact that landings of northern anchovy have on average far exceeded those of Pacific mackerel since 2001 in terms of both tonnage and ex-vessel revenue.[18] This scenario appears to be inconsistent with the intended distinctions between the two categories, which are meant to assign greater scientific and management resources to those stocks with greater importance to the broader CPS fishery

[16] PFMC. April 2011. Supplemental CPSMT Report. Agenda Item C.3.b
[17] PFMC. September 2011. Coastal Pelagic Species Fishery Management Plan as amended through Amendment 13. P. 8
[18] PFMC. June 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches; Stock Assessment and Fishery Evaluation 2011. SAFE Tables, Appendix A.

Last, we'd like to point out that this request would not require an FMP amendment and all the associated workload concerns. According to the CPS FMP:

> *Changes to the appropriate management category for each species can be made annually by the Council based on all available data, including ABC levels and MSY control rules, and the goals and objectives of this FMP. . .In addition, CPS in the Monitored management category can be reassigned to Active management on short notice under the point-of-concern framework.*[19]

An Ecosystem-Based Approach to Management

Focusing increased attention on northern anchovy is also essential to managing the CPS assemblage with an ecosystem-based approach. As noted by the Ecosystem Plan Development Team in November 2011:

> *…the greatest proportion of energy flow in the California Current Ecosystem appears to be through krill, market squid, northern anchovy, Pacific sardine and Pacific herring.*[20]

This means that the most important finfish forage species off of our West Coast are Pacific sardine, northern anchovy and Pacific herring. Of these three species, only Pacific sardine and northern anchovy are the subject of coastwide federally managed fisheries. From an ecosystem perspective, the Council cannot truly accomplish the CPS FMP objective of maintaining adequate forage for dependent predators without having sufficient knowledge on the abundance and status of both of these keystone forage species. This is also consistent with the Council's Research and Data Needs for northern anchovy which state:

> *Reasonable estimates of their (northern anchovy and jack mackerel) current biomass are needed for sound ecosystem management, particularly before ecosystem models can be used to accurately forecast dynamics of planktivorous organisms in the food web.*[21]

Ecosystem and multi-species models are currently being developed and refined to inform the fishery decision-making process and to help usher in the transition to ecosystem-based fishery management. One of the key questions these models seek to answer regards food availability and forage abundance for managed and other species of concern. The importance of northern anchovy in the marine food web, as well as its importance as a commercial stock, requires that we know more about its status and role in the ecosystem.

[19] PFMC. September 2011. Coastal Pelagic Species Fishery Management Plan as amended through Amendment 13. P. 9
[20] PFMC. February 2013. Pacific Coast Fishery Ecosystem Plan. Public Review Draft of Ecosystem Initiatives Appendix. Page A-10.
[21] PFMC. July 2013. Research and Data Needs. P.48

Conclusion

In many regards, the CPS FMP utilizes innovative approaches to managing fisheries with an ecosystem-based approach. The FMP itself recognizes that its managed stocks are important to the broader ecosystem as forage. Additionally it contains an explicit objective to maintain adequate forage for dependent predators. It also manages some stocks in the fishery by using environmental indices as a proxy for productivity, establishes a cutoff for rebuilding purposes, and reduces catch as abundance declines. In short, the CPS FMP can serve as a model for ecosystem-based management of forage stocks.

Having current and reliable information on northern anchovy will allow the Council to act with more certainty in setting catch levels that provide for sustainable fishing activity as well as adequate forage for marine wildlife. Having this information will also further advance the transition to ecosystem-based fishery management by giving resource managers a clearer picture on ocean conditions, forage availability, food web dynamics and ultimately how our fisheries impact and are impacted by the ecosystem. In the absence of this kind of information, an ecosystem-based approach calls for managers to act with a high level of precaution, as we are requesting here. Once sufficient information is available and utilized, the Council will be able to manage with a higher degree of certainty and reduce the level of precaution needed to ensure achievement of its ecosystem goals and objectives. In closing, it is for these reasons we are requesting that the Council and the NMFS NW Region begin to shift additional attention and resources to data collection, scientific research, assessment, and management of northern anchovy.

Thank you in advance for your time and consideration. We look forward to continuing to work with the Council to ensure a healthy ocean and sustainable fisheries.

Sincerely,

Steve Marx
Senior Associate, U.S. Oceans, Pacific
The Pew Charitable Trusts
smarx@pewtrusts.org

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL REPORT ON ESTABLISHING MAXIMUM SUSTAINABLE YIELD (MSY) REFERENCE POINT FOR NORTHERN ANCHOVY

The Coastal Pelagic Species Advisory Subpanel (CPSAS) and Coastal Pelagic Species Management Team (CPSMT) received a joint briefing from National Marine Fisheries Service (NMFS) staff and reviewed Agenda Item E.3.a, Supplemental Attachment 1: NMFS Report. The briefing and the NMFS report both highlighted the challenges of establishing a maximum sustainable yield (MSY) for a fishery with limited catch, biological, and productivity data. These data constraints have also been discussed during previous Council meetings.

Reviewing the alternatives presented in the NMFS report, the CPSAS supports Option 3, the MSY first recommended by the Scientific and Statistical Committee in November, 2010. This alternative uses the default fishing mortality rate for Pacific mackerel of 0.3 as an MSY proxy for the northern subpopulation of northern anchovy. During our joint discussion with the CPSMT, it was noted that anchovy are more productive than Pacific mackerel, so although biological data is limited, this MSY is conservative.

The future possibility of mining additional biological data from existing data sets was discussed. At present however, setting F_{MSY} equal to 0.3 for anchovy represents the best available science.

PFMC
11/01/13

Agenda Item E.3.c
Supplemental CPSMT Report
November 2013

COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON MAXIMUM SUSTAINABLE YIELD (MSY) REFERENCE POINT FOR NORTHERN ANCHOVY

The Coastal Pelagic Species Management Team (CPSMT) reviewed a report from the National Marine Fisheries Service (NMFS) (Agenda Item E.3.a, Supplemental Attachment 1, NMFS Report) to the Council regarding the legal judgment necessitating action by the Council. In that document, NMFS proposed the Scientific and Statistical Committee-recommended F_{msy} of 0.3 for the northern subpopulation of northern anchovy. The CPSMT supports the use of an F_{msy} of 0.3 to specify maximum sustainable yield (MSY) for the northern stock of northern anchovy. The CPSMT also supports the regulatory process outlined by the June 2013 NMFS letter to the Council.

PFMC
11/02/13

Ms. Dorothy M. Lowman
Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Agenda Item E.3, Establish Maximum Sustainable Yield (MSY) Reference Point for Northern Anchovy

Dear Chair Lowman and Council Members:

I am writing on behalf of Greenburger's, a restaurant that prides itself on the use of sustainably sourced, local products to create classic American fare. At Greenburger's, we aim to be as eco-conscious as possible, paying special attention to every detail, from the décor, to the condiment bar, to the hand soap in the bathroom made from glycerin derived from recycled kitchen grease. This is why we understand the importance of sustainable fishing advocacy and the need to maintain a healthy and productive Pacific Ocean. I write to urge the Pacific Fishery Management Council to establish a Maximum Sustainable Yield (MSY) reference point for the northern subpopulation of northern anchovy and to prioritize data collection, scientific research, and management of northern anchovy.

Northern anchovy is a keystone forage species in the California Current Ecosystem and is preyed upon by a wide variety of marine wildlife, including commercially and recreationally valuable fish, mammals, and seabirds. Furthermore, while northern anchovy is not actively managed, there is a significant U.S. fishery that produces catches, which have ranged between 2,000-20,000 metric tons per year over the past 15 years. As catches of Pacific sardine continue to decrease, more fishing efforts will shift toward northern anchovy. The Council must act now to set a MSY reference point for northern anchovy in a way that leaves enough food in the ocean to support the broader ecosystem.

Setting these ecosystem-based MSY reference points will require current and reliable information on the status of the northern anchovy population. However, the last time managers measured the population was in 1995. A lot can change in two decades, which is why we need up-to-date science. Therefore, we request that the Council and the National Marine Fisheries Service begin to shift additional resources to data collection, scientific research, assessment, and management of northern anchovy. Robust

information on forage species like northern anchovy is critical to ensuring that we leave enough in the water to sustain predators and support a well functioning ecosystem.

Thank you for your time and attention to this matter. We appreciate your stewardship of our marine resources and the work you do to maintain healthy oceans and sustainable fisheries.

Respectfully yours,

Stefanie Nudelman, CEO
Greenburger’s

ENDANGERED HABITATS LEAGUE
DEDICATED TO ECOSYSTEM PROTECTION AND SUSTAINABLE LAND USE

October 21, 2013

Ms. Dorothy M. Lowman, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Agenda Item E.3, Establish Maximum Sustainable Yield (MSY) Reference Point for Northern Anchovy

Dear Chair Lowman and Council Members:

I am writing on behalf of the Endangered Habitats League (EHL), a non-profit organization dedicated to ecosystem protection and sustainable land use. As Southern California's only regional conservation group, EHL has led the way in establishing an unprecedented, interconnected system of nature reserves. By focusing on science-based priorities, we continue the monumental work of preserving our natural heritage for future generations. We understand the importance of sustainable fishing advocacy and the need to maintain a healthy and productive Pacific Ocean. That is why I write to urge the Pacific Fishery Management Council to establish a Maximum Sustainable Yield (MSY) reference point for the northern subpopulation of northern anchovy and to prioritize data collection, scientific research, and management of northern anchovy.

Northern anchovy is a keystone forage species in the California Current Ecosystem and is preyed upon by a wide variety of marine wildlife, including commercially and recreationally valuable fish, mammals, and seabirds. Furthermore, while northern anchovy is not actively managed, there is a significant U.S. fishery that produces catches, which have ranged between 2,000-20,000 metric tons per year over the past 15 years. As catches of Pacific sardine continue to decrease, more fishing efforts will shift toward northern anchovy. The Council must act now to set a MSY reference point for northern anchovy in a way that leaves enough food in the ocean to support the broader ecosystem.

Setting these ecosystem-based MSY reference points will require current and reliable information on the status of the northern anchovy population. However, the last time managers measured the population was in 1995. A lot can change in two decades, which is why we need up-to-date science. Therefore, we request that the Council and the National Marine Fisheries Service begin to shift additional resources to data collection, scientific research, assessment, and management of northern anchovy. Robust information on forage species like northern anchovy is critical to ensuring that we leave enough in the water to sustain predators and support a well functioning ecosystem.

Thank you for your time and attention to this matter. We appreciate your stewardship of our marine resources and the work you do to maintain healthy oceans and sustainable fisheries.

Sincerely,

Dan Silver
Executive Director

EARTHJUSTICE

OCEANA | Protecting the World's Oceans

October 21, 2013

Dorothy Lowman, Chair
Pacific Fishery Management Council
1100 NE Ambassador Place, #101
Portland, OR 97220

RE: Establishment of Maximum Sustainable Yield and other required management measures for Northern Anchovy

Dear Ms. Lowman and Council Members:

Oceana and Earthjustice request that the Council initiate an amendment process for the Coastal Pelagic Species Fishery Management Plan ("CPS FMP") to establish a maximum sustainable yield ("MSY") for the northern subpopulation of northern anchovy and to establish other required status determination criteria and biological reference points. In addition, the Council should request that the agency complete an updated stock assessment for northern anchovy, request the National Marine Fisheries Service ("NMFS") set an Annual Catch Limit for the fishery, and remove the antiquated "active" vs. "monitored" distinction in the CPS FMP.

Northern anchovy are a critical source of food for many marine predators in the California Current ecosystem, including humpback whales, porpoises, California brown pelicans, sea lions, seals, and others. They also play a significant role in the diets of managed fish species in the salmon, groundfish and highly migratory species Fishery Management Plans. Anchovy are important prey for species like Chinook and coho salmon, albacore, bluefin tuna, thresher sharks, and many rockfishes, such as rougheye rockfish and black rockfish.

Given the species' ecological importance and the likelihood that fishing effort on anchovies is likely to increase in the near future as the sardine population declines, it is critical that the Council establish all necessary management measures and that the agency update the science underlying those management measures. Doing so will bring northern anchovy management into compliance with the law. Taking these steps is necessary to prevent overfishing of anchovy and to ensure that the fishery is managed in a sustainable manner that accounts for the needs of marine predators and other commercial and recreational fisheries.

The CPS FMP currently lacks several management measures for northern anchovy that are required by the Magnuson-Stevens Fishery Conservation and Management Act ("MSA") and its implementing regulations. The FMP does not specify a maximum sustainable yield ("MSY") or MSY proxy, optimum yield, or a minimum stock size threshold ("MSST"). In a recent decision, the Northern District of California held that the failure to include an MSY proxy in Amendment 13 to the CPS FMP violated the MSA and ordered NMFS to develop and implement this measure. *Oceana, Inc. v. Blank, et al.*, Case No 3:11-cv-06257-EMC (N.D. Cal. April 12, 2013). While the court did not reach substantive claims regarding the failure to assess and specify OY

or establish MSST for northern anchovy, these measures must, by law, be included in the CPS FMP.

The MSA requires that the CPS FMP assess and specify MSY and OY for all stocks in the fishery, including northern anchovy.[1] NMFS regulatory guidelines clarify that the FMP must specify MSY, or "other measures of reproductive potential, based on the best scientific information available, that can serve as reasonable proxies for MSY, F_{MSY}, or B_{MSY}, to the extent possible."[2] Interactions with other stocks should be taken into account when establishing MSY and "because MSY values are estimates or are based on proxies . . . the degree of uncertainty in the estimates should be identified, when possible, through the stock assessment process and peer review . . . ."[3] Where uncertainty cannot be calculated (such as when proxies are used), "a proxy for the uncertainty itself should be established based on the best scientific information, including comparison to other stocks."[4]

"Optimum yield" is equivalent to maximum sustainable yield from the fishery, "as reduced by any relevant economic, social, or ecological factor."[5] Because careful management of forage species is critical to sustaining ecosystems like the California Current Ecosystem, the National Standard 1 regulations specify that managers must pay serious attention to "maintaining adequate forage for all components of the ecosystem" and maintaining ecological processes.[6] Furthermore, "[e]ven where quantification of . . . ecological factors is not possible, the FMP still must address them in its OY specification."[7]

The MSA further requires FMPs to include "objective and measurable criteria for identifying when the fishery to which the plan applies is overfished" as well as an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks in that fishery.[8] The National Standard 1 guidelines further specify the criteria that fishery management councils "must" include in their FMPs and FMP amendments in order to provide clear measures for determining when a stock is overfished, experiencing overfishing, or approaching an overfished condition.[9] These required measures, known as status determination criteria ("SDCs"), include minimum stock size thresholds.

Having these measures specified within the CPS FMP is not only required by law, it is beneficial to the fishery and the ecosystem. Experience with Pacific sardines and northern anchovy has shown that these forage species are easily mismanaged; fishing pressure has accelerated natural declines, slowed recovery, and kept the population from realizing its potential. The lack of an

[1] 16 U.S.C. § 1853(a)(3).
[2] 50 C.F.R. § 600.310(e)(1)(iv). MSY is "the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g. gear selectivity), and the distribution of catch among fleets." 50 C.F.R. § 600.310(e)(1)(i).
[3] 50 C.F.R. § 600.335(e)(1)(iv).
[4] *Id.*
[5] 16 U.S.C. § 1802(33) (emphasis added).
[6] 50 C.F.R. § 600.310(e)(3)(iii)(C).
[7] 50 C.F.R. § 600.310(e)(3)(iv).
[8] 16 U.S.C. § 1853(a)(10).
[9] 50 C.F.R. § 600.310(c).

overfished threshold poses a serious conservation risk, because without it, fishery managers have no benchmark for determining when a population is overfished. This means that rebuilding plans will not be developed for depleted species, and adequate management attention will not be given to those species. Moreover, failing to specify a reasonable MSY or MSY proxy prevents the accurate specification of OY. The absence of an adequately assessed and specified OY makes it impossible to determine whether northern anchovy catch levels account for the species' ecological and economic importance as prey for marine predators and other commercially fished species.

Therefore, the CPS FMP must be amended to assess and specify all of these required measures for northern anchovy. The Council may not forego specifying an MSST for northern anchovy—or any other species in the fishery—on the basis that the species is "monitored" instead of "managed". This distinction has no basis in the law. Neither the MSA nor the National Standard 1 guidelines allow for the "monitored" category of stocks in the fishery. NMFS regulations state that "[a]s a default, all stocks in an FMP are considered to be 'in the fishery' unless they are identified as [ecosystem component] species through an FMP amendment process."[10] They further state that FMPs must include status determination criteria, as well as MSY and OY specifications, for all stocks in the fishery.[11] Therefore, we request the Council remove the antiquated distinction between "active" and "monitored" species in the FMP altogether and instead manage all stocks "in the fishery" as required under the MSA.

Unfortunately, available science on the current status and productivity of northern anchovy is woefully outdated and incomplete. Current anchovy management recommendations are based on decades-old data and an unverified assumption with no supporting analysis that anchovy exhibit similar productivity to Pacific mackerel.[12] As you know, the CPS FMP was originally the Northern Anchovy FMP, and it contained management benchmarks such as a CUTOFF biomass to account for the importance of northern anchovy to their predators. Now we have other useful guides like the Lenfest Forage Fish Task Force recommendations for how to manage forage species with low levels of information, including severely restricting fishing so that depletion caused by fishing is no more than 20% of the unfished population.[13] This background could serve as a starting point for the tasks currently before the Council.

Given that this species is both vitally important to the California Current food chain and the subject of increasing fishing effort, it is critical to update the science upon which management measures are based. We therefore request that NMFS and the Council complete an updated stock assessment for northern anchovy. In the meantime, establishing MSA-required reference points—MSY, OY, and MSST—for this stock should be completed immediately using the best available information. These reference points could be updated in the future if new biological information becomes available.

[10] 50 C.F.R. § 600.310(d)(1).
[11] 50 C.F.R. § 600.310(c)(1-6).
[12] PFMC November 2010. Agenda Item I.2.c Supplemental SSC Report. The SSC comments that "anchovy are likely to be as productive as Pacific mackerel" but provides no supportive information or analysis.
[13] Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D., Plagányi, É., Sainsbury, K., and Steneck, R.S. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.

Moreover, there is no Annual Catch Limit specified for the fishery, and therefore the crucial means to prevent overfishing is not in place. If this and other fundamental fishery management requirements cannot be established, the fishery should be closed.

We strongly encourage the Council to use the upcoming FMP amendment process to establish an updated, scientifically sound, and legally compliant management framework for the northern anchovy fishery. While the court order only compels the establishment of MSY for the species, specification of OY and MSST are required by law and necessary to prevent overfishing and account for ecological, economic, and social needs. Establishing these required measures as part of a single FMP amendment will provide an orderly, efficient process and produce a more cohesive management framework. Moreover, the time is ripe for bringing northern anchovy management into the 21st century. The increasing ecological importance of northern anchovy and the potential for increasing fishing pressure make it all the more necessary to ensure that northern anchovy management is based on sound science and fully accounts for ecosystem needs.

We appreciate your time and consideration, and look forward to discussing these matters with you further.

Sincerely,

Andrea A. Treece

Staff Attorney, Oceans Program
Earthjustice
50 California Street, Suite 500
San Francisco, CA 94111

Ben Enticknap

Pacific Campaign Manager & Senior Scientist
Oceana
222 NW Davis Street, Suite 200
Portland, OR 97209

Ms. Dorothy M. Lowman
Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Agenda Item E.3, Establish Maximum Sustainable Yield (MSY) Reference Point for Northern Anchovy

Dear Chair Lowman and Council Members:

I am a second generation Marine Ecologist - my father, Garth I Murphy, was the founding coordinator of CALCOFI and instrumental in introducing the word ECOLOGY into fisheries management. He was personally involved in research on maximum sustainable biomass of the Pacific Sardine and the 18 year moratorium required to get that biomass to its current level, which is about 10 per cent of historic highs of 600,000 metric tons.

I worked for two years on the Marine Life Protection Act Initiative South Coast project, an eye opening exercise in marine ecosystem interdependencies: everything connected and every disconnect we make a mistake and counterproductive.

I am very concerned about the state of fish stocks in the California Current and worldwide. At 68 I have personally witnessed drastic falls in populations of all species, and especially those commercially harvested by seining and other net sets. I have witnessed the disappearance of sardines from the Sea of Cortez, caught in nets and boats left over from the destroyed shrimp industry, essential forage fish mostly sold for pig food to grow more profitable pork in Sinaloa and Sonora states.

It is a fool's game to expect ocean biomass of commercial fish species to recover without immediate measures to protect all parts of the Marine Food Web. We need immediate cross-ecosystem action in order to halt and reverse the steady but not inevitable decline of the natural abundance of marine ecosystems and the California Current.

I write to urge the Pacific Fishery Management Council to establish a Maximum Sustainable Yield (MSY) reference point for the northern subpopulation of northern anchovy and to prioritize data collection, scientific research, and management of northern anchovy.

Northern anchovy is a keystone forage species in the California Current Ecosystem and is preyed upon by a wide variety of marine wildlife, including commercially and recreationally valuable fish, mammals, and seabirds. Furthermore, while northern anchovy is not actively managed, there is a significant U.S. fishery that produces catches, which have ranged between 2,000-

20,000 metric tons per year over the past 15 years. As catches of Pacific sardine continue to decrease, more fishing efforts will shift toward northern anchovy. The Council must act now to set a MSY reference point for northern anchovy in a way that leaves enough food in the ocean to support the broader ecosystem.

Setting these ecosystem-based MSY reference points will require current and reliable information on the status of the northern anchovy population. However, the last time managers measured the population was in 1995. A lot can change in two decades, which is why we need up-to-date science. Therefore, we request that the Council and the National Marine Fisheries Service begin to shift additional resources to data collection, scientific research, assessment, and management of northern anchovy. Robust information on forage species like northern anchovy is critical to ensuring that we leave enough in the water to sustain predators and support a well functioning ecosystem.

The stronger an ecosystem management stance you take, the more efficient and productive your management efforts will be, and the quicker the general marine ecosystem will revert to its historic natural state of abundance, which I presume is the goal of the PFMC.

Thank you for considering my comments and for your continued commitment to a permanently productive marine fisheries ecosystem.

Sincerely,

Garth Murphy, Founder
Integrated Ecosystems Management
649 South Vulcan Avenue
Encinitas, CA 92024

MISO HARNEY sushi

3964 Harney St. San Diego, Ca 92110 619.295.3272 Fax 619.295.0727
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www.HarneySushi.com

Ms. Dorothy M. Lowman
Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Agenda Item E.3, Establish Maximum Sustainable Yield (MSY) Reference Point for Northern Anchovy

Dear Chair Lowman and Council Members:

As a master sushi chef and the founder of Harney Sushi Corporation, which has recreated the sushi industry experience over the past 10 years, I am committed to providing my customers with sustainable fish, never compromising taste or quality. With two restaurant locations in San Diego and Oceanside, my team and I have fostered relationships to ensure that we are educating our diners and developing a local economy and culture of sustainable seafood. We understand that maintaining a healthy, balanced, and productive Pacific Ocean is everyone's responsibility.

This is why I write to urge the Pacific Fishery Management Council to establish a Maximum Sustainable Yield (MSY) reference point for the northern subpopulation of northern anchovy and to prioritize data collection, scientific research, and management of northern anchovy.

Northern anchovy is a keystone forage species in the California Current Ecosystem and is preyed upon by a wide variety of marine wildlife, including commercially and recreationally valuable fish, mammals, and seabirds. Furthermore, while northern anchovy is not actively managed, there is a significant U.S. fishery that produces catches, which have ranged between 2,000-20,000 metric tons per year over the past 15 years. As catches of Pacific sardine continue to decrease, more fishing efforts will shift toward northern anchovy. The Council must act now to set a MSY reference point for northern anchovy in a way that leaves enough food in the ocean to support the broader ecosystem.

Setting these ecosystem-based MSY reference points will require current and reliable information on the status of the northern anchovy population. However, the last time managers measured the population was in 1995. A lot can change in two decades, which is why we need up-to-date science. Therefore, we request that the Council and the National Marine Fisheries Service begin to shift additional resources to data collection, scientific research, assessment, and management of northern anchovy. Robust information on forage species like northern anchovy is critical to ensuring that we leave enough in the water to sustain predators and support a well functioning ecosystem.

We look forward to the Council taking positive action that gives us the security of knowing we can rely on a healthy ocean to provide an economic engine for years to come. Thank you for your stewardship of our marine resources.

Respectfully yours,

Dustin Summerville, President
Harney Sushi Restaurants

Audubon CALIFORNIA

Dorothy Lowman, Chair
Pacific Fishery Management Council
1100 NE Ambassador Place, #101
Portland, OR 97220

October 21, 2013

Dear Ms. Lowman and Council Members,

On behalf of Audubon California and our more than 150,000 members and supporters, and Shearwater Journeys, we are writing to urge the Council to focus enhanced attention on northern anchovy. We specifically request the Council initiate management for this fishery as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and its implementing regulations. This would include conducting a full stock assessment in order to develop an ecosystem-based Optimal Yield (OY) approach for anchovy. Furthermore, because an Annual Catch Limit has not been established for the fishery, the crucial means to prevent overfishing is not in place. Until these basic requirements of MSA are met, we believe commercial fishing on this essential prey species should be discontinued.

Importance of anchovy to predators

Increased Council attention on anchovy is essential to managing the CPS forage assemblage with an ecosystem-based approach. The Council's Fishery Ecosystem Plan notes:

… the greatest proportion of energy flow in the California Current Ecosystem appears to be through krill, market squid, northern anchovy, Pacific sardine and Pacific herring.

The undersigned owner of Shearwater Journeys has been leading pelagic trips in Monterey Bay and throughout California since 1976, and notes that in years when anchovies appear in central California (tending to arrive in June or later) they support incredible assemblages of wildlife. For example, 100 or more humpback whales were seen feeding on "a wall of anchovies" in Monterey

Bay in September of this year. Shearwater Journeys and many other regional businesses are supported directly or indirectly by the presence of anchovies and subsequent aggregation of marine wildlife and large fish.

A growing number of predator/prey studies describe the importance of anchovy across seasons and taxa. Anchovy is of extremely high importance to predators due its small size, inshore distributions, and year-round availability. More than 50 predator species in the CCS consume anchovy.[1] The seasonal diet of Chinook salmon in California, for example, can be over 90 percent anchovy in some years.[2] Marine birds use a diversity of prey items across seasons and geographies, however, anchovy, together with juvenile rockfish, can reasonably be described as the most important single prey species for the millions of breeding and visiting seabirds in Mexico through Oregon. Numerous seabirds including brown pelicans, short-tailed, sooty, Buller's, flesh-footed, pink-footed, and black-vented shearwaters,[3]common murres, rhinocerous auklets, Craveri's murrelet, Scripps's murrelet, and California least tern all rely on anchovy for one or more seasons of the year.[4,5,6]

Anchovies must be actively managed

We understand that regulations have not been issued by NMFS to establish a harvest quota or a cutoff for the anchovy fishery in either subpopulation. This is due to the fact that the fishery is assigned to the "Monitored" rather than "Active" Category in the Coastal Pelagic Species Fishery Management Plan (CPS FMP). Yet, this is clearly an active fishery. Since 2001 landings of the combined subpopulations of anchovy have ranged between 2000-20,000 mt/year over the last 15 years.[7] In its Situation Summary for agenda item E.3, NMFS describes an Overfishing Limit (OFL) of 39,000 mt and an Acceptable Biological Catch (ABC) of 9750 mt for the northern subpopulation. The CPS FMP states that:

Any stock supporting catches approaching the ABC levels should be actively managed unless there is too little information available or other practical problems.

The CSP FMP also provides a "point of concern framework" which is "the Council's primary tool (along with setting HGs, ACLs, ACTs, or harvest quotas) for exercising resource stewardship responsibilities."

The process is intended to foster continuous and vigilant review of Pacific Coast CPS stocks and fisheries. The process is also to prevent overfishing or any other resource damages. The CPSMT will monitor the fishery throughout the year, and account for any new information on status of each species or species group to determine if a resource conservation or ecological issue exists… The Council may act quickly and directly to address resource conservation or ecological issues. …A "point-of-concern" occurs when one or more of the following is found or expected (among others):

- *Any adverse or significant change in the biological characteristics of a species (age composition, size composition, age at maturity, or recruitment) is discovered.*
- *Any adverse or significant change in ecological factors such as the availability of CPS forage for dependent species or in the status of a dependent species is discovered.*

There is evidence both these criteria are being met. First, while there are no recent stock assessments and virtually no information on the status of either subpopulation of northern anchovy, limited data suggest that stocks are depressed. Larval anchovy have been generally

declining in the CalCOFI survey for the past 20 years[8], and have been nearly absent in these trawl surveys in central California region since 2008[9]. As noted below, adult anchovies have been absent from the diets of breeding brown pelicans in the southern California bight in the last five years. Anecdotally, the undersigned (D. Shearwater) notes that anchovies "disappeared" from central California in 2008 and this year, 2013, is the first year they seem to have "reappeared" (again, in late June) at a scale that can be detected by casual observers focused on wildlife aggregations associated with schools of anchovy. This underscores the critical need for a stock assessment.

Second, there appears to be dramatic change in the availability of CPS forage for dependent species, due to the dearth of anchovies and sardines in recent years. Brown pelicans, for example, are heavily dependent on abundance and/or availability of anchovies during the prebreeding and breeding periods. [10,11]Anchovies comprised 33% -100% of the diets of breeding pelicans in six years of surveys that took place at the U.S. Channel Islands between 1991-2005, including two years where anchovies comprised 100% of the diet.[12] Sardines comprise the rest of the diet of these birds.

Biologists at Channel Islands National Park, the only U.S breeding colony for the species, have noted a general decline in reproductive success since 2010, culminating in near-total nesting failure in 2012 and a likely nesting failure in 2013, according to preliminary data.[13] Biologists have noted that in the absence of contaminant, disease, or disturbance effects, local prey availability during the breeding season is most likely the primary driver of the these reproductive failures.[14]

Furthermore, National Marine Fisheries Service scientists have recently reported that sardines are in a collapsed condition,[15] and in central California, sardines have been scarce since 2010.[16] Yet, the Pacific Fisheries Management Council has a statutory responsibility to ensure a forage reserve for brown pelicans. The Federal Register notice of removal of the brown pelican from the Endangered Species List notes that:

The Coastal Pelagic Species Management Plan (CPSMP) will continue to ensure that adequate forage is available to pelicans if economic conditions change and northern anchovies become more intensively fished. The CPSFMP will also ensure that other forage fishes used by pelicans, such as Pacific sardines and Pacific mackerel, are also managed to preserve adequate forage reserves…food supplies are assured by the CPSFMP.[17]

Clearly, the U.S. Department of the Interior, acting through the U.S. Fish and Wildlife Service, expects NMFS and the Council to ensure the adequacy of the forage needs of brown pelicans via maintaining stocks of sardine and anchovy.

Optimum yield under MSA

We recommend the Council adopt an Optimum Yield (OY) approach for anchovy that explicitly accounts for its role as prey for a wide suite of other fishery species and wildlife. OY is defined by MSA Section 3(33) which defines "optimum," with respect to the yield from a fishery, as the amount of fish that "is prescribed on the basis of MSY from the fishery, as reduced by any

relevant social, economic and ecological factors." In the case of anchovy, "economic and ecological factors" include the foundational importance of anchovy as prey for economically valuable species such as salmon, tuna, whales and seabirds. Data is available to integrate energetic considerations of predators into an OY approach for developing status determination criteria. Peer-reviewed methodologies are available for managing forage fish, especially the Lenfest recommendations which include approaches such as establishing cutoffs when stock levels fall to 20% or 40% of unfished biomass (Bo).[18]

Thank you for your time and attention, and for your work in advancing ecosystem-based fishery management. Our members, supporters and clients are passionate about marine birds and other marine wildlife, and are very interested in precautionary management of forage stocks including anchovy. We look forward to continued engagement on this issue.

Sincerely,

Anna Weinstein
Seabird and Marine Program Manager

Debra Shearwater
President, Shearwater Journeys

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[1] Thayer, JA, AI Szoboszlai, WJ Sydeman (In prep) California Current predator diet database.
[2] Thayer, J.A., *et al.* (In review) Changes in California Chinook salmon diet over the past 50 years: Relevance to the recent population crash. *Mar Ecol Prog Ser.*
[3] Lyday, S. et al. 2013. Shearwaters as ecological indicators: towards predicting fish catch in the California Current. https://app.box.com/s/o3cf5a2xssm3qvu19r9q/1/1161890651/10450888935/1
[4] Thayer et al. (i) ibid.
[5] Sydeman, W. et al. 2001. Climate change, reproductive performance and diet composition of marine birds in the southern California Current system, 1969–1997. Progress in Oceanography 49: 309–329
[6] Thayer, J. et al. 2008. Forage fish of the Pacific Rim as revealed by diet of a piscivorous seabird: synchrony and relationships with sea surface temperatureCan. J. Fish. Aquat. Sci. 65: 1610–1622
[7] PFMC. June 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches; Stock Assessment and Fishery Evaluation 2011. SAFE Tables, Appendix A.
[8] Hsieh, C.H., et al. (2005) A comparison of long term trends and variability in populations of larvae of exploited and unexploited fishes in the Southern California region: a community approach. *Prog Ocean* 67:160–185.
[9] Bjorkstedt, E. et al. 2012. State of the California Current 2011-2012: ecosystems respond to local forcing as La Nina wavers and wanes. CalCOFI Rep., Vol. 53.
[10] Anderson, D. et al. 1980. Brown pelicans as anchovy stock indicators and their relationships to commercial fishing. CalCOFI Rep., Vol. XXI, 1980.
[11] Anderson, D. et al. 1982. Brown pelicans: influence of food supply on reproduction. OIKOS 39: 23-31.
[12] Harvey, L. 2013. California Institute of Environmental Studies. California Brown Pelican reproductive decline on the Channel Islands colonies. Unpublished data. March.
[13] Harvey, L. Unpublished data.
[14] Harvey, L. 2013. Ibid.
[15] Zwolinski, J. and D. Demer. 2012. A cold oceanographic regime with high exploitation rates in the northeast Pacific forecasts a collapse of the sardine stock. Proceedings of the National Academy of Sciences (PNAS)109(11).
[16] Bjorkstedt, E. ibid.

[17] Federal Register / Vol. 74, No. 220 / Tuesday, November 17, 2009 / Rules and Regulations. 50 CFR 17 Endangered and Threatened Wildlife and Plants; Removal of the Brown Pelican (*Pelecanus occidentalis*) From the Federal List of Endangered and Threatened Wildlife; Final Rule.

[18] Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D., Plagányi, É., Sainsbury, K., and Steneck, R.S. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.

Comments on Northern Anchovy Management

Ben Enticknap

Geoff Shester

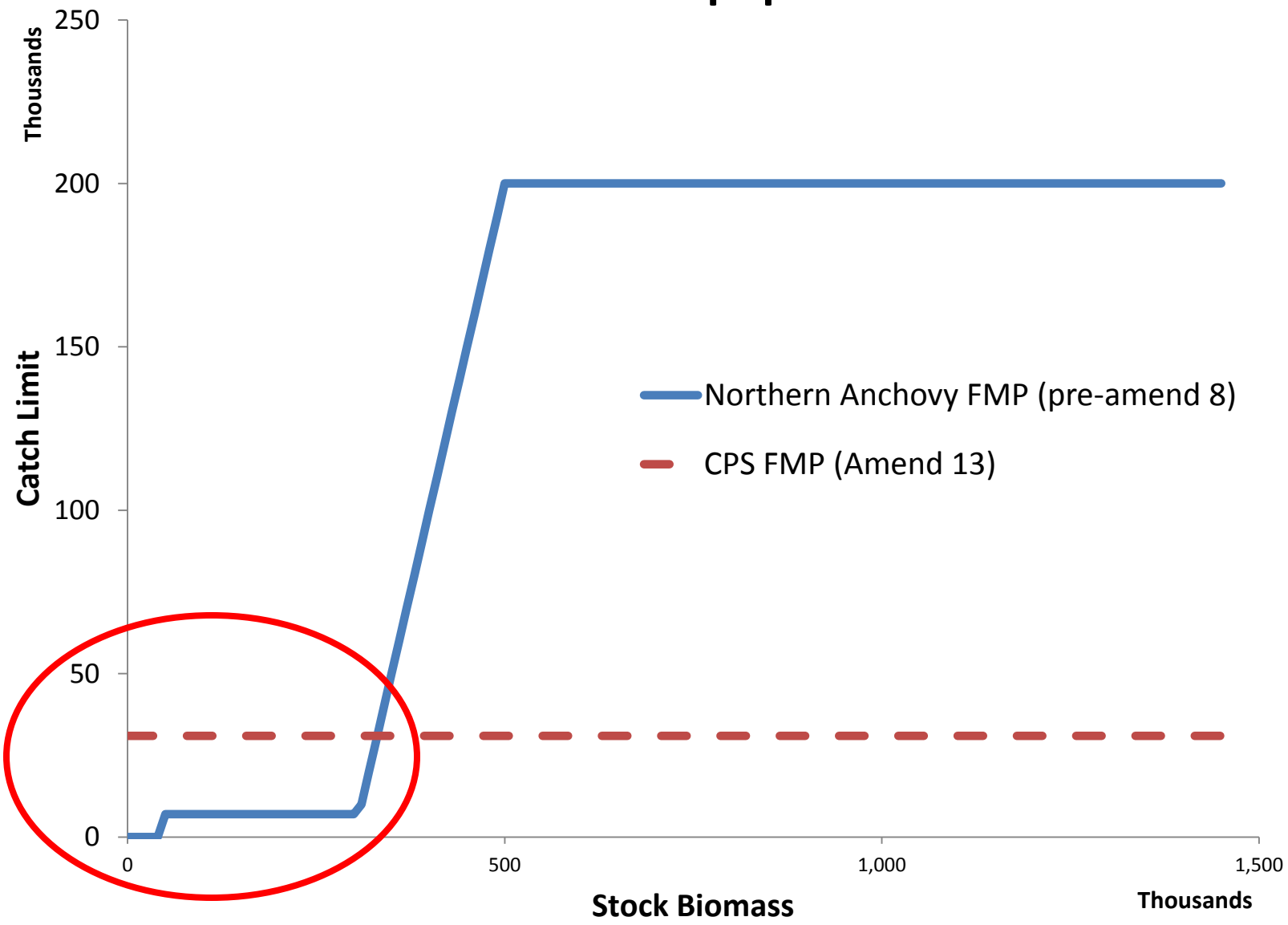
OCEANA | Protecting the World's Oceans

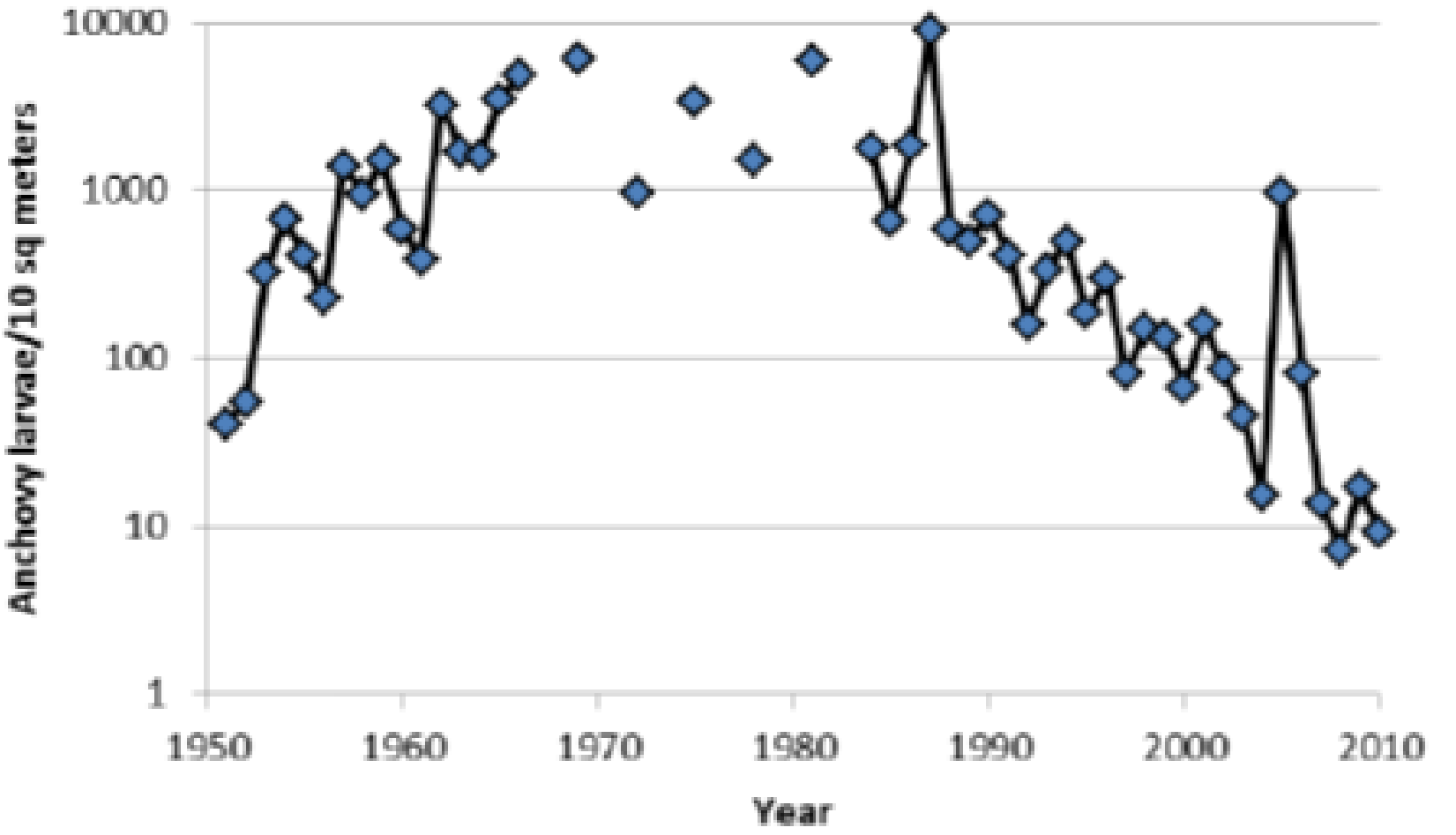
Table 3.2-1. CPS FMP specifications for Status Determination Criteria

	MSY	MFMT	MSST	ABC	OY
Pacific sardine	MSY control rule	Catch exceeding ABC	50,000 mt	Equal to MSY control rule calculation	Currently at or below MSY
Pacific (chub) mackerel	MSY control rule	Catch exceeding ABC	18,200 mt	Equal to MSY control rule calculation	Currently at or below MSY
N. anchovy Northern Subpop.	Not specified	Catch exceeding ABC	Not specified	25% of MSY Catch level	Not specified
N. anchovy Central Subpop.	Estimated at 123,000 mt	Catch exceeding ABC	50,000	25% of estimated MSY or 31,000mt 25,000mt in U.S.	Currently at or below ABC
Market squid	F_{MSY} resulting in egg escapement ≥ 30%	F_{MSY} resulting in egg escapement ≤ 30%	Not specified	F_{MSY} resulting in egg escapement ≥ 30% mt	107,049mt
Jack mackerel	Age/Area based potential yield	Catch exceeding ABC	Not specified	48,000 mt 31,000mt in U.S.	Currently at or below ABC
Krill or Euphausiids	Not specified	Not specified	Not specified	Not specified	0

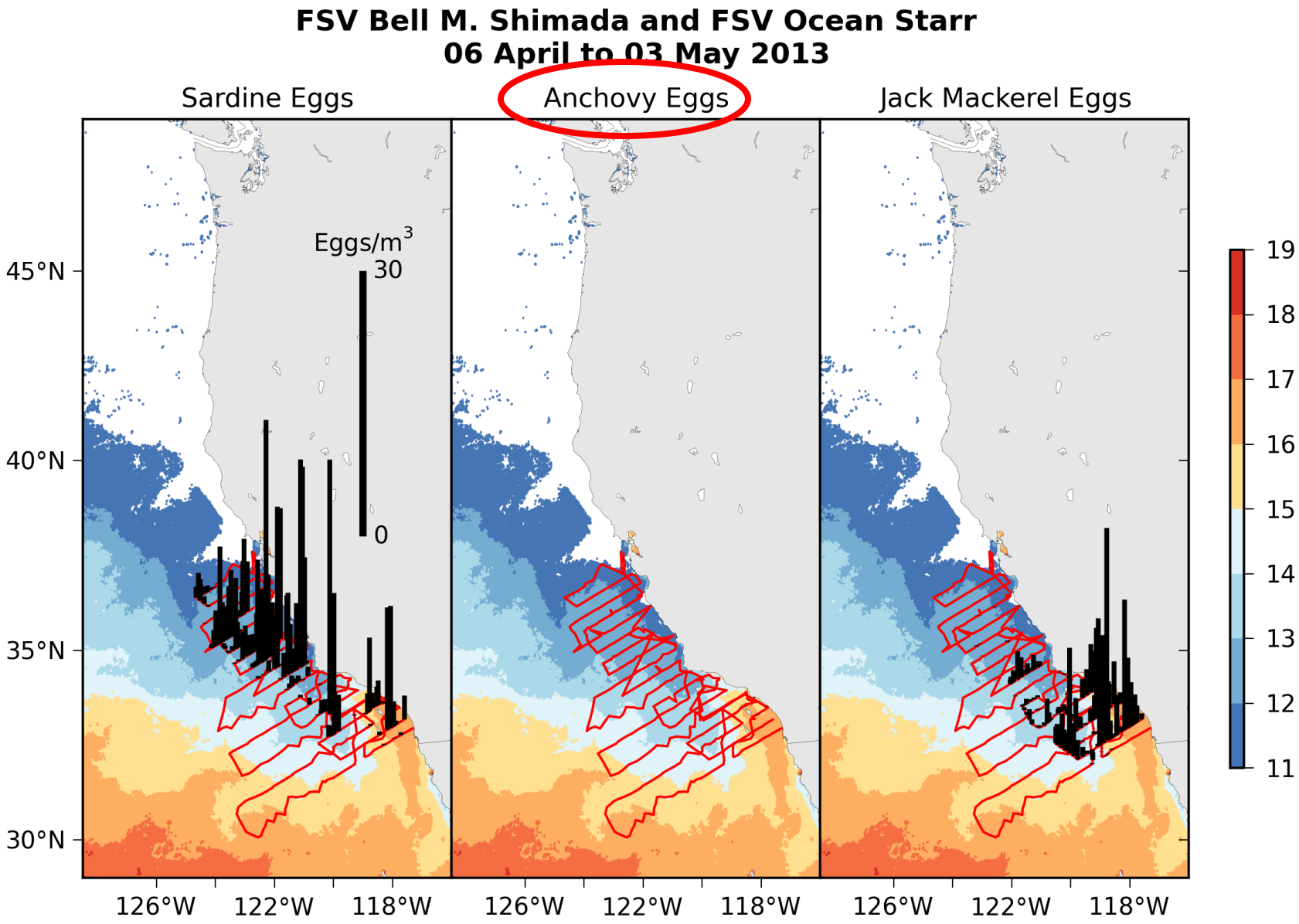
From CPS FMP Amend 13 EA

Harvest Rules for N. Anchovy Central Sub-population





CalCOFI, Southern California (Courtesy Alec MacCall)



From Nov 2013 NMFS Report

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON ESTABLISHING MAXIMUM SUSTAINABLE YIELD (MSY) REFERENCE POINT FOR NORTHERN ANCHOVY

No new scientific information relevant to establishing an maximum sustainable yield (MSY) for the northern subpopulation of northern anchovy is available, and so the Scientific and Statistical Committee (SSC) reiterates its recommendation from November 2010 that F_{MSY}=0.3. This is the default exploitation rate for Pacific mackerel, and is deemed appropriate because northern anchovy are likely to be at least as productive as Pacific mackerel, and likely have higher natural mortality, which would typically be associated with a higher F_{MSY}. The SSC notes that when used in the context of coastal pelagic species (CPS) management, F_{MSY} is an annual exploitation rate rather than an instantaneous fishing mortality rate.

Reference points for monitored CPS stocks such as the northern subpopulation of northern anchovy are difficult to determine due to limited data to estimate biomass and productivity. This subpopulation is currently lightly fished, with inconsistent effort, making the time series of catch an unreliable indicator of stock status. Due to both high uncertainty and large fluctuations in stock biomass, a fixed biomass-based or catch-based MSY is not meaningful.

F_{MSY} should be revisited if new information on productivity becomes available.

PFMC
11/01/13

METHODOLOGY PRELIMINARY TOPIC SELECTION AND REVIEW PROCESS

The Pacific Fishery Management Council's (Council) Terms of Reference (TOR) for Methodology Reviews adopted in early 2012 describes a procedure for considering new methodologies related to the assessment and management of coastal pelagic species (CPS) and groundfish. Although the TOR focuses on methodologies that are useful components for stock assessments, it can be used to consider other methods such as economic analyses and ecosystem-based fishery management.

For CPS topics, the TOR process calls for a 1-2 page proposal to be submitted by the methodology proponent, submitted for the briefing book of the "appropriate Council meeting." In recent years, this has occurred at November Council meetings. The proposal should include the title, the names of the principals, a statement of how the proposed methodology will improve assessment and management for the stocks in question, and an outline of the field and analytical methods. The proposal is reviewed by the Scientific and Statistical Committee, Coastal Pelagic Species Management Team (CPSMT), and Coastal Pelagic Species Advisory Subpanel (CPSAS), and the Council. If the Council approves the review of the proposed methodology, Council and NMFS staff will schedule a methodology review panel meeting, with the appropriate independent experts, plus a representative each from the CPSMT and the CPSAS. The panel will then submit a report its findings, for Council consideration.

At this meeting, one new methodology has been proposed by the California Department of Fish and Wildlife and California Wetfish Producers Association (Agenda Item E.4.a, Attachment 1), to establish an index of abundance for sardines in nearshore waters off southern California. If the proposal were endorsed by the Council, the timing of any review would be problematic for any results to be used in the next stock assessment under the new fishing year regime, as it is scheduled for Council adoption at the April 2014 Council meeting. However, should the Council endorse a review of this methodology and approve it by the June 2014 Council meeting, it may be useful for the next summer field season.

The proposed survey methodology arrives in the context of the February 2013 Pacific Sardine Harvest Parameters Workshop, which sought to address new information regarding the relationship between temperature and sardine productivity. The technical report that analyzes the potential change in temperature indices (from the Scripps Pier temperature index to the CalCOFI temperature index) will be considered by the Council at its March 2014 meeting.

Since the Council has adopted a new fishing year and stock assessment delivery timing, the Council may wish to formalize a new CPS methodology review process. Notably, the Council has scheduled consideration of a new groundfish methodology review process for the March 2014 Council meeting, with intent to see if it can mirror some of the salmon methodology review process successful features. As a possible aid in discussing guidance for the CPS methodology review process, Council staff has prepared a draft Council Operating Procedure that might be useful in assignments to the CPSMT and CPSAS for further consideration at a future meeting (Agenda Item E.4.a, Attachment 2).

At this meeting, the Council will consider one methodology proposal, and will consider the process for proposing and conducting methodology reviews.

Council Action:

1. **Consider topics for review.**
2. **Consider a CPS methodology review process for this and future management cycles.**

Reference Materials:

1. Agenda Item E.4.a, Attachment 1: *California Department of Fish and Wildlife/California Wetfish Producers Association proposal for Southern California Bight Aerial Survey*.
2. Agenda Item E.4.a, Attachment 2: Draft Council Operating Procedure 24.
3. Agenda Item E.4.c, Attachment 3, Public Comment.

Agenda Order:

a. Agenda Item Overview — Kerry Griffin
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action:** Consider Methodology Topics for Review and Provide Guidance on a Methodology Review Process

PFMC
10/11/13

Proposal for Methodology Review of the Southern California Bight Aerial Survey for Inclusion into the Pacific Sardine Stock Assessment

1. Title: Southern California Bight Aerial Survey (SCS)
2. Name of Proposers:
    a) California Department of Fish and Wildlife: Kirk Lynn.
    b) California Wetfish Producers Association: Diane Pleschner-Steele.
3. How the proposed methodology will improve assessment and management for the stock(s) in question: The SCS survey will provide information on the southern portion of the U.S. Pacific sardine stock, particularly the nearshore waters (within three miles) of the Southern California Bight (SCB). Since 2009, sardine stock assessments have incorporated aerial survey data, but these surveys have not covered nearshore southern California waters, although the core of the sardine population is thought to reside in the SCB. To date, nearshore abundance has been extrapolated from offshore acoustic surveys.
4. Outline of methods: The current survey design includes aerial transects spanning the Southern California Bight, and along the mainland (Santa Barbara to San Diego) and Channel Islands coastlines (Figure 1). Once sardines are sighted, school biomass is estimated and documented on log sheets. Photos are also taken with an automated camera system attached to a GPS, similar to the system used in the Northwest sardine aerial survey. Identification of species is validated by boat sampling. Aerial survey data will be used to determine a relative index of abundance.

Aerial Sardine Survey – Southern California Bight

Introduction

Pacific sardine is a transboundary resource within the California Current Ecosystem whose population center and recruitment are assumed to concentrate near the Southern California Bight (SCB) and Baja CA (Hill et al. 2012). Currently the Pacific sardine resource is assessed annually using a combination of field survey methods. These include daily/total egg production (DEP/TEP) and acoustic surveys conducted seasonally by the Southwest Fisheries Science Center (SWFSC), focused primarily in offshore waters in and around the SCB and along the central coast; and an aerial survey in the Pacific Northwest conducted since 2009 by the northwest sardine fishing industry (NWSS).

The NWSS aerial survey protocol (Jagielo et al. 2012) was adapted from the traditional spotter pilot index (Lo et al. 1992) covering the period 1985-2005; this index was dropped from the sardine stock assessments in 2007 in part because spotters were no longer flying routinely for the fleet in CA (Hill et al. 2007). In 2012, CWPA and CDFW agreed to collaborate on a new survey protocol, modifying the NWSS method by including the nearshore area (i.e., inside 3 miles) where young sardines (and anchovy) congregate in CA. If it is demonstrated that the sampled sardine are predominantly young recruits, the resulting index may serve as an index of recruitment. This new survey will add to the available data used in management of the fishery:

- Most of the CA sardine fishery takes place inside 3 miles from shore, while the NWSS survey expressly excludes the area inside 3 miles to avoid mistaking anchovy for sardine. Sardines behave differently in CA, where fish congregate near shore, versus the northwest, where they form feeding aggregations offshore. By including the nearshore, this survey restores the abundance index originally conducted by spotter pilots that was removed from recent stock assessments.
- This nearshore survey also provides for a better assessment of sardine (and other coastal pelagic species) in nearshore waters than extrapolations from acoustic measurements taken from greater than a few miles offshore.
- Providing an index of relative abundance in CA waters adds important information to complement the estimates of sardine biomass generated from other survey methods.
- An additional index of abundance in future stock assessments will improve biomass estimates and provide more confidence in management, both for sardine and potentially other coastal pelagic species (CPS), such as anchovy.

Methods

The survey area consists of sixteen open water transects originating from the mainland (Santa Barbara to San Diego) to the extent of the outer Channel Islands, as well as the coastlines of both the mainland and each of the

Channel Islands (Figure 1). Surveys began in summer (July-August) 2012 and have continued with spring (April-May) 2013 and summer (August-September) 2013 surveys. The 2012 design is represented by Group A (green). In 2013, open water transects were randomly chosen from 5 options: the 2012 design + 4 others based on offsetting the 2012 design by 3 nm increments. Group D (black) was selected for the spring 2013 survey, and Group A was again flown for the summer 2013 survey.

The basic method is to fly transects with an experienced spotter pilot observer looking to the right. When sardine (and beginning with summer 2013, other CPS) are identified and confirmed, the plane flies over the fish and photos are taken with the camera system set at 80 percent overlap. The camera system software records time, location, speed, altitude and other information with each image. CDFW staff also record on a log sheet the time and frame number when photos of fish are being taken, the observer-estimated number of schools and tonnage (including percent species composition of mixed schools), along with other relevant comments. Separate flights are paired with boat sampling of observed CPS schools from the air. These boat samples (via diver video, hook-and-line) are used to validate observer identification of species, and provide information on size and age structure of the observed fish.

After the schools are photographed, the log sheets are used to find the corresponding photos with schools. Once identified, these photos are then enhanced with Adobe Lightroom software, and the school areas are measured in Adobe Photoshop. The measured areas give information on relative density; in turn, adjusted for survey area coverage, this density information yields information on abundance. Separately, the observer estimates also provide information on school abundance and are used to derive point estimates of abundance. Over time, a generalized linear model (GLM) will be developed to analyze the data and serve as a predictive tool.

Results

Observation data from the summer 2012, spring 2013, and summer 2013 field seasons are summarized in Figure 2 and Table 1. The 2012 surveys were conducted from July 30 to August 17, the spring 2013 surveys from April 22 to May 21, and the summer 2013 survey from August 1 to October 4. Boat sampling results demonstrated accurate aerial identification of sardine and CPS.

Sardine school areas in photos from the summer 2012 season have been measured, with 12% of recorded observations corresponding to 76% of estimated tons matched with survey photos. These percentages were 24% and 78%, respectively, for the spring 2013 season. These rates are expected to increase with the summer 2013 data (as yet unanalyzed), when immediate post-survey flight reviews of fish observations with the observer were initiated.

Point estimates of abundance from observer tonnage estimates were 31,649 tons for summer 2012 and 12,280 tons for spring 2013. Summer 2013 data analyses are not complete yet. These estimates are based on observer coverage from the airplane (dependent on altitude and distance to shore) and total survey study area.

Relevance to management

Pacific sardines and anchovy are important species in the CPS management complex, and are a vital ecological component as forage species. These species are also very important to the CPS 'wetfish' industry and California's fishing economy. The goal of this collaborative research program is to determine an index of relative abundance by modifying existing aerial survey methods, coupled with the traditional spotter pilot index, to produce information of critical importance to improve sardine biomass estimates and trends in abundance. This survey can be useful to assess other CPS as well.

Effective assessment of nearshore sardine abundance, an important potential measure of recruitment, is currently missing from stock assessments. Providing an index of abundance in California, including the nearshore as well as offshore, is needed to forecast trends in population abundance, and can also be used to assess the sardine rate of migration between the population center in Southern CA and the Pacific Northwest.

References

Hill, K. T., E. Dorval, N. C. H. Lo, B. J.Macewicz, C. Show, and R. Felix-Uraga. 2007. Assessment of the Pacific sardine resource in 2007 for U.S. management in 2008. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-413. 178 p.

Hill, K. T., P. R. Crone, N. C. H. Lo, D.A. Demer, J.P. Zwolinski, and B. J. Macewicz. 2011. Assessment of the Pacific sardine resource in 2012 for U.S. management in 2013. Pacific Fishery Management Council, Nov 2012 Briefing Book, Agenda Item G.3.b. 193 p.

Jagielo, T. H., Howe, R., and M. Mikesell. 2012. Northwest Aerial Sardine Survey. Sampling Results in 2012. Prepared for Northwest Sardine Survey, LLC. Pacific Fishery Management Council, Nov 2012 Briefing Book, Agenda Item G.3.a. 82p.

Lo, N.C.H., Jacobson, L.D and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based On delta-lognormal models. Can. J. Fish. Aquat. Sci. 49: 2515-2526.

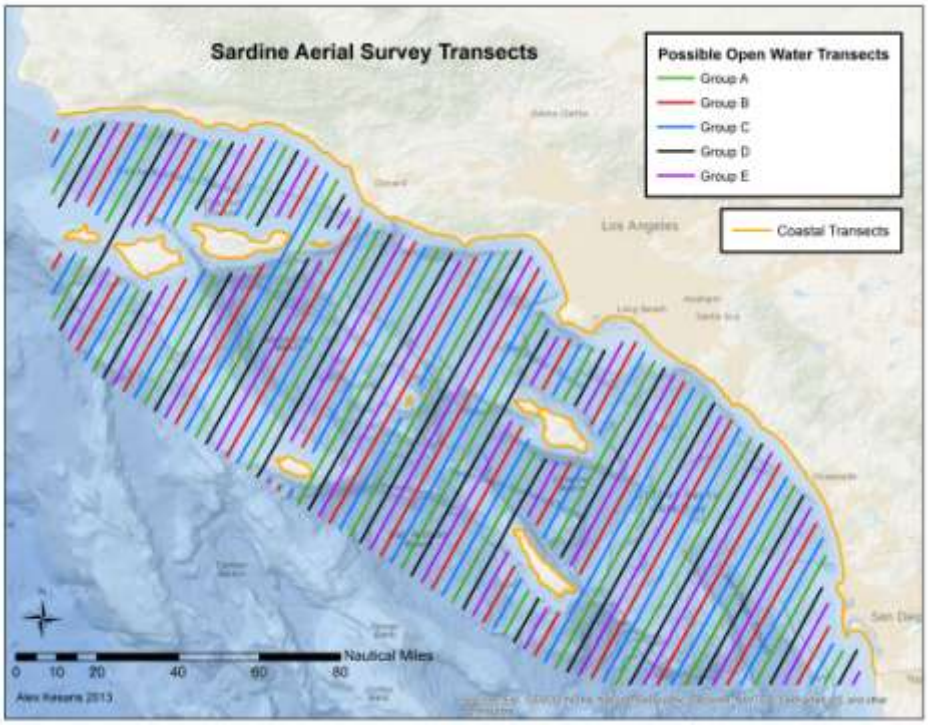


Figure 1. Survey design consisting of mainland and island coastal transects, and potential open water transects (one transect group randomly chosen each season).

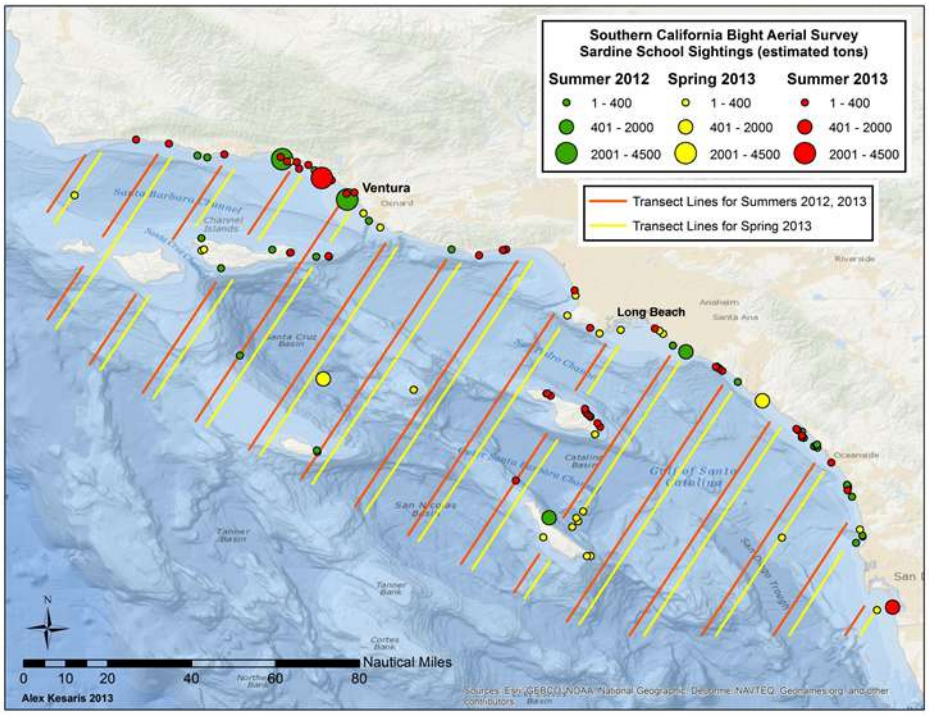


Figure 2. Sardine sightings from 2012 and 2013 surveys.

Table 1. Summary of field data from summer 2012, spring 2013, and summer 2013 seasons.

Summer 2012

Date	Est Tons	Est # Schools	Latitude	Longitude
7/30/2012	1200	NA	32.9666	-118.5086
8/6/2012	10	2	34.0327	-118.8959
8/6/2012	10	1	34.1464	-119.2244
8/6/2012	13	8	34.3466	-119.4394
8/6/2012	3000	65	34.3913	-119.5683
8/6/2012	15	1	34.3981	-119.8662
8/6/2012	5	1	34.4059	-119.9048
8/8/2012	5	2	32.8664	-117.2893
8/8/2012	25	1	32.8926	-117.263
8/8/2012	5	1	32.8957	-117.2639
8/8/2012	5	1	33.0497	-117.3054
8/8/2012	4	1	33.0845	-117.3233
8/8/2012	10	1	33.0873	-117.3206
8/8/2012	15	1	33.0931	-117.3221
8/8/2012	8	1	33.0973	-117.3257
8/8/2012	5	1	33.2504	-117.4562
8/8/2012	18	5	33.2455	-117.4431
8/8/2012	5	1	33.2538	-117.4475
8/8/2012	10	2	33.2572	-117.444
8/8/2012	55	8	33.2841	-117.4966
8/8/2012	95	3	33.2924	-117.5046
8/8/2012	28	3	33.3081	-117.5035
8/8/2012	250	7	33.5065	-117.7591
8/8/2012	50	1	33.5587	-117.8315
8/8/2012	1250	50	33.6259	-117.9652
8/8/2012	175	5	33.6506	-118.0171
8/11/2012	38	3	33.2282	-119.4284
8/11/2012	130	8	33.2345	-119.4307
8/11/2012	5	1	34.093	-119.8893
8/11/2012	1	1	33.9578	-119.8115
8/11/2012	100	3	34.0319	-119.6078
8/11/2012	20	1	33.6114	-119.7367
8/17/2012	1	2	34.0036	-119.4331
8/17/2012	3000	100	34.2308	-119.3106
	9564	292		

Spring 2013

Date	Est Tons	Est # Schools	Latitude	Longitude
4/22/2013	5	1	32.9198	-117.274
4/22/2013	850	15	33.4315	-117.6614
4/22/2013	1	1	33.6975	-118.0556
4/22/2013	5	1	33.7095	-118.0701
4/22/2013	10	1	33.7129	-118.2244
4/22/2013	1	1	33.7703	-118.4363
4/22/2013	50	4	33.8498	-118.4038
4/23/2013	4	1	34.1202	-119.1791
4/23/2013	13	5	34.1759	-119.2457
4/23/2013	15	2	34.3126	-119.4086
4/23/2013	6	1	34.3836	-119.5348
4/23/2013	5	1	34.2481	-120.3929
4/25/2013	4	1	33.6988	-118.3081
4/25/2013	1	1	34.0283	-119.889
4/25/2013	25	3	34.0327	-119.8791
5/2/2013	15	1	33.2978	-118.3259
5/2/2013	14	1	32.5999	-117.2059
5/7/2013	3	1	32.8879	-117.5835
5/20/2013	75	1	33.4757	-119.0459
5/20/2013	28	1	33.475	-119.0469
5/20/2013	1000	12	33.5183	-119.4055
5/21/2013	55	2	32.8142	-118.3436
5/21/2013	8	1	32.814	-118.3585
5/21/2013	14	1	32.8889	-118.5318
5/21/2013	60	2	32.9302	-118.4169
5/21/2013	25	1	32.9531	-118.3926
5/21/2013	25	1	32.9663	-118.4004
5/21/2013	15	1	32.9918	-118.3731
	2330	65		

Summer 2013

Date	Est Tons	Est # Schools	Latitude	Longitude
8/1/2013	600	13	32.6116	-117.1443
8/1/2013	28	2	33.0759	-117.3233
8/1/2013	5	1	33.1857	-117.3879
8/1/2013	6	4	33.2858	-117.5046
8/1/2013	3	1	33.2935	-117.5048
8/1/2013	1	1	33.3152	-117.5207
8/1/2013	4	2	33.3196	-117.5263
8/1/2013	3	1	33.55	-117.8205
8/1/2013	15	3	33.5601	-117.8337
8/1/2013	27	3	33.5672	-117.8423
8/1/2013	9	1	33.5664	-117.8461
8/1/2013	100	20	33.7183	-118.0883
8/1/2013	10	2	33.7211	-118.3454
8/5/2013	15	1	33.8701	-118.4072
8/5/2013	50	2	34.0328	-118.6787
8/5/2013	25	1	34.0293	-118.69
8/5/2013	70	1	34.0305	-118.6924
8/5/2013	20	1	34.0095	-118.7866
8/15/2013	1	1	33.1143	-118.6408
8/20/2013	80	1	34.0039	-119.3831
8/20/2013	3	3	34.0064	-119.3849
8/20/2013	10	1	34.0195	-119.5369
8/20/2013	8	1	34.02	-119.5351
8/28/2013	4	1	33.3277	-118.3058
8/28/2013	3	1	33.3424	-118.3165
8/28/2013	9	5	33.3673	-118.3444
8/28/2013	1	1	33.372	-118.3488
8/28/2013	1	1	33.3798	-118.3577
8/28/2013	120	18	33.3896	-118.365
8/28/2013	35	1	33.3994	-118.3658
8/28/2013	4	2	33.4517	-118.5023
8/28/2013	12	3	33.46	-118.519
8/28/2013	30	4	33.4606	-118.5162
9/6/2013	4	1	34.4693	-120.1485
9/6/2013	4	2	34.4533	-120.0184
9/6/2013	5	1	34.4101	-119.798
9/6/2013	9	1	34.2588	-119.282
9/6/2013	35	1	34.2541	-119.3132
9/6/2013	60	11	34.3079	-119.3727
9/6/2013	400	31	34.3075	-119.3721
9/6/2013	4500	125	34.3165	-119.4107
9/6/2013	45	3	34.3683	-119.4646
9/6/2013	15	1	34.3535	-119.5013
9/6/2013	80	4	34.3798	-119.5108
9/6/2013	35	2	34.382	-119.5489
9/6/2013	24	3	34.3998	-119.5748
	6528	290		

24

DRAFT COUNCIL OPERATING PROCEDURE
Methodology and Data Review Process for Coastal Pelagic Species

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PURPOSE

To establish procedures for the review and Council approval of Coastal Pelagic Species (CPS) methodology and data reviews. These reviews are typically related to CPS stock assessments, although they may be applied to methods in other areas, e.g., economic analysis or ecosystem-based fishery management. The procedure is intended to provide peer review of the survey and analytical methods to ensure that research surveys, data collection, data analyses, and other scientific techniques in support of CPS stock assessments are the best scientific information and facilitate the use of information to facilitate the use of information to the Council. The procedure is also intended to provide technical peer review of other methodologies that could be considered under this structure.

OBJECTIVES AND DUTIES

In the case of new methodologies that have not been approved by the Council, the proponents of such new methodologies will submit a brief proposal for inclusion in the appropriate briefing book, for consideration by advisory bodies and the Council. The timing of the proposal submission is synchronized with the stock assessment schedule established by the Council (see schedule below). For existing methodologies that the CPSMT and SSC together agree should be reviewed, the principals of any such methodology should be notified suitably in advance of the appropriate briefing book deadline, order to submit a brief description of the methodology. In both cases, the proposal should include:

- Title
- Name of proposers (including researchers who will participate at the methodology review and will be expected to conduct analyses during that review;
- A description of how the proposed methodology will improve assessment and management of the stock(s) in questions; and
- Outline of the field and analytical methods to be employed.

Proponents and/or principals of methods to be reviewed should be prepared to present their proposal to the SSC, the relevant MT, and the full Council. Proponents should also include a description of the funding, logistics, or other factors that would indicate the likelihood of success of a proposed methodology. The proposed methodology should be field tested, and preferably there will be available data for one or more years. Untested or experimental methods are typically not appropriate for this type of review.

If the Council approves a methodology to be reviewed, the appropriate Staff Officer will work with the methodology proponents, the SSC, and the Southwest Fisheries Science Center (SWFSC) to schedule the review.

Methodology principals are responsible for providing a report, at least two weeks in advance of the panel review meeting, and a draft report as described in the corresponding Terms of Reference. The panel Chair and the appropriate Staff Officer should develop a Terms of Reference (TOR), or utilize the existing TOR to provide additional guidance for conducting of the panel meeting. The panel normally include a Chair, at least one "external" member (i.e., someone outside the Council family and not involved in management or assessment of West Coast fisheries, often designated by the Center for Independent Experts), and at least two additional members. In addition, the Chair of the CPSMT and the Chair of the CPSAS may appoint one member of each advisory body to be official representatives to the review panel meeting, although they are not considered members of the review panel. The review panel will develop and submit a report to the Council, for consideration at the appropriate Council meeting. The report will include recommendations about whether the methodology should be used, and guidance on any additional work necessary before the methodology can be used.

Schedule

Month	**Activity**
TBD	Proponents submit brief proposal for Council consideration
TBD	Staff schedules MRP meeting and Panel
TBD	MRP convenes to consider methodology
TBD	MRP develops report for the appropriate Council meeting briefing book
TBD	Council considers whether to approve the methodology for potential future use in assessments

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL REPORT ON METHODOLOGY TOPIC SELECTION AND REVIEW PROCESS

The Coastal Pelagic Species Advisory Subpanel (CPSAS) and Coastal Pelagic Species Management Team (CPSMT) met jointly and heard a presentation from Kirk Lynn, California Department of Fish and Wildlife (CDFW), regarding the aerial survey of the Southern California Bight conducted collaboratively with the California Wetfish Producers Association (CWPA). CDFW and CWPA submitted a proposal for this survey to be considered for a methodology review, with the potential for the survey to be incorporated into future Pacific sardine stock assessments. Mr. Lynn pointed out the intent of the survey is to develop an index of abundance, and potentially of recruitment for sardine, as well as other CPS in the future.

The CPSAS supports this aerial survey, as well as a continuation of the Northwest aerial survey, and recommends both for inclusion in a methods review, in spring 2014. The CPSAS notes the importance of including multiple indices of abundance to improve stock assessments. In addition, the CPSAS believes that the acoustic trawl survey now conducted for sardine and other CPS should be included in a methods review.

PFMC
11/02/13

COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON METHODOLOGY PRELIMINARY TOPIC SELECTION AND REVIEW PROCESS

The Coastal Pelagic Species Management Team (CPSMT) received a presentation by Mr. Kirk Lynn, California Department of Fish and Wildlife (CDFW), on a proposal for a methodology review of the Southern California Bight Aerial Survey of Pacific Sardine (SCBAS) as described in Agenda Item E.4.a, Attachment 1. The survey principals (CDFW and California Wetfish Producers Association) propose the review to establish the readiness for potential inclusion of the SBAS in future stock assessments. Such a review would also provide guidance on any changes that may be needed for the survey results to be used to improve the sardine stock assessment.

In June 2013, the CPSMT supported a methodology review for the Southwest Fisheries Science Center Hydroacoustic-Trawl Survey (A-T) and the Northwest Sardine Survey (NWSS) (Agenda Item I.3.b, Supplemental CPSMT Report), and noted that other surveys approved by the Council for review could potentially be conducted concurrently.

The CPSMT notes that an independent review of the Southwest Fisheries Science Center Sardine-Hake survey (SaKe) will be conducted in January 2014 to ensure that it is reliably assessing hake and sardine biomass.

The CPSMT also recommends that a joint review be conducted for the NWSS and the SCBAS before June 2014. This will enable either survey to incorporate any recommendations resulting from the review into their surveys. The NWSS has not been reviewed since 2009. The CPSMT supports the SCBAS review for the purpose of providing guidance for potential subsequent inclusion in sardine stock assessments.

The CPSMT also considered the draft Council Operating Procedure (COP) 24 Methodology and Data Review Process for Coastal Pelagic Species (Agenda Item E.4.a, Attachment 2) and recommends its adoption. This draft COP complements the combined groundfish and CPS Terms of Reference for methodology reviews.

PFMC
11/02/13

Agenda Item E.4.b
Supplemental SSC Report
November 2013

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON 2014 METHODOLOGY PRELIMINARY TOPIC SELECTION REVIEW AND PROCESS

Mr. Kirk Lynn (CDFW) provided the Scientific and Statistical Committee (SSC) with an overview of the aerial survey for Pacific sardine in the Southern California Bight. This survey is a partnership between the CDFW and the California Wetfish Processors Association. The survey involves a series of transects during which an observer visually estimates the tonnage and number of schools on each transect and photographs are taken throughout the transect. The tonnage of fish estimated for the Bight could be used to create a relative index of abundance for use in assessments. The data collected on species composition of schools could be validated using samples collected using jigging. That sampling could also be used to provide biological information on the size composition of fish schools.

The SSC identified several technical issues that would be discussed during a review of this aerial survey and relayed them to the proponents. Addressing some of these issues will require the collection of additional data. The proponents of the survey should consider whether it will be possible to sufficiently address these issues by the time of a review. A review of the California Bight survey could potentially occur during Spring 2014 at the earliest, ideally in conjunction with a review of the acoustic-trawl survey or the aerial survey in the Pacific Northwest.

The SSC reviewed the draft Council Operating Procedure (COP) 24. The COP should make clear the link with the Terms of Reference developed for conducting methodology reviews for groundfish and Coastal Pelagic Species. In addition, it should be made clear that the TOR referred to on page 2 of the COP pertains to the technical aspects of the specific methodology being reviewed.

PFMC
11/02/13

CALIFORNIA WETFISH PRODUCERS ASSOCIATION
PO Box 1951 • Buellton, CA 93427 • Office: (805) 693-5430 • Mobile: (805) 350-3231 • Fax: (805) 686-9312 • www.californiawetfish.org

October 7, 2013

Ms. Dorothy Lowman, Chair
And Members of the Pacific Fishery Management Council
7700 NE Ambassador Place #200
Portland OR 97220-1384

RE: Agenda Item E.4.c Methods Review Topics

Dear Ms. Lowman and Council members,

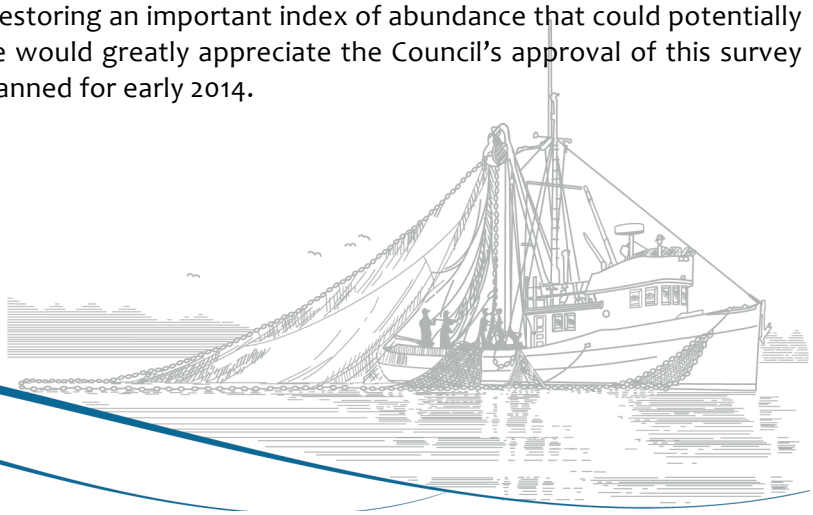
The California Wetfish Producers Association (CWPA) represents the majority of coastal pelagic species 'wetfish' fishermen and processors in California. On behalf of California's wetfish industry, we ask the Council for your support of the collaborative research program that we have initiated in partnership with the California Department of Fish and Wildlife, whose goal is to develop an index of relative abundance for sardine, and potentially other CPS (i.e. anchovy) by modifying existing aerial survey methods, coupled with the traditional spotter pilot index, to produce information of critical importance to improve sardine biomass estimates and trends in abundance.

As we have testified in the past, and as is noted in the Proposal for Method Review submitted by the California Department of Fish and Wildlife (Agenda Item E.4. **Proposal for Methodology Review of the Southern California Bight Aerial Survey for Inclusion into the Pacific Sardine Stock Assessment)** Pacific sardines and anchovy are important species in the CPS management complex. In addition to their importance as forage, these species are also very important to the CPS 'wetfish' industry and California's fishing economy.

Effective assessment of nearshore sardine abundance, an important potential measure of recruitment, is currently missing from stock assessments. Providing an index of abundance in California, including the nearshore as well as offshore, is needed to forecast population trends. By partnering with CDFW, CWPA hopes to advance the state of knowledge of sardine and other CPS. We believe the method developed by CDFW scientists, blending the traditional spotter pilot index with new technology developed in the Northwest aerial Sardine Survey, is a positive step toward restoring an important index of abundance that could potentially serve as a recruitment index in the future. We would greatly appreciate the Council's approval of this survey proposal for inclusion in the Methods Review planned for early 2014.

Thank you for your consideration.
Best regards,

Diane Pleschner-Steele
Executive Director



2014 PACIFIC SARDINE STOCK ASSESSMENT AND MANAGEMENT, INCLUDING TRIBAL SET-ASIDE

The start date for the Pacific sardine fishery is moving from January 1 to July 1. This change was adopted by the Council at the June 2013 meeting, and will take effect July 1, 2014. This means that the Council must adopt an interim set of harvest specifications and management measures for the January 1 through June 30, 2014 time frame. To inform this decision the Southwest Fisheries Science Center (SWFSC) has developed a projection biomass estimate, based on the most recent full stock assessment (2011), updated with catch and survey information (Agenda Item E.5.b, Supplemental Attachment 2). A full stock assessment will be conducted and reviewed by the Council at the April 2014 meeting, at which time harvest specifications and management measures will be adopted for the fishing year that will run July 1, 2014 through June 30, 2015.

The projection estimate being considered by the Council at the November 2013 meeting is based on the 2011 full assessment, updated with new abundance data from four indices of relative abundance: the SWFSC's daily and total egg production estimates of spawning biomass off California, the industry-led aerial sardine survey, and acoustic-trawl survey (A-T) estimates of biomass along the west coast. The A-T estimates used survey data from the SWFSC's spring and summer surveys. The summer survey was a joint hake-sardine coastwide research cruise, covering the entire west coast from the Mexico border to the northern tip of Vancouver Island.

At the November Council meeting, the SSC will review the projection assessment and make an overfishing limit (OFL) recommendation on which to base management measures. The Council will consider a range of acceptable biological catch (ABC) levels associated with various P* (risk of overfishing) alternatives, and will establish harvest measures, including an annual catch limit (ACL) and an annual catch target (ACT). In making these decisions, the Council should consider the Quinault request for a sardine harvest allocation (Agenda Item E.5.a, Attachment 1), and the Northwest Aerial Sardine Survey, LLC notice of intent to conduct EFP research (Agenda Item E.2.a, Attachment 1). The prior year's EFP proposal is also included electronically (Agenda Item E.2.a, Attachment 2).

Council Action:

1. **Approve the Pacific Sardine Projection Assessment and Pacific sardine OFL.**
2. **Adopt final P*, ABC, ACL and, if appropriate, ACT specifications and management measures for January 1-June 30 2014, including consideration of a Quinault Tribal allocation and EFP proposals**

Reference Materials:

1. Agenda Item E.5.a, Attachment 1: Letter from Ed Johnstone, Quinault Fisheries Policy Spokesperson, regarding the Quinault Indian Nation's intent to establish a tribal allocation and to participate in the January-June, 2014 Pacific sardine fishery.
2. Agenda Item E.5.b, Supplemental Attachment 2: SWFSC projection biomass estimate

Agenda Order:

a. Agenda Item Overview — Kerry Griffin
b. Survey and Assessment Report — Kevin Hill
c. Reports and Comments of Advisory Bodies and Management Entities
d. Public Comment
e. **Council Action**: Adopt Final Pacific Sardine Stock Assessment and Management Measures for January through June 2014.

10/10/13

Quinault Indian Nation
POST OFFICE BOX 189 ☐ TAHOLAH, WASHINGTON 98587 ☐ TELEPHONE (360) 276 - 8211

Mr. Rod McInnis
Regional Administrator
Southwest Region, NMFS
501 W. Ocean Blvd. Suite 4200

August 22, 2013

Dear Mr. McInnis,

Per Title 50 of the Code of Federal Regulations (CFR), part 660, the Quinault Indian Nation intends to again exercise its treaty right to enter into the Pacific Sardine fishery for the January 1 through June 30 fishery in 2014. This is a unique situation as the fishery is being transferred to a new July 1-June 30 annual fishery from the former January 1- December 31 fishery as directed by the Pacific Fishery Management Council (PFMC).

§ 660.518 Pacific Coast Treaty Indian Rights.

(a) Pacific Coast treaty Indian tribes have treaty rights to harvest CPS in their usual and accustomed fishing areas in U.S. waters.

(b) For the purposes of this section, "Pacific Coast treaty Indian tribes" and their "usual and accustomed fishing areas" are described at §660.324(b) and (c).

(c) Boundaries of a tribe's fishing area may be revised as ordered by a Federal court.

(d) *Procedures.* The rights referred to in paragraph (a) of this section will be implemented in accordance with the procedures and requirements of the framework contained in Amendment 9 to the FMP and in this Subpart.

(1) The Secretary, after consideration of the tribal request, the recommendation of the Council, and the comments of the public, will implement Indian fishing rights.

(2) The rights will be implemented either through an allocation of fish that will be managed by the tribes or through regulations that will apply specifically to the tribal fisheries.

(3) An allocation or a regulation specific to the tribes shall be initiated by a written request from a Pacific Coast treaty Indian tribe to the NMFS Southwest Regional Administrator at least 120 days prior to the start of the fishing season as specified at §660.510 and will be subject to public review according to the procedures in §660.508(d).

(4) The Regional Administrator will announce the annual tribal allocation at the same time as the annual specifications.

(e) The Secretary recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. Accordingly, the Secretary will develop tribal allocations and regulations in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus. [66 FR 44987, Aug. 27, 2001]

Quinault seeks 1,000 metric tonnes to meet the needs of our fishers during this uniquely short fishing season. This does not set precedent for determination of our treaty share of Pacific Sardines in the Quinault Indian Nation's Usual and Accustomed (U&A) marine fishing area which we believe to be 50% of the harvestable tonnage of fish available in any given year in our U&A.

Accordingly, this does not preclude the Quinault Indian Nation from seeking additional Pacific Sardine tonnage for the 2013-2014 season which begins July 1, 2014.

The Quinault Department of Fisheries will regulate our fishery and we look forward to working with NMFS to facilitate our entry into the Sardine fishery in an orderly manner consistent with PFMC and NMFS management. We thank you for your assistance and stand ready to answer any questions you may have. Please contact me directly if you need further information at (360)276-8215 ext. 368

Sincerely,

Ed Johnstone,
Quinault Fisheries Policy Spokesperson

c.c. Dan Wolford, Chair, Pacific Fisheries Management Council
Phil Anderson, Director, Washington Department of Fish and Wildlife
Mark Helvey, Asst. Regional Administrator for Sustainable Fisheries
Judson Feder, Regional Counsel, Southwest Region

PACIFIC SARDINE BIOMASS PROJECTION IN 2013 FOR U.S. MANAGEMENT DURING THE FIRST HALF OF 2014 (EXECUTIVE SUMMARY)

Kevin T. Hill
NOAA Fisheries Service
Southwest Fisheries Science Center
8901 La Jolla Shores Drive
La Jolla, California 92037-1508

Submitted to

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

October 25, 2013

INTRODUCTION

The Pacific sardine resource is assessed annually in support of the Pacific Fishery Management Council's (PFMC) process of specifying acceptable catch levels for the U.S. fishery. In June 2013, the PFMC adopted a change to the fishery start date from January 1 to July 1, effective 2014. The following catch-only projection was conducted to provide a biomass estimate for interim harvest specifications during the first six months of 2014. The projection model included updated catches from 2012 and 2013, but does not include other fishery or survey data collected over the past year. New data will, however, be incorporated in the next full assessment tentatively scheduled for early March 2014. The 2014 full assessment will serve as the basis for the new fishery management cycle beginning July 1, 2014.

METHODS

The following catch-only projection for 2014 management is based on data and methods described by Hill et al. (2011, 2012), as reviewed by a Stock Assessment Review (STAR) Panel in September 2011 and the Scientific and Statistical Committee's (SSC) coastal pelagic species (CPS) Subcommittee during October 2012. The assessment projection was conducted using Stock Synthesis (SS v. 3.21d). The 2012 update model files (Hill et al. 2012) served as the basis for this projection.

The assessment includes sardine landings (metric tons) from six major fishing regions: Ensenada (ENS), southern California (SCA), central California (CCA), Oregon (OR),

Washington (WA), and British Columbia (BC). Catch data for the fisheries off ENS, SCA, and CCA were pooled into a single 'MexCal' fleet, in which selectivity was modeled separately for each season (S1 and S2). Catch data from OR, WA, and BC were combined and treated as a single 'PacNW' fleet in the model. The sardine model is based on a July-June model year, with two semester-based seasons per year (S1=Jul-Dec and S2=Jan-Jun).

Details regarding the projection estimate are as follows:

- Landings for model steps 2011-2 through 2012-2 (i.e., calendar year 2012 through the first half of 2013) were revised with updated landings data for all fishing regions (ENS to BC). See Table below.
- The projection was parameterized as one year of forecasted catch (fixed, dead) for the three fleets included in the model.
- Landings for model step 2013-1 (i.e., Jul-Dec 2013) were based on final data for BC, WA, and OR, and projected through the end of 2013 for CCA and SCA (see Table below). The ENS landings were not available after June 2013, so the 2013-1 model step was substituted with 2012-1 landings. Landings for the 2013-1 and 2013-2 model steps were included as fixed catch in the forecast file.
- The bias adjustment ramp (Methot & Taylor 2011) for recent years of the main data period ('first recent year for no bias adjustment in MPD') was advanced from 2011 to 2012 in the CTL file. The estimated alternative bias adjustment relationship matched well to the model, and there was negligible impact on model results.
- No other data or parameterization changes were made to the assessment model.

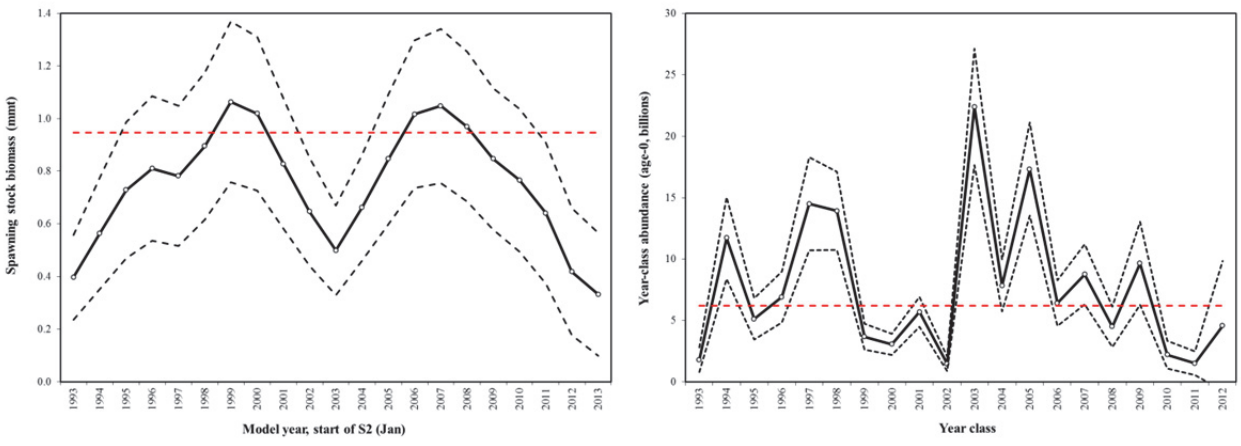
Calendar year-semester	Model year-semester	ENS	SCA	CCA	OR	WA	BC	Total
2004-1	2003-2	11,213	15,232	2,146	2,204	235	180	31,209
2004-2	2004-1	30,684	17,161	13,163	33,908	8,564	4,258	107,739
2005-1	2004-2	17,323	15,419	115	692	324	0	33,874
2005-2	2005-1	38,000	14,834	7,825	44,316	6,605	3,231	114,811
2006-1	2005-2	17,601	17,158	2,033	102	0	0	36,893
2006-2	2006-1	39,636	16,128	15,711	35,547	4,099	1,575	112,696
2007-1	2006-2	13,981	26,344	6,013	0	0	0	46,338
2007-2	2007-1	22,865	19,855	28,769	42,052	4,663	1,522	119,726
2008-1	2007-2	23,488	24,127	2,515	0	0	0	50,130
2008-2	2008-1	43,378	6,962	24,196	22,940	6,435	10,425	114,336
2009-1	2008-2	25,783	9,251	11,080	0	0	0	46,114
2009-2	2009-1	30,128	3,310	13,935	21,482	8,025	15,334	92,215
2010-1	2009-2	12,989	19,428	2,909	437	511	422	36,695
2010-2	2010-1	43,832	9,925	1,397	20,415	11,870	21,801	109,240
2011-1	2010-2	18,514	12,526	2,713	0	0	0	33,754
2011-2	2011-1	51,823	5,115	7,358	11,023	8,008	20,719	104,047
2012-1	2011-2	10,235	11,906	3,673	2,874	2,932	0	31,620
2012-2	2012-1	39,575	6,896	569	39,744	32,510	19,172	138,465
2013-1	2012-2	9,780	2,680	84	149	1,421	0	14,115
2013-2	2013-1	*39,575*	*3,858*	*864*	26,599	27,285	0	98,181

RESULTS

Spawning Biomass, Recruitment, and Stock Biomass

Per the 2012 assessment update, recruitment was modeled using the Ricker stock-recruitment relationship (σ_R=0.727), with steepness being estimated at h=2.8. Virgin recruitment (R_0) was estimated to be 6.22 billion age-0 fish (red dashed line), and virgin spawning stock biomass (SSB) was estimated to be 0.946 mmt (red dashed line). The SSB increased throughout the 1990s, peaking at 1.063 million metric tons (mmt) in 1999 and 1.048 mmt in 2007. The SSB is projected to be 0.332 mmt (CV=0.35) as of January 2014. Recruitment (year-class abundance) peaked at 14.5 billion fish in 1997, 22.4 billion in 2003, 17.3 billion in 2005, and 9.65 billion in 2009. The 2010 and 2011 year classes were the weakest in recent history. Recent survey and fishery data provide no indication of a sizable year class since 2009.

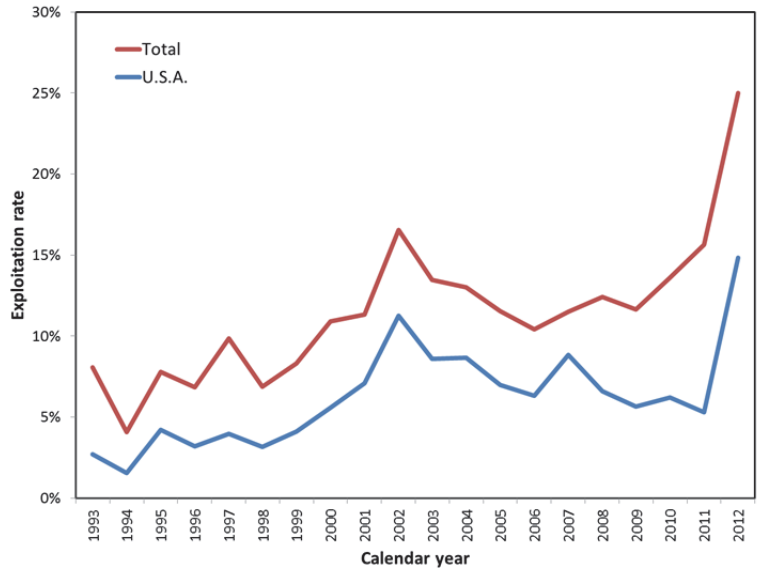
Calendar year-semester	Model year-semester	Stock biomass (mt)	SSB (mt)	SSB Std. Dev	Recruit abundance (billions)	Recruit Std Dev
2003-1	2002-2	723,342	646,484	102,588		
2003-2	2003-1	646,971			22.387	2.367
2004-1	2003-2	511,357	499,399	85,307		
2004-2	2004-1	989,222			7.851	1.053
2005-1	2004-2	951,788	662,323	100,683		
2005-2	2005-1	1,118,270			17.316	1.891
2006-1	2005-2	1,012,870	847,236	123,603		
2006-2	2006-1	1,371,320			6.410	0.927
2007-1	2006-2	1,284,380	1,016,840	140,557		
2007-2	2007-1	1,356,870			8.754	1.227
2008-1	2007-2	1,192,610	1,047,870	146,546		
2008-2	2008-1	1,279,250			4.491	0.824
2009-1	2008-2	1,110,770	968,909	142,208		
2009-2	2009-1	1,093,190			9.648	1.690
2010-1	2009-2	930,069	846,669	134,507		
2010-2	2010-1	1,051,900			2.220	0.555
2011-1	2010-2	907,777	765,872	135,396		
2011-2	2011-1	866,584			1.521	0.481
2012-1	2011-2	699,258	640,511	133,969		
2012-2	2012-1	635,551			4.575	2.632
2013-1	2012-2	442,396	418,225	120,590		
2013-2	2013-1	493,479			---	---
2014-1	2013-2	378,120	331,964	116,721		



Stock biomass, used for calculating harvest specifications, is defined as the sum of the biomasses for sardine ages one and older (age 1+). Stock biomass increased rapidly throughout the 1990s, peaking at 1.36 mmt in 1999 and 1.37 mmt in 2006. Stock biomass is projected to be 378,120 mt as of January 2014:

Exploitation Status

Exploitation rate is defined as the calendar year catch divided by the total mid-year biomass (July-1, ages 0+). Based on the latest model and historic catches, the U.S. exploitation rate approached 15% and total exploitation (including Mexico and Canada landings) was about 25% during 2012. U.S. and total exploitation rates follow:



Calendar year	U.S.A.	Total
2000	5.57%	10.91%
2001	7.07%	11.34%
2002	11.26%	16.55%
2003	8.59%	13.46%
2004	8.68%	13.02%
2005	6.99%	11.53%
2006	6.33%	10.43%
2007	8.85%	11.50%
2008	6.59%	12.43%
2009	5.64%	11.64%
2010	6.23%	13.59%
2011	5.30%	15.63%
2012	14.85%	24.98%

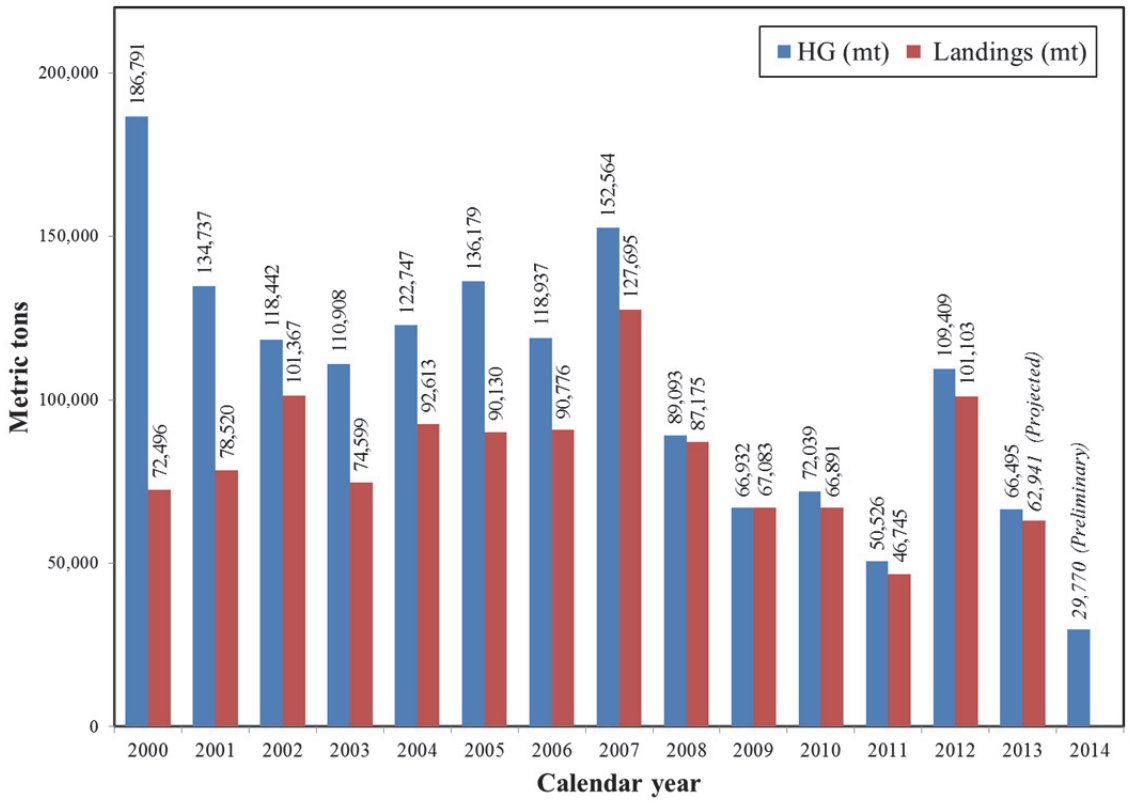
Harvest Control Rules

Harvest guideline

Based on results from the projection model, the preliminary harvest guideline (HG) for the U.S. fishery in calendar year 2014 will be 29,770 mt. The HG was calculated as follows:

$$HG_{2014} = (BIOMASS - CUTOFF) \bullet FRACTION \bullet DISTRIBUTION,$$

where HG_{2014} is the total U.S. quota for 2014, BIOMASS (378,120 mt) is the stock biomass (ages 1+) at the start of the 2014 fishing year (PFMC 2012, 2013), CUTOFF (150,000 mt) is the lowest level of biomass for which harvest is allowed, FRACTION (15%) is the percentage of biomass above the CUTOFF that can be harvested, and DISTRIBUTION (87%) is the average portion of BIOMASS assumed in U.S. waters. The HG values and catches since 2000 are displayed below. The preliminary 2014 HG is 55% lower than the HG established for 2013. The 29,770 mt HG will be divided into seasonal (i.e. Season 1) and other allocations during the November 2013 Council meeting.



OFL and ABCs

The Magnuson-Stevens Reauthorization Act requires fishery managers to define an overfishing limit (OFL), allowable biological catch (ABC), and annual catch limit (ACL) for species managed under a federal management plan (FMP). By definition, ABC must always be lower than the OFL based on uncertainty in the assessment approach. The SSC has recommended the P-star buffer calculation to mitigate scientific uncertainty when defining ABC, which was adopted under Amendment 13 to the CPS FMP.

The estimated biomass of 378,120 mt (ages 1+), an F_{MSY} proxy of 0.18, and a distribution proportion of 87% of the stock in U.S. waters results in a U.S. OFL of 59,214 mt for 2014. The CV of the terminal year SSB was equal to 0.352 (σ =0.341) and thus, is still within the sigma

level (0.36) specified for Tier 1 assessments. The ABC buffer will depend on the probability of the overfishing level (P-star) policy chosen by the PFMC. Uncertainty buffers and ABC values associated with a range of discrete P-star values are provided as follows:

	Harvest Control Rule Formulas								
	$OFL = BIOMASS * F_{MSY} * DISTRIBUTION$								
	$ABC_{P\text{-}star} = BIOMASS * BUFFER_{P\text{-}star} * F_{MSY} * DISTRIBUTION$								
	HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION								
Harvest Formula Parameters									
BIOMASS (ages 1+, mt)	378,120								
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
$ABC\ Buffer_{Tier\ 1}$	0.95577	0.91283	0.87048	0.82797	0.78442	0.73861	0.68859	0.63043	0.55314
$ABC\ Buffer_{Tier\ 2}$	0.91350	0.83326	0.75773	0.68553	0.61531	0.54555	0.47415	0.39744	0.30596
F_{MSY}	0.18								
FRACTION	0.15								
CUTOFF (mt)	150,000								
DISTRIBUTION (U.S.)	0.87								
Harvest Control Rule Values (MT)									
OFL =	**59,214**								
$ABC_{Tier\ 1}$ =	56,595	54,052	51,544	49,027	46,448	43,736	40,774	37,330	32,753
$ABC_{Tier\ 2}$ =	54,091	49,340	44,868	40,592	36,435	32,304	28,076	23,534	18,117
HG =	**29,770**								

DISCUSSION

The Pacific sardine population is projected to continue a downward trend attributed largely to low recent recruitments. While no new biological-composition data for fisheries or surveys were included in the forecast model, the downward population trajectory and assumption of poor recent recruitment is consistent with preliminary observations from various sources along the Pacific coast of North America:

- The British Columbia fleet captured no sardine during the Summer 2013 (Jordan Mah, CDFO, pers. comm.);
- The Canada DFO trawl survey found no sardine off the coast of Vancouver Island during the Summer 2013 (Linnea Flostrand, CDFO, pers. comm.);
- The SWFSC's Spring 2013 survey found few young sardine (no age-0, few age-1) in trawl collections off California (Jenny McDaniel, SWFSC, pers. comm.);
- The Summer 2013 SaKe survey observed small volumes of sardine off California (relative to WA and OR) and no sardine off Canada;
- Preliminary acoustic-trawl survey (ATM) estimates from Spring and Summer 2013 indicate lower biomass than estimated from the two surveys conducted in 2012 David Demer, SWFSC, pers. comm.);
- INAPESCA conducted an ATM survey along the outer Baja California península during the Summer 2012. No sardine were observed in northern Baja California (Manuel O. Nevarez, INAPESCA, pers. comm.);
- Poor recent recruitment is indicated in recent assessments;

- Commercial catches are lower than normal in California;
- California's live-bait fishery off San Diego has communicated some difficulty locating sardine in 2013, instead targeting anchovy.

ACKNOWLEDGMENTS

The following individuals provided recent sardine catch data in an accurate and timely manner (north to south): Linnea Flostrand, Sean MacConnachie, and Jordan Mah (Canada DFO); Carol Henry (WDFW); Jill Smith (ODFW); Elizabeth Hellmers and Kirk Lynn (CDFW); and Manuel O. Nevarez (INAPESCA-Mexico). Your cooperation is greatly appreciated!

LITERATURE CITED

Hill, K. T., P. R. Crone, N. C. H. Lo, B. J. Macewicz, E. Dorval, J. D. McDaniel, and Y. Gu. 2011. Assessment of the Pacific sardine resource in 2011 for U.S. management in 2012. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-487. 260 p. http://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-487.pdf

Hill, K. T, Crone, P. R., Lo, N. C. H., Demer, D. A., Zwolinski, J. P. and Macewicz, B. J. Assessment of the Pacific sardine resource in 2012 for US management in 2013. US Department of Commerce. NOAA Technical Memorandum NMFS-SWFSC-501, 142 pp. http://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-501.pdf

Methot, R.D. and I.G. Taylor. 2011. Adjusting for bias due to variability of estimated recruitments in fishery assessment models. Can. J. Fish. Aquat. Sci., 68:1744-1760.

PFMC. 2012. Scientific and Statistical Committee report on the Pacific sardine stock assessment and management for 2013, including preliminary EFP proposals and tribal set aside. Pacific Fishery Management Council, November 2012 Briefing Book, Agenda Item G.3.c. Supplemental SSC Report. http://www.pcouncil.org/wp-content/uploads/G3c_SUP_SSC_NOV2012BB.pdf

PFMC. 2013. Scientific and Statistical Committee report on sardine harvest parameters workshop report. Pacific Fishery Management Council, April 2013 Briefing Book, Agenda Item I.1.b. Supplemental SSC Report. http://www.pcouncil.org/wp-content/uploads/I1b_SUP_SSC_APR2013BB.pdf

PACIFIC SARDINE BIOMASS PROJECTION FOR U.S. MANAGEMENT DURING JAN-JUN 2014

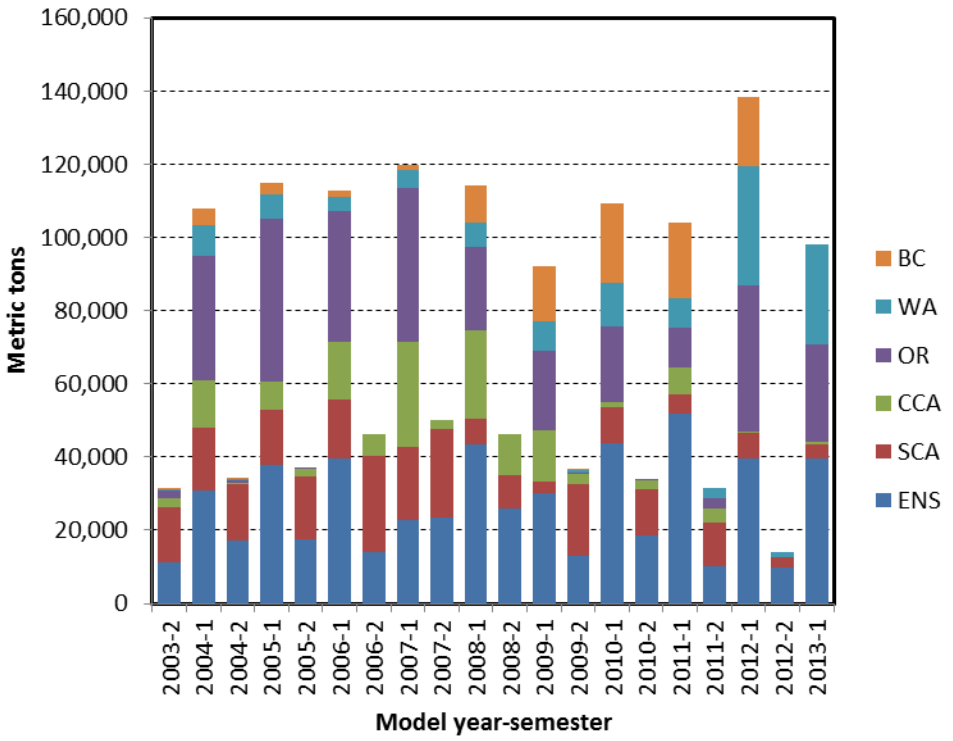
Kevin T. Hill
Fisheries Resources Division
Southwest Fisheries Science Center
NOAA National Marine Fisheries Service

Background & Methods

- In June 2013, the Council adopted a change to the fishery start date from January 1 to July 1, effective 2014;
- New fishery and survey data collected over the past year will be incorporated in the next benchmark assessment scheduled for a STAR panel in early March 2014;
- The following catch-only projection assessment was conducted to provide a biomass estimate for setting interim harvest specifications during the first six months of 2014;
- Data and models are fully described in Hill et al. (2011 & 2012);
- The catch-only projection model included updated and projected catches from 2012 and 2013;
- No other changes to data or model parameterization.

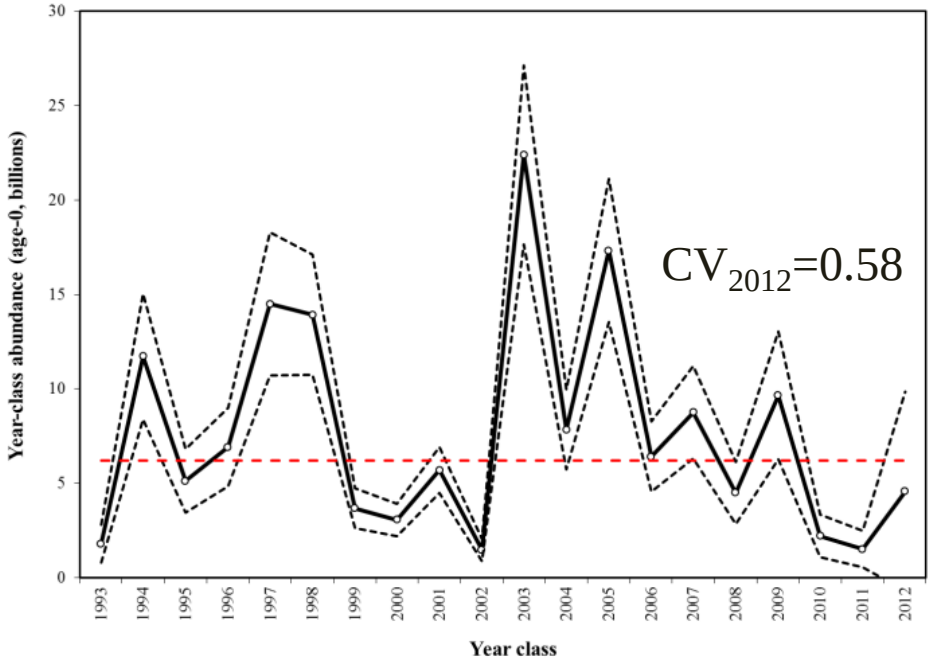
Landings

Calendar year-semester	Model year-semester	ENS	SCA	CCA	OR	WA	BC	Total
2004-1	2003-2	11,213	15,232	2,146	2,204	235	180	31,209
2004-2	2004-1	30,684	17,161	13,163	33,908	8,564	4,258	107,739
2005-1	2004-2	17,323	15,419	115	692	324	0	33,874
2005-2	2005-1	38,000	14,834	7,825	44,316	6,605	3,231	114,811
2006-1	2005-2	17,601	17,158	2,033	102	0	0	36,893
2006-2	2006-1	39,636	16,128	15,711	35,547	4,099	1,575	112,696
2007-1	2006-2	13,981	26,344	6,013	0	0	0	46,338
2007-2	2007-1	22,865	19,855	28,769	42,052	4,663	1,522	119,726
2008-1	2007-2	23,488	24,127	2,515	0	0	0	50,130
2008-2	2008-1	43,378	6,962	24,196	22,940	6,435	10,425	114,336
2009-1	2008-2	25,783	9,251	11,080	0	0	0	46,114
2009-2	2009-1	30,128	3,310	13,935	21,482	8,025	15,334	92,215
2010-1	2009-2	12,989	19,428	2,909	437	511	422	36,695
2010-2	2010-1	43,832	9,925	1,397	20,415	11,870	21,801	109,240
2011-1	2010-2	18,514	12,526	2,713	0	0	0	33,754
2011-2	2011-1	51,823	5,115	7,358	11,023	8,008	20,719	104,047
2012-1	**2011-2**	**10,235**	**11,906**	**3,673**	**2,874**	**2,932**	**0**	**31,620**
2012-2	**2012-1**	**39,575**	**6,896**	**569**	**39,744**	**32,510**	**19,172**	**138,465**
2013-1	**2012-2**	**9,780**	**2,680**	**84**	**149**	**1,421**	**0**	**14,115**
2013-2	**2013-1**	***39,575***	***3,858***	***864***	**26,599**	**27,285**	**0**	**98,181**

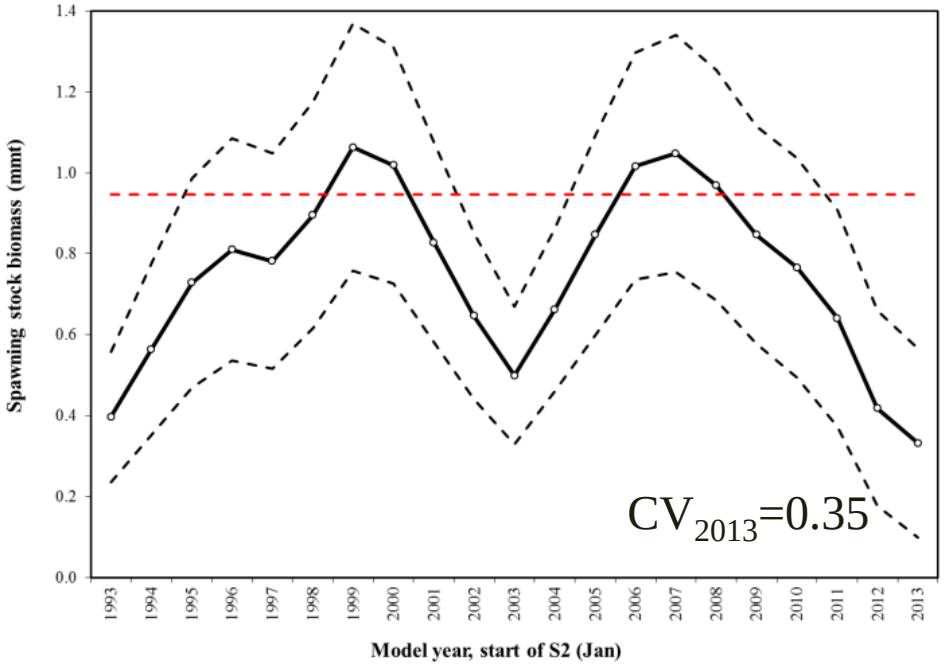


Results:

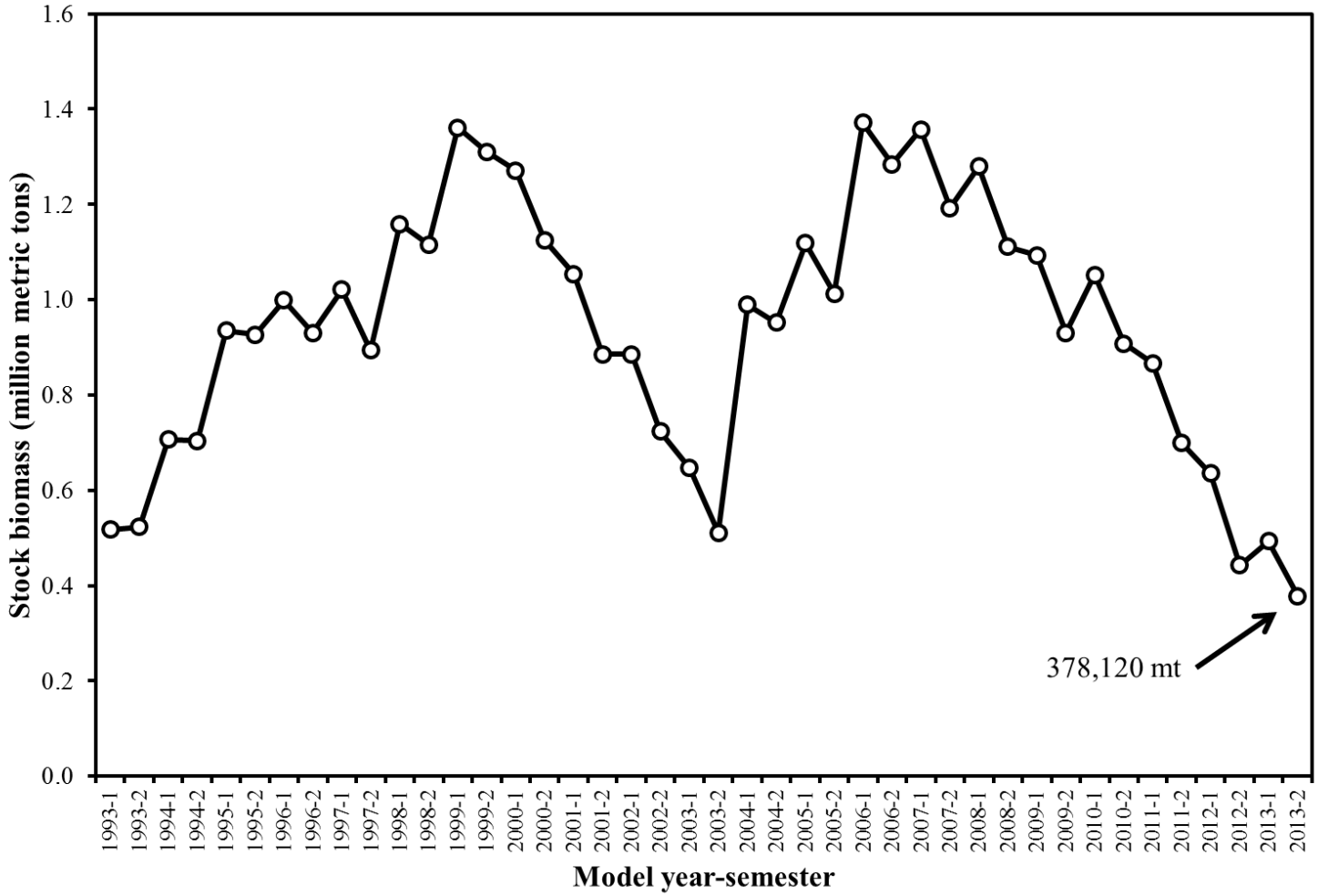
Recruit abundance



Spawning Stock Biomass

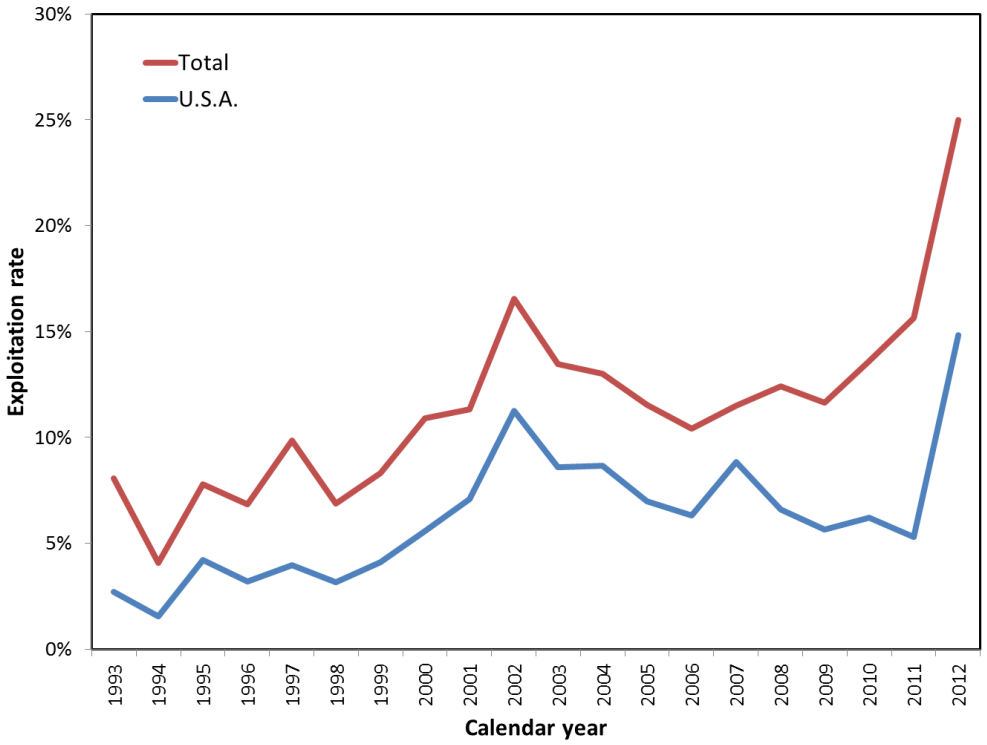


Results: Stock Biomass



Results:

Retrospective Exploitation Rates (Ages 0+)

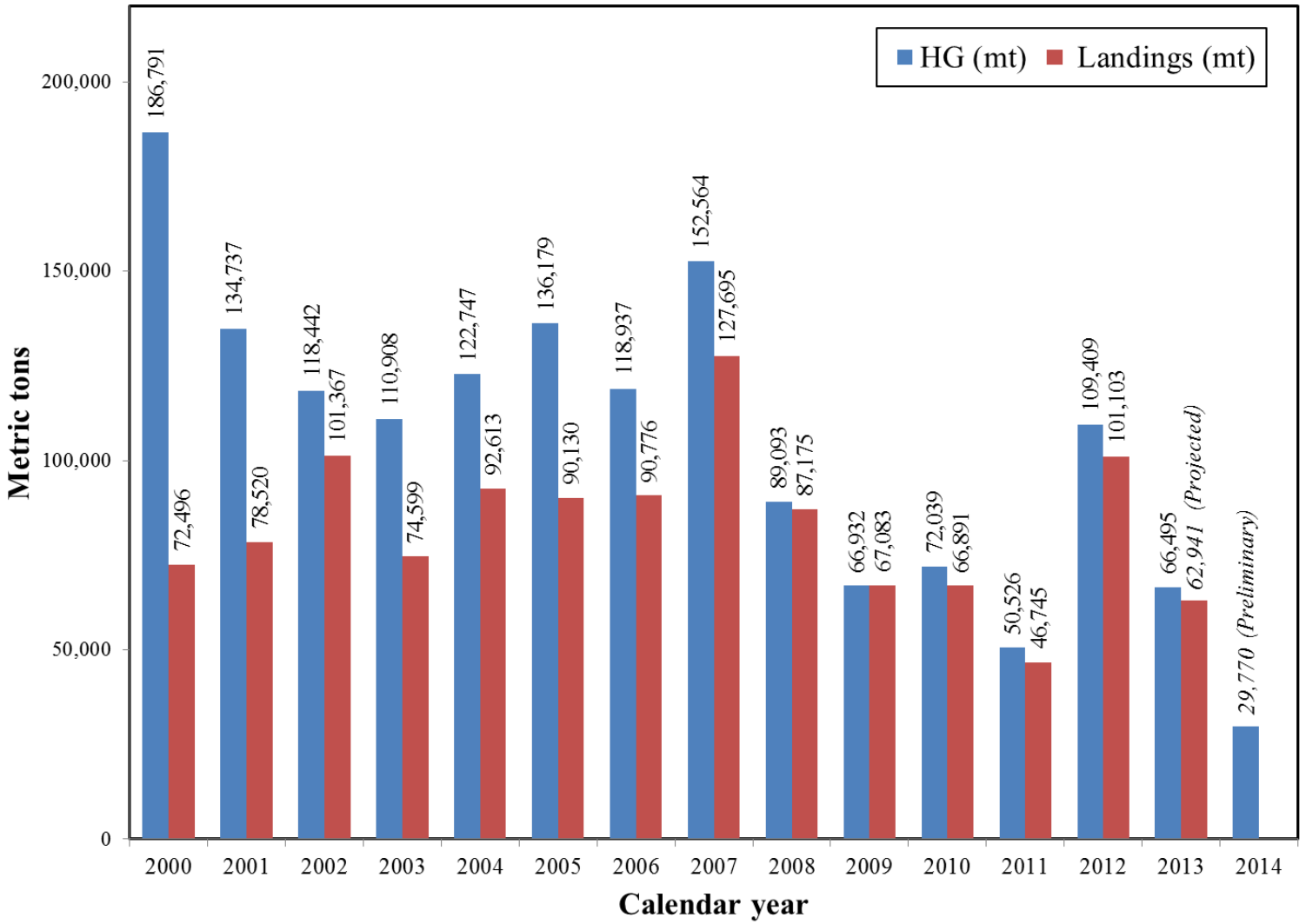


Calendar year	U.S.A.	Total
2000	5.57%	10.91%
2001	7.07%	11.34%
2002	11.26%	16.55%
2003	8.59%	13.46%
2004	8.68%	13.02%
2005	6.99%	11.53%
2006	6.33%	10.43%
2007	8.85%	11.50%
2008	6.59%	12.43%
2009	5.64%	11.64%
2010	6.23%	13.59%
2011	5.30%	15.63%
2012	14.85%	24.98%

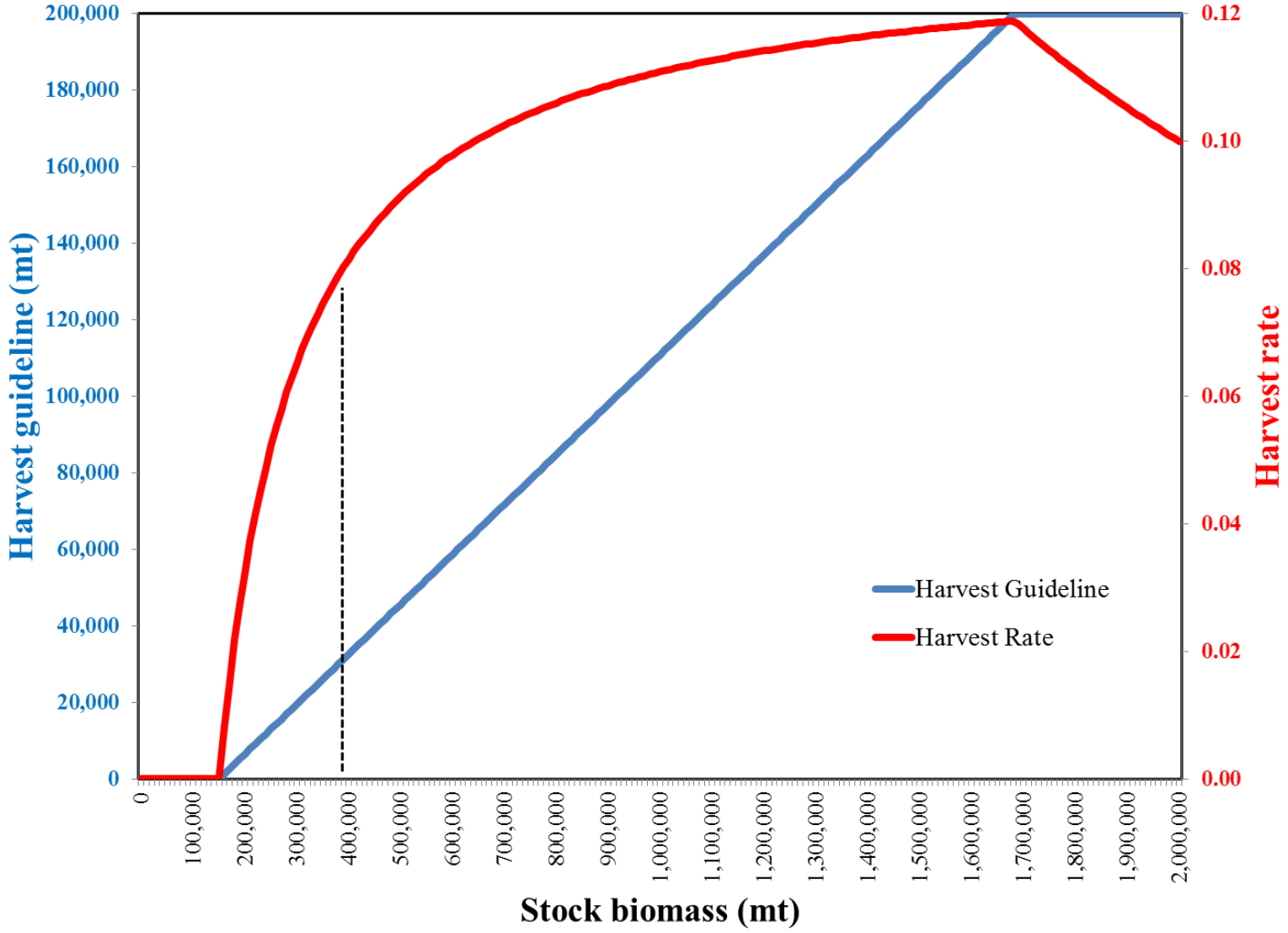
Harvest Control Rules

	Harvest Control Rule Formulas								
	OFL = BIOMASS * F_{MSY} * DISTRIBUTION								
	$ABC_{P\text{-star}}$ = BIOMASS * $BUFFER_{P\text{-star}}$ * F_{MSY} * DISTRIBUTION								
	HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION								
Harvest Formula Parameters									
BIOMASS (ages 1+, mt)	378,120								
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
ABC $Buffer_{Tier\ 1}$	0.95577	0.91283	0.87048	0.82797	0.78442	0.73861	0.68859	0.63043	0.55314
ABC $Buffer_{Tier\ 2}$	0.91350	0.83326	0.75773	0.68553	0.61531	0.54555	0.47415	0.39744	0.30596
F_{MSY}	0.18								
FRACTION	0.15								
CUTOFF (mt)	150,000								
DISTRIBUTION (U.S.)	0.87								
Harvest Control Rule Values (MT)									
OFL =	**59,214**								
$ABC_{Tier\ 1}$ =	56,595	54,052	51,544	49,027	46,448	43,736	40,774	37,330	32,753
$ABC_{Tier\ 2}$ =	54,091	49,340	44,868	40,592	36,435	32,304	28,076	23,534	18,117
HG =	**29,770**								

Harvest Guideline & Catch History



Harvest Rate Under the HG Control Rule



Discussion

Downward population trajectory and estimates of poor recent recruitment are consistent with recent, preliminary observations along the Pacific coast of North America:

- The British Columbia fleet captured no sardine during the Summer 2013;
- The Canada DFO trawl survey found no sardine off the coast of Vancouver Island during the Summer 2013;
- The SWFSC's Spring 2013 survey found few young sardine (no age-0, few age-1) in trawl collections off California; Most fish >20 cm.
- The Summer 2013 SaKe survey observed small volumes of sardine off California (relative to WA and OR) and no sardine off Canada; All fish >20cm.
- Preliminary acoustic-trawl survey (ATM) estimates from Spring and Summer 2013 indicate lower biomass than estimated from the two surveys conducted in 2012;
- INAPESCA conducted an ATM survey along the outer Baja California península during the Summer 2012. No sardine were observed in northern Baja California;
- Commercial catches have been lower than normal in California;
- California's live-bait fishery off San Diego has indicated some difficulty locating sardine in 2013, instead targeting anchovy.

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL REPORT ON 2014 PACIFIC SARDINE STOCK ASSESSMENT AND MANAGEMENT

The Coastal Pelagic Species Advisory Subpanel (CPSAS) and Coastal Pelagic Species Management Team (CPSMT) received a briefing from Dr. Kevin Hill (Southwest Fisheries Science Center) and reviewed Agenda Item E.5.b, Supplemental Attachment 2: Executive Summary – Sardine Biomass Projection in 2013 for US Management during the first half of 2014.

The CPSAS understands that this "catch-only" projection is a bridge to account for the period January 1 through June 30, 2014, and that a full assessment will undergo stock assessment review (STAR) panel review in March 2014. The outcome of that review will determine the management measures for the new fishing year, commencing July 1, 2014 through June 30, 2015.

Management Measures

(1) The CPSAS recommends the following management measures for the interim January-June 2014 sardine fishery, based on the biomass projection of 29,770 metric tons (mt).

Harvest Guideline	29,770mt
Seasonal Allocation (Jan 1-June 30)	10,420mt (35%)
Tribal Allocation	1,000mt
Incidental Set Aside	500mt
Adjusted (Directed) Allocation	8,920mt

(2) After the closure of the directed sardine fishery, the CPSAS recommends a total of 500 mt be set aside for incidental catch of sardine in other CPS fisheries in the January-June 2014 period. The incidental landing allowance in other CPS fisheries should be raised to 45 percent Pacific sardine by weight, to account for the possibility of mixed-fish catches.

The CPSAS notes that the harvest guideline (HG) developed for this interim assessment is more precautionary than any Tier 1 acceptable biological catch specified, highlighting the precautionary nature of the HG control rule.

PFMC
11/03/13

COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON 2014 PACIFIC SARDINE STOCK ASSESSMENT AND MANAGEMENT, INCLUDING TRIBAL SET-ASIDE

The Coastal Pelagic Species Management Team (CPSMT) and the Coastal Pelagic Species Advisory Panel (CPSAS) received a presentation from Dr. Kevin Hill concerning the Pacific sardine stock projection conducted in 2013. The CPSMT recommends that the Pacific Fishery Management Council (Council) adopt the catch-only projection for management of the 2014 sardine fishery (Agenda Item E.5.b, Supplemental Attachment 2). Based upon the January 2014 age 1+ biomass estimate of 378,120 metric tons (mt), the harvest control rule produces a harvest guideline (HG) of 29,770 mt (Table 1 below). The 2014 biomass estimate represents a 42 percent decrease from the updated stock assessment previously adopted by the Council in November, 2012. The CPSMT recognizes the results of the catch update do not include the 2013 survey results. Although a biomass estimate, overfishing limit (OFL), acceptable biological catch (ABC), annual catch limit (ACL) and HG will be set for the full year, due to the change in fishery start date, the allocation will only be set for the January 1- June 30 (interim) period. To inform management for the new fishing season starting on July 1, 2014, a full stock assessment is scheduled for the spring of 2014. At that time, harvest control rule values will be reset for the new fishing season July 2014 – June 2015.

Harvest Specifications for 2014

Table 1 (below) contains the resulting OFL and a range of acceptable biological catch (ABC) values based on various P* (probability of overfishing) values. The CPSMT recommends that the ACL equal the ABC resulting from the Council's P* choice, and that the annual HG/annual catch target be set equal to 29,770 mt. Considering the results of the full stock assessment conducted in 2011, the Council chose a P* of 0.40 for the 2012 and 2013 fisheries.

The CPSMT concurs with the CPSAS that the incidental catch for CPS fisheries for the interim allocation period be set to 500 mt and that the incidental landing allowance for CPS fisheries be no more than 45 percent Pacific sardine by weight. Accounting for the incidental set aside, and for a Quinault Indian Nation request for 1,000 mt (Agenda Item E.5.a, Attachment 1), the CPSMT recommends adoption of the allocation scheme in Table 2 below.

The CPSMT reviewed Dr. Hill's projection of the stock and deems it provides the best available estimate to inform the current harvest control rule. The CPSMT recognizes that Pacific sardine recruitment is low and the stock has declined in recent years. However, an important characteristic of the HG control rule is that the effective harvest rate declines with biomass. This is evidenced in that the 2014 HG results in an effective harvest rate of eight percent. Additionally, the HG is approximately half the OFL and below the ABC at all P* levels.

Table 1. Pacific sardine harvest formula parameters for 2014.

	Harvest Control Rule Formulas								
	OFL = BIOMASS * F_{MSY} * DISTRIBUTION								
	$ABC_{P\text{-}star}$ = BIOMASS * $BUFFER_{P\text{-}star}$ * F_{MSY} * DISTRIBUTION								
	HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION								
Harvest Formula Parameters									
BIOMASS (ages 1+, mt)	378,120								
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
ABC Buffer	0.95577	0.91283	0.87048	0.82797	0.78442	0.73861	0.68859	0.63043	0.55314
F_{MSY}	0.18								
FRACTION	0.15								
CUTOFF (mt)	150,000								
DISTRIBUTION (U.S.)	0.87								
Harvest Control Rule Values (MT)									
OFL =	**59,214**								
ABC =	56,595	54,052	51,544	49,027	46,448	43,736	40,774	37,330	32,753
ACL =	Less than or equal to ABC								
HG =	**29,770**								

Table 2. Preliminary Pacific sardine allocation scheme for January 1-June 30, 2014

Harvest Guideline	29,770mt
Seasonal Allocation (Jan 1-June 30)	10,420mt (35%)
Tribal Allocation	1,000mt
Incidental Set Aside	500mt
Adjusted (Directed) Allocation	8,920mt

PFMC
11/03/13

Agenda Item E.5.c
Supplemental SSC Report
November 2013

SCIENTIFIC AND STATISTICAL REPORT ON 2013PACIFIC SARDINE STOCK ASSESSMENT AND MANAGEMENT, INCLUDING TRIBAL SET-ASIDE

The Scientific and Statistical Committee (SSC) heard a presentation from Dr. Kevin Hill on the new Pacific sardine biomass projection. No new survey data are included in the projection model; however, catch data that were previously included as preliminary estimates are now incorporated as actual values for the second semester of 2011 and the first and second semesters of 2012. The additional data enabled estimation of 2012 year class recruitment, which was below the historical average.

The harvest guideline (29,770 mt) has decreased from the previous assessment, resulting from a declining trend in biomass, coupled with a change in timing of the biomass estimate from the middle to the end of the year.

The SSC endorses the overfishing limit for the calendar year 2014 (59,214 mt) which will be updated (superseded) by a new assessment scheduled to be reviewed in March 2014. The new assessment will incorporate updated fishery composition data for the US, and new survey data, including 1) a spring 2013 daily egg production method (DEPM) estimate, and 2) spring and summer 2013 acoustic-trawl survey (ATM) estimates. Based on preliminary survey reports, a continued decline is expected.

The SSC recommends keeping the stock at category 1 for the purpose of deriving the acceptable biological catch (ABC). The SSC also notes that a continuing shortcoming of the Stock Synthesis model (no coefficient of variation of summary biomass) should be addressed. This information is routinely needed to derive the P* buffer, and would greatly aid calculation of ABCs going forward.

PFMC
11/02/13

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October 21, 2013

Ms. Dorothy Lowman, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220-1384

RE: 2014 Pacific Sardine Management

Dear Ms. Lowman and Council Members:

Oceana continues to have grave concerns about the conservation and management of Pacific sardine. Pacific sardine are a highly valuable forage species in the California Current Ecosystem. It is clear that the sardine population is in a significant state of decline, if not a complete collapse. We look forward to seeing the updated assessment at this meeting, but what we have heard so far is disconcerting. Reports from scientists, managers, and industry at the September Pacific Fishery Management Council (PFMC or "Council") Coastal Pelagic Species (CPS) advisory body meeting indicate there are no signs of significant recruitment,[1] the fishing industry did not find sardine off British Columbia, and catch in the fishery this year off California was dismal due to a lack of sardine. Given the continued decline of the Pacific sardine population, we request that:

1. The sardine fishery be closed via emergency regulation for the remainder 2013 (our June 2013 letter makes the same request)[2]; and
2. The fishery be closed for the first half of 2014 until a full management strategy evaluation can be completed, reviewed, and adopted by the Council; and any opening is contingent on a major increase in estimated biomass and recruitment.

The Council and National Marine Fisheries Service (NMFS) should focus on reviewing and updating the Pacific sardine harvest control rule and completing an updated stock assessment. In addition to the serious decline, the Council has not applied the appropriate temperature index (CalCOFI) in determining the harvest rate (FRACTION) for sardine management. Last June, information, which continues to be valid, was presented to the Council showing that the Scripps Pier-based FRACTION led to overfishing. It is also clear that the "sigma" value used to assess scientific uncertainty does not account for projection uncertainty, which is particularly important given that the Council is now making decisions using projections from the 2012 Assessment. This too must be revised. Before resuming the sardine fishery, we request that NMFS and the PFMC:

[1] PFMC. November 2012. Agenda Item G.3 B. Sardine Assessment Report. The 2012 sardine assessment found that the 2010 and 2011 year classes were the weakest in recent history.
[2] Oceana, June 2013. Agenda Item I.4.d Public Comment

1. Ensure the FRACTION parameter is based on the new CalCOFI temperature index (not Scripps Pier);
2. Direct the SSC to reevaluate the sigma value used to assess scientific uncertainty associated with the overfishing level and in setting the allowable biological catch, specifically with regard to uncertainty in F_{MSY} and projection uncertainty; and
3. Consider, evaluate, and adopt Oceana's proposed Pacific sardine harvest control rule, included in our June 2013 letter to the PFMC and NMFS, as a part of a full management strategy evaluation that considers changes to all parameters in the sardine harvest control rule (i.e. CUTOFF, DISTRIBUTION, FRACTION and MAXCAT).[3]

The 2012 stock assessment found that the Pacific sardine population declined 52% over the past six years.[4] Recruitment is the lowest it has been in decades, coastwide exploitation rates have increased substantially in recent years, and the stock biomass is far below the "critical biomass" threshold (SSB < 740,000 mt) identified by NMFS sardine stock assessment scientists. NMFS scientists Zwolinski and Demer published a study last year in the Proceedings of the National Academy of Sciences forecasting this collapse and documenting the repeated failure of managers to respond.[5] The authors concluded that:

> ***[a]larming is the repetition of the fishery's response to a declining sardine stock - progressively higher exploitation rates targeting the oldest, largest, and most fecund fish.***

The dearth of sardines is now having ramifications in the ecosystem as indicated by an unprecedented number of yearling California sea lions starving on the beach earlier this year.[6] While some minor aspects of the 2012 Zwolinski and Demer publication were the subject of a rebuttal, the predictions in this study appear strikingly accurate, and the fundamental conclusions of the fishery's effect on the stock remain unchallenged. This year, catch in the fishery off California was seriously depressed, there were no sardine off Canada, and in the places it can find sardines in the Pacific Northwest, the fishery continues to focus on the oldest, largest, and most fecund fish. In their article, Zwolinski and Demer wrote that the prior collapse of the sardine population (1930s to 1950s) was characterized by:

1. Negative phase of the PDO;
2. Focus of the fishery on the oldest, largest, most fecund fish;
3. Decline of the sardine biomass below a critical level (critical biomass);
4. Shift in the dominant species and their schooling behavior; and

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[3] Id.
[4] Hill et al. 2012. Assessment of the Pacific sardine resource in 2012 for U.S. Management in 2013. PFMC November 2012. Agenda Item G.3.b Supplemental Assessment Report 2.
[5] Zwolinski, J. and D.A. Demer. 2012. A cold oceanographic regime with high exploitation rates in the Northeast Pacific forecasts a collapse of the sardine stock. Proceedings of the National Academy of Sciences (PNAS) 109 (11). 4175-4180. Available at: http://www.pnas.org/content/early/2012/02/24/1113806109.full.pdf and PFMC, Agenda Item C.1b8, supplemental public comment. March 2012. http://www.pcouncil.org/wp-content/uploads/C1b_SUP_PC8_SHESTER_MAR2012BB.pdf.
[6] NOAA. California Sea Lion Unusual Mortality Event in California. http://www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm

5. Halt in the seasonal sardine migration.[7]

Many of the same observations are justified now, and we are experiencing similar oceanographic conditions.

Importantly, fishing pressure on this declining sardine population can have major and lasting impacts. Fishing pressure can accelerate the collapse of the sardine population and extend the time it takes to recover the population. During periods of significant decline, sardines are most vulnerable to fishing pressure. There is low recruitment and almost no "surplus" production; therefore, right now, any fishing is overfishing.

Our concerns cannot be resolved simply by adopting a more precautionary "P*" value when setting catch levels. It would be inappropriate to use P* to address known errors in the harvest control rule or the failure of sigma to account for known uncertainties. If the Council is aware of such errors, those errors should be fixed immediately before setting catch levels. Fundamental problems with the sardine harvest control rule including the temperature index used to set FRACTION, a flawed DISTRIBUTION parameter, and the extremely low CUTOFF must be addressed. Unless the updated stock assessment finds the sardine population has substantially rebounded, we request the fishery be closed the first half of 2014 and that the Council and NMFS focus efforts on developing an ecosystem-based CUTOFF value, a revised FRACTION, an accurate DISTRIBUTION parameter, and a revised sigma value.

Thank you for your time and consideration.

Sincerely,

Ben Enticknap
Pacific Campaign Manager and Senior Scientist

Attachments:

1. Leschin-Hoar, C. (2013, October 15). Lost at Sea: Fishers Can't Find Sardines and Climate Change May Be To Blame. Takepart.com. Accessed at: http://www.takepart.com/article/2013/10/15/canadas-sardine-collapse-bad-news

2. Pynn, L. (2013, October 15) BC sardine fishery collapse affects both economy and ecology. Vancouver Sun. Accessed at: http://www.vancouversun.com/travel/Sardine+fishery+collapse+affects+economy+ecology/9036436/story.html

[7] Zwolinski and Demer. 2012. *Supra note* 5.

Lost At Sea: Fishers Can't Find Sardines and Climate Change May Be To Blame

Changing water temperatures, poor reproduction, and other factors weighed.

October 15, 2013

Clare Leschin-Hoar

The sardines off the western coast of Canada have completely disappeared.

No one knows exactly what has happened to the $32 million commercial fishery, but what we do know is stunning: The region's sardine fishermen returned to port empty-handed after failing to catch a single fish according to a report Tuesday. Poof! Vanished. Gone.

Although you may not eat sardines on a regular basis, (though we think you should), the health of this tiny forage fish has had scientists worried for some time.

Sardines, along with anchovy and menhaden, form the base of the food chain for species that range from bluefin tuna to humpback whales to sea birds and dolphins. Forage fish are critically important to the aquaculture industry as well, where they're ground up, turned into fishmeal, and fed to popular species like farmed salmon.

Geoff Shester, a scientist with conservation group Oceana says they've been concerned about the Pacific sardine fishery for some time and warns that effects from a collapse could last for decades.

"This is about the entire Pacific coast including the U.S. and Mexico, not just British Columbia," says Shester. "If fishermen have stopped fishing because they've hit their quota, that's one thing. But they're stopping because they can't find any fish. That means fishery management is failing."

Indeed, Oceana isn't the only group worried. The collapse was predicted by prominent scientists who said ocean conditions—including a change in temperature—and poor reproduction rates are contributing to the sardines' decline.

At least one study has found that climate change is causing the geography of where fish are found to shift, which may be what we're seeing in Canada, too.

Fishing pressures on the ecosystem also play an important role. When sardines are in a productive cycle, they can be fished aggressively and their stock can withstand it, while leaving enough for ocean predators, Shester said.

"But if you don't respond to a natural decline fast enough by limiting fishing, you're suddenly in big trouble," says Shester. "It makes the crash even worse because you'll have fewer sardines remaining. When conditions get productive again, they can't bounce back because there aren't enough of them to begin with."

Canada isn't alone in declining sardine stocks. Paul Shively, forage fish campaign manager for Pew Charitable Trusts, says we're seeing a similar trend in the U.S. The numbers are striking. In 2007, the U.S. brought in 127,500 metric tons of Pacific sardines. In 2010, the number shrunk to 66,817 metric tons, and by 2011 that number declined to 44,000 metric tons.

“We can’t do a lot about the changing temperatures of the ocean and the natural cycles it goes through, but what we can do is to keep from fishing the bottom out of that. We don’t want to fish those last remaining fish,” he said.

Shively is worried about more than just sardines. While sardines are protected under fishery management plans, he points out that there are no such protections for other important species like smelt, Pacific saury and lantern fish.

“If someone wants to fish them, there are no limits on what they can take,” says Shively.

As for the sardine fishery, Shester says we should be paying close attention to the news coming from Canada.

“We’re in an emergency situation right now. Any fishing is overfishing when the stock is in this condition.”

Sardine fishery collapse affects economy, ecology

Loss of $32-million industry felt along entire food chain

BY LARRY PYNN, VANCOUVER SUN - OCTOBER 15, 2013

A $32-million commercial fishery has inexplicably and completely collapsed this year on the B.C. coast.

The sardine seine fleet has gone home after failing to catch a single fish. And the commercial disappearance of the small schooling fish is having repercussions all the way up the food chain to threatened humpback whales.

Jim Darling, a Tofino-based whale biologist with the Pacific Wildlife Foundation, said in an interview Monday that humpbacks typically number in the hundreds near the west coast of Vancouver Island in summer. They were observed only sporadically this year, including by the commercial whale watching industry.

"Humpbacks are telling us that something has changed," he said. "Ocean systems are so complex, it's really hard to know what it means. For one year, I don't think there's any reason to be alarmed, but there is certainly reason to be curious."

Humpbacks instead were observed farther offshore, possibly feeding on alternative food sources such as herring, sandlance, anchovies, or krill, but not in the numbers observed near shore in recent years.

The sardine, also known as pilchard, has a uniquely fascinating history.

Sardines supported a major fishery on the B.C. coast in the mid-1920s to mid-1940s that averaged 40,000 tonnes a year.

Then the fish mysteriously disappeared - for decades - until the first one was observed again in 1992 during a federal science based fishery at Barkley Sound on the west coast of Vancouver Island.

With the re-emergence of the sardines came the humpbacks, around 1995, becoming so numerous in coastal waters off Vancouver Island that they supplanted grey whales as the star attraction of the whale-watching industry.

Peter Schultze, a senior guide and driver with Ocean Outfitters, said humpbacks are normally found seven to 10 kilometers or closer to shore, but this year were about 18 to 32 kilometers out. That meant for more travel time and fuel burned and less time with the humpbacks, if they were observed at all. "There were a lot of days where people got skunked."

Overfishing had long been blamed for the disappearance of sardines from B.C. waters. But scientists today attribute the overriding cause to changes in ocean conditions that proved unfavorable to sardines.

B.C. started commercial fishing for sardines in 2002, and in 2013 had an allowable catch of about 25,000 tonnes, which compares with a total estimated population of 659,000 tonnes.

"This year was unexpected," said Lisa Mijacika, a resource manager with Fisheries and

Oceans Canada in Vancouver, noting fishing did take place in California and Oregon. "They are a migratory fish heavily influenced by ocean conditions." Scientists from Canada, the U.S., and Mexico will meet in December to try to find answers to the sardine's movements.

There are now 50 B.C. commercial sardine licenses, half held by First Nations. The fishery normally operates from July to November, but not this year.

"They've given up looking, pulled the plug," confirmed Lorne Clayton, executive-director of the Canadian Pacific Sardine Association. "It certainly was disappointing. It's cost them time, fuel, and crew to go out and look, with no compensation."

While seiners fishing close to the surface got skunked, he noted that commercial hake fishermen with trawl nets at depths of 200 to 350 meters reported catching hake "filled with sardines," Clayton said. "I think they didn't come to the surface this year. Right now, it's all speculation."

Darling said that doesn't explain the sudden change in humpback behavior off the island. "If sardines were there in any number, you'd think the whales would have figured that out," he said. "I don't think anyone really has a bead on what's going on."

Clayton said the B.C. sardine fishery has a wholesale value of about $32 million, with the fish going into the canned market, as well as for reduction and oil. The loss of the fishery this year could have repercussions for next.

"Not only does it affect their livelihood but it puts a hole in the marketplace," he said. Even if sardines come back next season, "you may have to claw your way back into the marketplace."

Clayton said that ocean temperatures tides, plankton and light are all factors that could be influencing the sardines.

"In a given year, fishermen have to search them out to go fishing. They don't just arrive at your boat."

He noted that the sardine fishery also collapsed this year in South Africa. "They disappeared entirely with no evidence at all."

Darling said society should question whether the greater value of sardines is as prey for natural predators in the ocean, including the humpbacks upon which the whale-watching industry depends so heavily.

"Would it not make sense to leave the fish that are driving the whole system and supporting virtually everything? There are some important questions to be asked about the sardine fishery."