Agenda Item I.2.c
CPSMT Report 1
November 2010

Specifications and Management Measures for Monitored CPS Stocks

At its June 2010 meeting, the Pacific Fishery Management Council (Council) heard from its Coastal Pelagic Species (CPS) advisory bodies, the Scientific and Statistical Committee (SSC), and the public on the matter of establishing Overfishing Limits (OFLs), Acceptable Biological Catch (ABCs), and Annual Catch Limits (ACLs) for monitored stocks under Amendment 13 to meet the NS1 guidelines. After reviewing a range of alternatives, the Council adopted the following final action for monitored stocks under Amendment 13:

- Maintain the default harvest control rules for monitored stocks as modified to specify the new management reference points. ACLs would be specified for multiple years until such time as the species becomes actively managed or new scientific information becomes available. The value of 0.25 in the ABC control rule (a 75 % buffer) will remain in use until recommended for modification by the Scientific and Statistical Committee and approved by the Council.

Control Rules for Monitored Species	
OFL	STOCK SPECIFIC MSY PROXY
ABC	OFL * 0.25
ACL	Equal to ABC or reduced by OY considerations.

- The Council confirmed that status determination criteria for the CPS FMP are to remain as currently specified with the exception of the northern subpopulation of northern anchovy (for which no criteria currently exist). The Council is anticipated to adopt a maximum sustainable yield (MSY) proxy for this subpopulation through the annual management cycle at its November meeting.

The control rules and harvest policies for monitored CPS stocks may be more generic, precautionary, and simpler than those used for actively managed stocks. Under the FMP, any stock supporting catches approaching the ABC or MSY levels should be actively managed unless there is too little information or other practical problems. The main use of the control rules for a monitored stock is to help gauge the need for active management and to trigger consideration to move a stock to active management. The goal is to move the stock to active management before it is experiencing overfishing or if other concerns prompt a move to active management. While landings are low and the stock remains in the monitored category, its status is assessed infrequently making estimates of MSY or MSST difficult and impractical. MSY proxies for market squid, jack mackerel and the central subpopulation are currently in place. In Amendment 8 of the CPS FMP, the benchmarks for monitored finfish stocks were truncated at the nearest thousand mt when they were adopted, as it was recognized that the estimates were not precise and this would provide an additional precaution against overfishing. The benchmarks for these

three stocks are listed in Table 1. Section 4.4 of Appendix B in Amendment 8 of the CPS FMP can be reviewed for details on the benchmarks for monitored finfish stocks. Details for market squid can be found in the market squid fishery management plan (CDFG 2005) and Amendment 10 of the CPS FMP (PFMC 2002).

Table 1. Management reference points for monitored stocks in the CPS FMP.

Jack Mackerel	Sources: MacCall and Stauffer (1983), Amendment 8 – Appendix B (PFMC 1998)	
OFL	Stock MSY proxy = 194,000mt	US Distribution MSY proxy = 126,000 mt
ABC	OFL x 0.25 = 48,000 mt	US ABC = 31,000 mt
Northern Anchovy, Central Subpop	Sources: Conrad (1991), Amendment 8 – Appendix B (PFMC 1998)	
OFL	Stock MSY proxy = 123,000mt	US Distribution MSY proxy = 100,000 mt
ABC	OFL x 0.25 = 31,000 mt	US ABC = 25,000 mt
Market Squid	Sources: CPS FMP Amendment 10 (PFMC 2002) and California Market Squid FMP (CDFG 2005)	
OFL	F_{MSY} proxy resulting in Egg Esc $\geq$ 30%	
ABC	245,348 mt	

At a joint meeting with the CPSMT October 5-7 in La Jolla, CA the CPS subcommittee of the SSC expressed interest in reviewing how the MSY proxies were derived and the data sources utilized. Details of how these proxies were derived can be found in the original sources, which are listed here to facilitate SSC review. The complete analyses done to derive these proxies are not repeated here and are beyond the scope of this summary document. However, the existing stock specific MSY proxies, their sources, the general method and date of their derivation are listed below. As was noted by the SSC in March and June 2010, these proxies are based on dated information and the 75% reduction buffer in the ABC control rule may need to be reevaluated. Consequently, major caveats of utilizing these proxies noted in the source documents, some of the key parameters utilized in their derivation, landings data for these stocks, and results of a vulnerability analysis for CPS stocks (Patrick et al. 2009) are summarized below to help evaluate if the application of the 75% reduction buffer is adequate to prevent overfishing. These finfish monitored stocks continue to experience limited targeted fishing pressure and relatively low levels of landings at this time.

Distribution

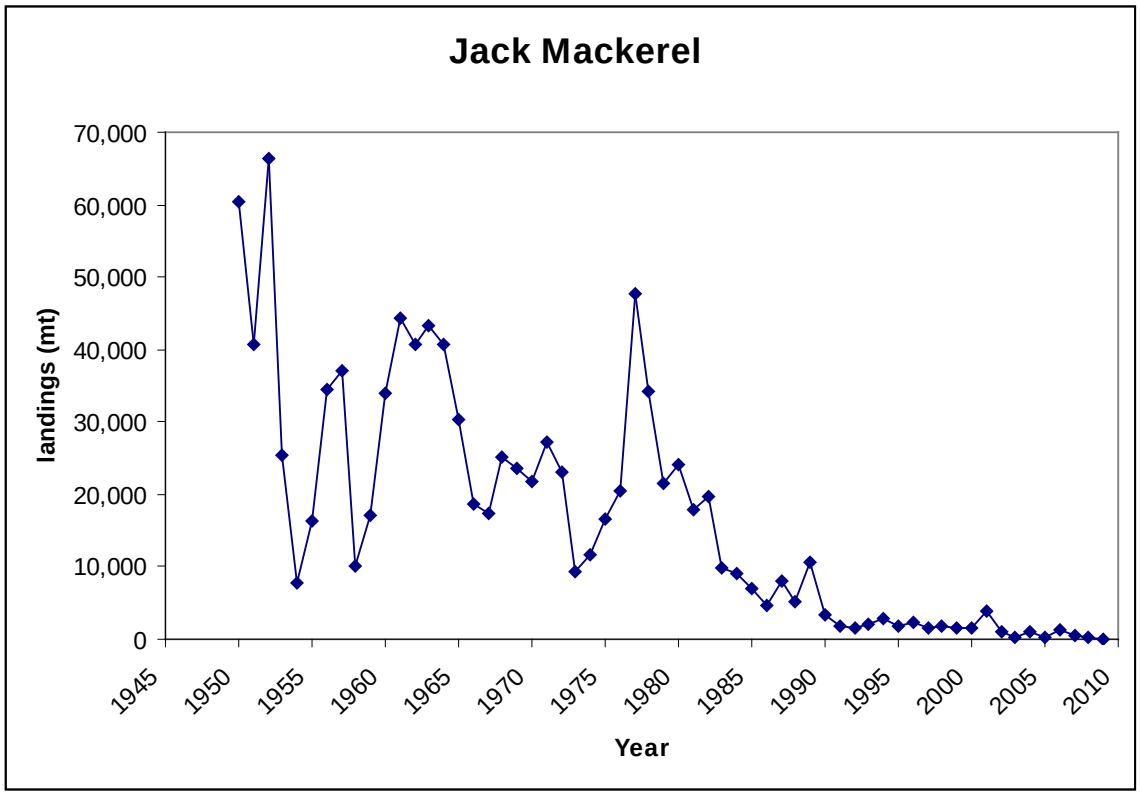
Details of the analysis, available data, and discussion of the management issues for harvest levels for US fisheries with these transboundary finfish stocks can be found in section 4.1.3 of Appendix B to Amendment 8 on pages B-84 to B-89. The MSY proxies

in Amendment 8 for jack mackerel and the central subpopulation of northern anchovy were based on the entire stock. It was recognized that these stocks did not reside entirely in US waters so a distribution term was utilized to account for the portion available to US fisheries. The best estimates of the portion of CPS stocks available in US waters were derived from CalCOFI egg and larvae collections (1951-1985) and aerial fish spotter data (1964-1992). The estimates represent an average of CalCOFI data for spring and summer and fish spotter data from summer through winter. Best estimates for the average distribution in US waters for monitored stocks of jack mackerel and the central subpopulation of northern anchovy were 65% and 82%, respectively. It was noted that it was unlikely that these estimates could be updated frequently, but that the estimate for jack mackerel should be updated if a significant fishery developed.

Jack Mackerel

The MSY proxy for jack mackerel was derived by MacCall and Staufer (1983) using a dynamic pool model with various assumptions about natural mortality and fecundity. Data collected in CalCOFI egg and larval surveys from 1951-1976 were utilized. Their estimates of initial total biomass ranged from 14,841,000 mt to 18,120,000 mt with potential yield ranging from 130,000 to 260,000 mt. The midpoint of potential yield, 194,000 mt was used as the MSY proxy for the entire stock of jack mackerel. The ABC was set to 48,000 mt for the entire stock and 31,000 mt for the portion available to fisheries in US waters based on the default MSY control rule.

Landings for this stock have declined substantially and have been relatively low since 1990 as effort and interest in targeting this species has declined.



Average jack mackerel landings (mt) for the last five decades with high and low values are given below.

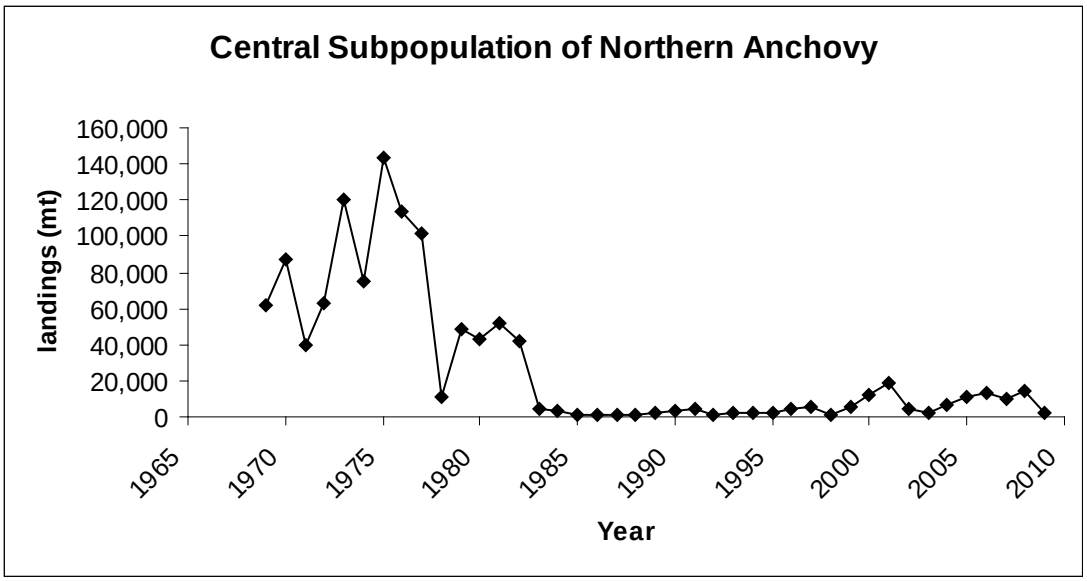
Time Period	Average landings	Highest landings	Lowest landings
1950 -1959	31,561	66,462	7,863
1960 -1969	31798	43,274	17,325
1970 - 1979	23,353	34,349	9,406
1980 - 1989	10,084	24,181	4,777
1990 - 1999	2,053	3,254	1,526
2000 -2009	1,027	3,839	121

Northern Anchovy - central subpopulation

The benchmarks for the central subpopulation of northern anchovy come from a bioeconomic model for the reduction fishery developed by Conrad (1991). Optimal biomass of ~733,000 mt and stock MSY of ~123,000 mt resulted from the modeled analysis. However, the author noted that the most recent (1990) biomass estimate was 299,410 mt (Jacobson and Lo 1991). The ABC was set to 31,000 mt for the stock and 25,000 mt for the portion available to fisheries in US waters based on the default MSY control rule.

There has been extensive work on biomass estimate modeling for this subpopulation with the most recent estimate of the spawning stock being 388,000 mt in 1995 (Jacobson et al. 1995). Jacobson et al. (1997) concluded that the abundance and biomass was at least as high in 1997 as it was in 1995 based on a qualitative analysis. Median biomass reported for this stock for the period 1953-1991 was 547,000 mt (Jacobson et al. 2001). Management options have also been examined (Jacobson and Thomson 1989).

Landings for this stock have declined substantially since the 1970s as the reduction fishery declined. The biomass of this stock also declined from the 1970s to the 1990s, which was probably related to environmental and ecological changes such as the Pacific Decadal Oscillation and/or the increase in the Pacific sardine biomass. However, mechanistic links between anchovy biomass and environmental and ecological changes are still poorly understood.



Average landings (mt) of central subpopulation of northern anchovy with high and low values for the last four decades are given below.

Time Period	Average landings	Highest landings	Lowest landings
1970 - 1979	80,349	120,327	11,439
1980 - 1989	15,320	52,308	1,390
1990 - 1999	3,076	5,718	1,124
2000 -2009	9,546	19,277	1,676

Market Squid

Market squid is a short-lived species that is exempt from ACLs under the NS1 guidelines. Current management establishes a threshold egg escapement of at least 30 percent as a proxy for MSY. The control rule for market squid and the MSY proxy are entirely different than for other monitored stocks. Details of the analysis and options examined are in Amendment 10 (PFMC 2002). The relationship between *F*msy and stock abundance is poorly understood. The biomass of the stock is unknown at this time. Although monitoring/modeling efforts to date provide useful descriptive statistics regarding population dynamics surrounding this species, further work would be necessary before implementing new methods for long-term management purposes. The substantial spatial and temporal variability in productivity of the population(s) off the central-southern California coast hinders the applicability methods to determine egg escapement in practical terms and ultimately, emphasizes the need for timely data collection, laboratory processing, and modeling, if any methods are to be employed formally in the future.The fishery takes place primarily in California and there is a state landing cap of 107,048 mt. The state landing cap is envisioned as a benchmark triggering reevaluation of the monitored status of this stock.

Management measures currently in place for market squid include:

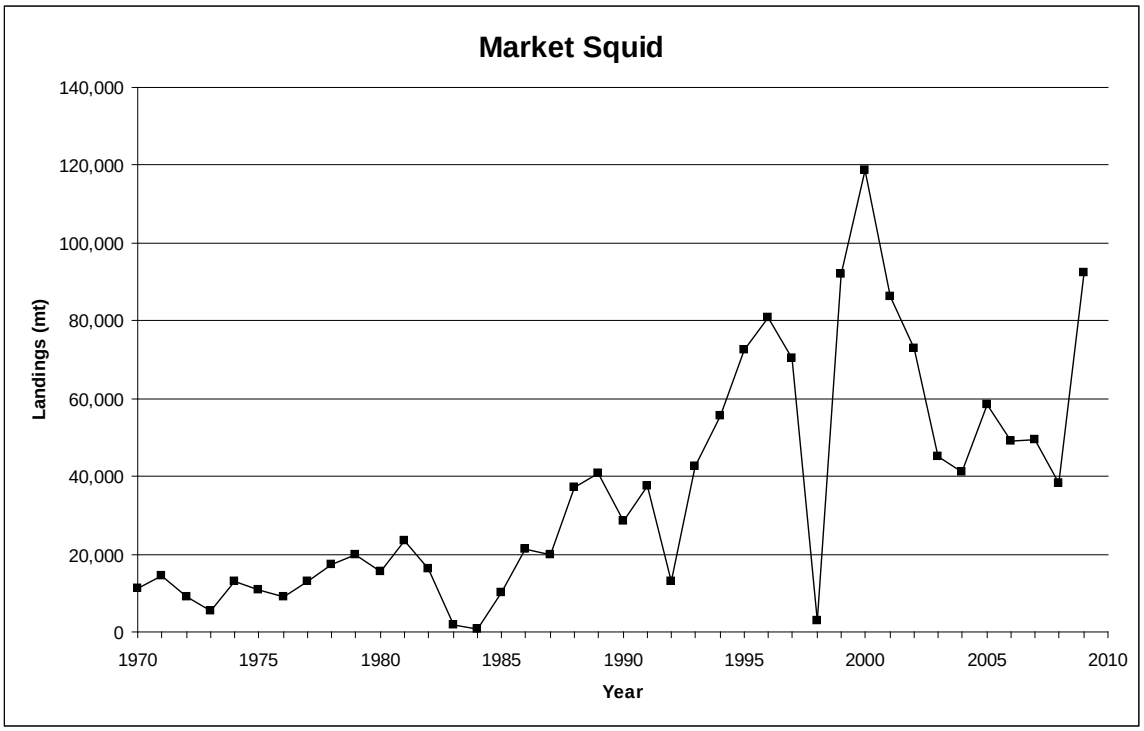
1. Temporal closures (weekend closures);

2. Spatial closures (marine protected areas, which include Channel Islands Marine Protection Areas (MPAs) and new and proposed MPAs under the California Marine Life Protection Act);
3. Gear closures (i.e., Santa Monica Bay, leeward side of Catalina, lighting restrictions in Gulf of the Farallones Marine Sanctuary);
4. Gear restrictions for light shields and wattage limits;
5. Continued monitoring programs used to evaluate the impact of the fishery on the resource;
6. Restricted access program designed to limit fleet participation in order to maintain a moderately productive and specialized fleet; and
7. State management framework (Marine Life Management Act), which provides specific guidelines for making management decisions.
8. State landing cap of 107,048 mt.

Other constraints that protect squid from overfishing include:

9. The population is utilized for commercial purposes within a fraction of the geographic range;
10. Fishing occurs within a limited portion of the depth range; and
11. Fishing pressure does not usually shift from traditional fishing areas to new areas when there is a decrease in availability of squid.

Landings for market squid have increased since the mid 1980s due to increased market demand and targeting of this species.



Average landings (mt) of market squid with high and low values for the last four decades are given below.

Time Period	Average landings	Highest landings	Lowest landings
1970 - 1979	12,300	19,982	5,471
1980 - 1989	18,725	40,893	564
1990 - 1999	49,563	91,950	2,895
2000 -2009	65,181	118,814	38,101

Northern Anchovy – northern subpopulation

No management benchmarks for this stock presently exist. This subpopulation ranges from Eureka, California to the Queen Charlotte Islands, British Columbia, Canada. Some key fishery independent data on this stock are summarized below:

- Egg and larvae surveys
    - Richardson (1981)
        - July 1975 – biomass 262,506 to 796,511 mt
        - July 1976 – biomass 144,654 to1,005,263 mt
        - July 1977 – acoustic estimate of 800,000 mt
        - Potential yield – 86,792 mt to 633,319 mt, lower if managed like central anchovy subpopulation
    - PFMC 1998 – CPS FMP Amendment 8 Appendix B
        - "Educated guess" correction factor reduces Richardson's spawning biomass estimates to a range of 87,000-116,000 mt
    - Emmett et al. (1997) in Forage Fish in Marine Ecosystems
        - No biomass estimate
        - Greatly reduced abundance and distribution of anchovy eggs and larvae in July 1994 and 1995 compared with Richardson's (1981) work in 1975 and 1976
        - Eggs present at only 1 station of 242 stations in 1994 (0.4%). Egg density 400/m^2
        - Max egg density in 1995 was 5,600/m^2 at 1 station
        - Larvae densities also lower and present at only 4% and 9% of stations in 1994 and 1995 compared with 47% and 57% presence in 1975 and 1976.

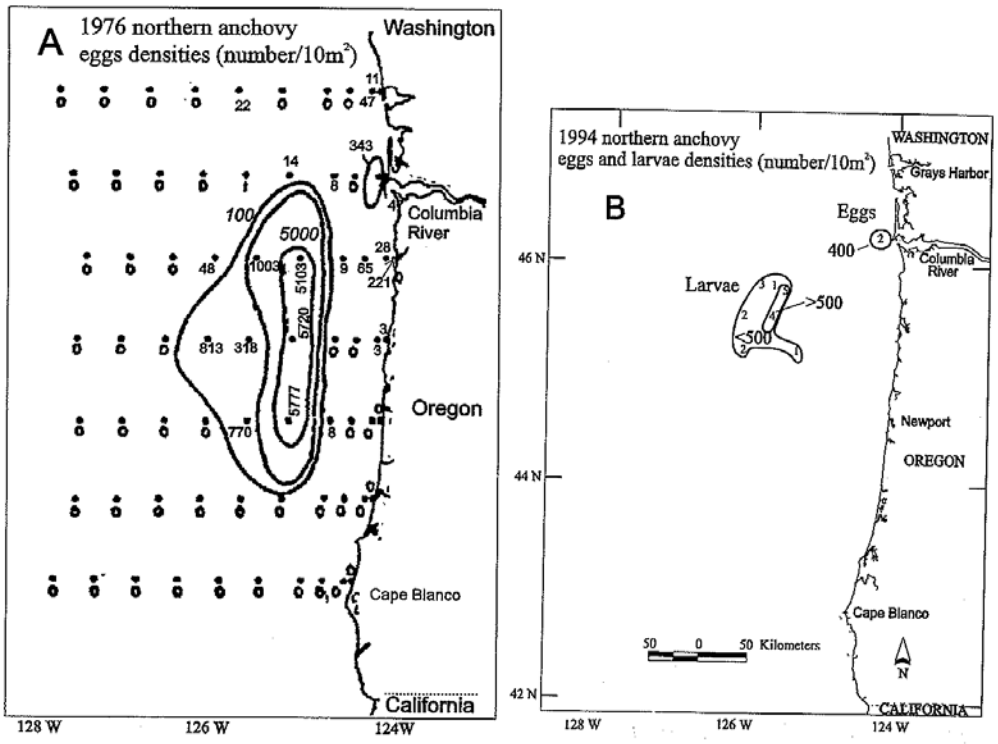
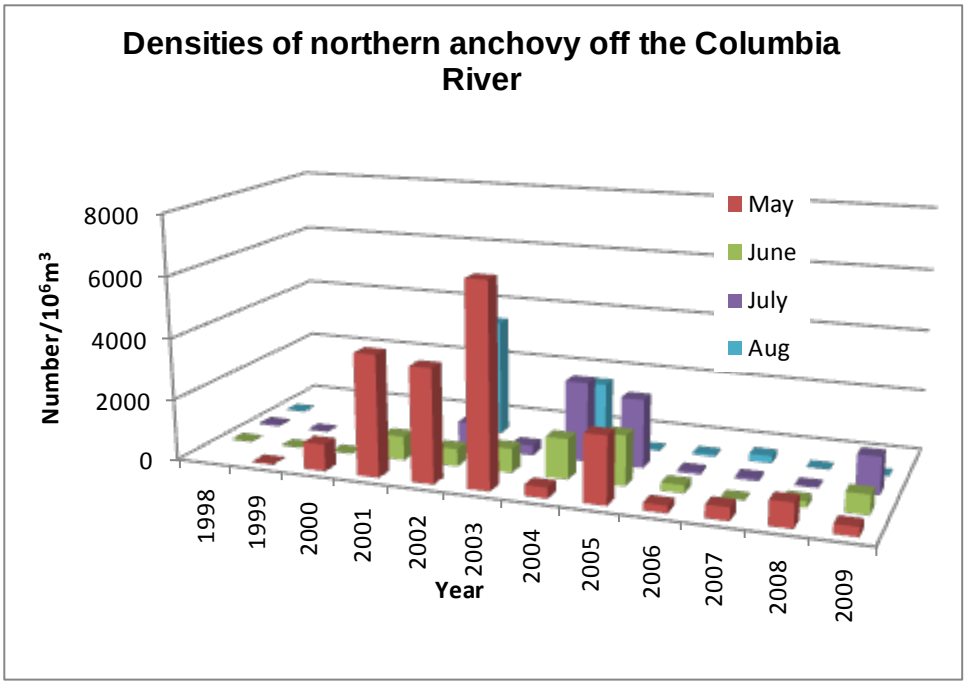


Figure 1. Location and density of northern anchovy eggs and larvae found in July 1976 (A) (from Richardson 1981) and July 1994 (B) from ichthyoplankton surveys off Oregon and southern Washington. Actual numbers of eggs and larvae captured in 1994 are shown in B. In 1994, larvae included some unidentified clupeid larvae that could have been northern anchovy or Pacific sardine.

Figure from Emmett et al. 1997.

- Acoustic estimate 2008
  - Zwolinski et al. (in prep.) SWFSC
    - 159,800 mt (CV >0.88)
    - Note: details of this estimate are not presently available for SSC review
- Relative index of abundance 1999-2009
  - Emmett (unpublished data in figure below, methods published in Emmett et al. 2001) found higher abundance in 2001 - 2005 than in 2006 - 2009

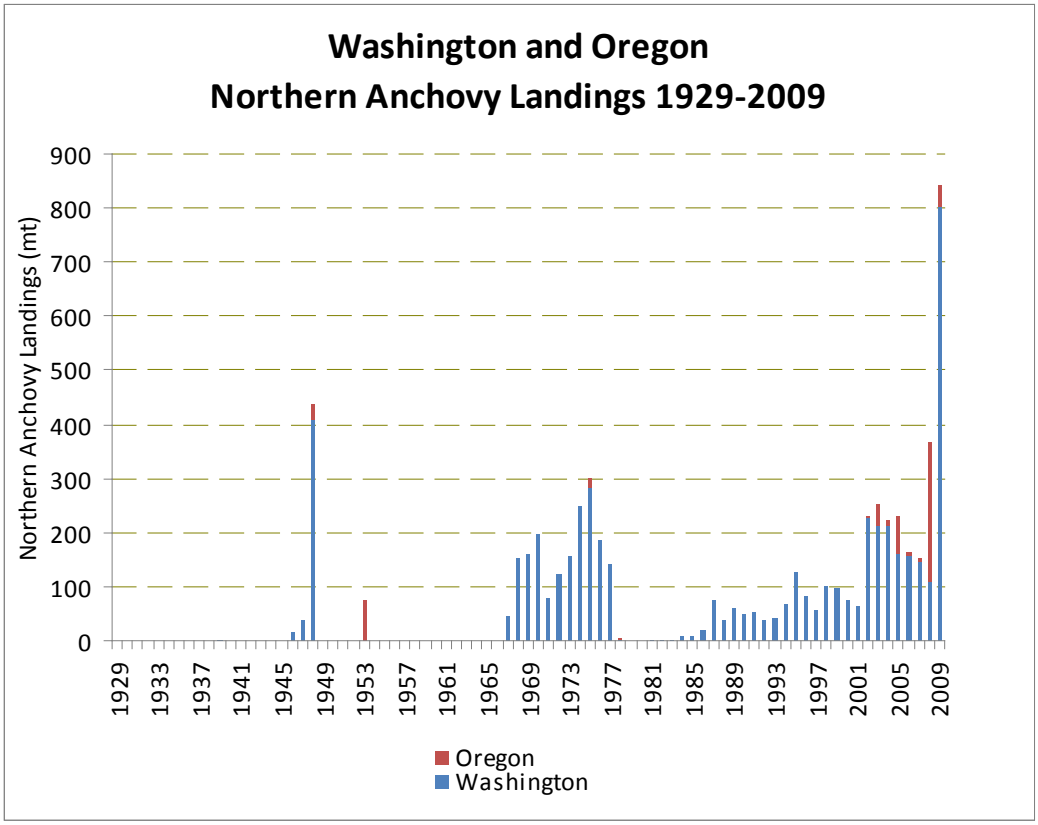


- Litz et al. (2008) examined ecology and distribution of the northern subpopulation
  - Recent population fluctuations likely related to timing of spring transition and abundance of cold water copepods
  - Strong year classes recruited earlier were caught in 2003 and 2004 and abundance decreased subsequently
  - Ages of anchovy sampled were 0-3 years

There are also substantial fishery data available for this stock from landings in Canada, Oregon, and Washington, which are summarized below:

- British Columbia, Canada landings
  - Stock Status report B6-08 (DFO 2002)
    - Max of 6,000 mt in 1941
    - Avg. 1939-1949 = 1,665.1 mt
    - Avg. 1950-1959 = 137.0 mt
    - Avg. 1960-1979 no data
    - Avg. 1980-1989 = 42.6 mt
    - Avg. 1990-1999 = 2.8 mt
    - Avg. 1997-2001 = 95.2 kg (range 0 – 272 kg)
    - Fishery closed in 2002

- Oregon and Washing landings combined



Average landings (mt) of northern subpopulation of northern anchovy with high and low values for the last six decades are given below.

Time Period	Average landings	Highest landings	Lowest landings
1950 -1959	8	76	0
1960 -1969	37	162	0
1970 - 1979	146	304	0.3
1980 - 1989	24	62	1
1990 - 1999	74	103	42
2000 -2009	262	845	68

Stock Vulnerability Considerations

The term "vulnerability" is referenced in sections of the NS1 guidelines that deal with 1) differentiating between "fishery" and "ecosystem component" stocks, 2) assembling and managing stock complexes, and 3) creating management control rules. Productivity and susceptibility indices were examined to determine stock vulnerability for California Current coastal pelagic species including both the actively managed and monitored stocks in the CPS FMP (Patrick et al. 2009). The vulnerability of a stock to become overfished

is defined in this report as the potential for the productivity of the stock to be diminished by direct and indirect fishing pressure. Vulnerability is expected to differ among stocks based on life history characteristics and susceptibility to the fishery. Vulnerability includes two key elements: 1) stock productivity (a function of the stock's life-history characteristics); and 2) stock susceptibility, or the degree to which the fishery can negatively impact the stock. Data quality was also considered in the analysis. This definition differs from that often used in evaluation of species at risk of extinction, where the concern is the likelihood of recovering from a diminished abundance and the focus is placed upon the productivity of the stock. In our case, a stock with a low level of productivity would not be considered vulnerable to fishing unless there was also some susceptibility of the stock to a fishery. The interaction between the productivity of a species and its susceptibility to a fishery has a long history in fisheries science.

CPS vulnerability scores (scale 0 to 2.83)
Pacific sardine - 1.2
Pacific mackerel - 1.5
Northern anchovy - 1.2
Market squid - 1.4

- CPS are not classified as 'vulnerable' resources. These species' productivity is high, susceptibility to the fishery is moderate, and overall vulnerability low compared with other fisheries/species, (e.g., majority of the sharks, groundfishes, and other species evaluated in Patrick et al. 2009).
- CPS are not currently 'overfished' or subject to 'overfishing' practices.

Biology generally supports less precautionary harvest recommendations for CPS than for most of the other exploited species that inhabit the CA current. However, these species are subject to high interannual and interdecadal variability in recruitment, the causes of which are largely unknown. This variability tempers their higher productivity scores and should be recognized in management of fisheries for these species.

Using Recent Catch to Develop OFLs, ABCs, ACLs, and ACTs
A recent presentation by fishery scientist Dr. Rick Methot (NMFS Office of Science & Technology and the Northwest Fisheries Science Center) provided an overview of ABC control rules and scientific uncertainty. The presentation is available at:
http://www.fisheriesforum.org/documents/11181_May2010Forum_Methot.pdf

Catch for the monitored CPS finfish stocks best fit into the scenario presented for recent catch being "small", based on the vulnerability analysis and historical catch information. Dr. Methot suggests that ABC and ACL be set above historical catch, that ACT be set at historical catch levels, and an increase in ACT be allowed if accompanied by cooperative research and close monitoring.

Acoustic data that can be utilized to provide information on biomass has been collected on NMFS research cruises and a proposal for reviewing methods to estimate biomass from acoustic data has been submitted by the SWFSC (see Agenda Item I.3.a Attachment 2, Terms of Reference for methodology reviews). Landings of these stocks are closely

monitored each year by state agencies. Thus, the monitored CPS finfish stocks may be good candidates for applying the methods suggested by Dr. Methot.

Options for Consideration

Option 1 - Adopt benchmarks for jack mackerel, northern anchovy (central population), and market squid based on existing stock specific MSY proxies from Table 1 and adopt benchmarks for northern anchovy (northern subpopulation) based on recent catch.

Option 2 – Adopt benchmarks for s based on MSY proxies from Table 1 with modifications suggested by SSC and adopt based benchmarks for northern anchovy (northern subpopulation) based on recent catch.

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