NATIONAL MARINE FISHERIES SERVICE REPORT

Situation: National Marine Fisheries Service will briefly report on recent developments in the coastal pelagic species fishery and other issues of relevance to the Council.

Council Task:

1.   Discussion.

Reference Materials: None.

Agenda Order:

1.   NMFS Report   Svein Fougner
         a.   Council Discussion

PFMC
2/20/02

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL COMMENTS ON
NMFS REPORT

The Coastal Pelagic Species Advisory Subpanel (CPSAS) would like to recommend that National Marine Fisheries Service trigger an automatic action to reopen the directed pacific mackerel fishery. Further, the CPSAS recommends this fishery begin no later than April 1st. The Council is not slated to discuss the mop- up fishery until the April meeting. However, given the mackerel landings to date, and the amount of harvest guideline which has not been landed, the CPSAS believes there is urgency to beginning the mop-up fishery as soon as possible. Due to time constraints, if NMFS waits until after the April council meeting to begin this process, it will likely be May before the mop-up fishery begins. Beginning the process prior to the April Council meeting will ensure that the industry has a higher probability of harvesting the majority of the harvest guideline available.

PFMC
03/14/02

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL COMMENTS ON
AMENDMENT 10

The Coastal Pelagic Species Advisory Subpanel (CPSAS) heard a presentation from Coastal Pelagic Species Management Team (CPSMT) Chairman Kevin Hill reviewing the draft document of Amendment 10 to the CPS fishery management plan (FMP).   The majority (7 of 8) of the CPSAS agree the draft represents a reasonable range of alternatives for issues relative to limited entry fleet capacity management and an maximum sustainable yield (MSY) control rule for squid.   The majority of the CPSAS believe the document is adequate for public review and recommends the Council send out the document for public review and comment.

Minority Report

Although the CPSAS was unanimous in agreeing that a reasonable range of alternatives exists for issues relative to limited entry fleet capacity, the minority opinion believes that for squid MSY, Alternative 4, the preferred alternative needs an additional sub-option. It is proposed that this sub-option use the same model as Alternative 4, but include an egg escapement threshold of 0.4 (40%). This is a reasonable alternative to consider because of (1) the environmental concerns from the rapid increase of its catches, (2) the fisheries propensity to crash during *El Niño* events, (3)   its importance to the ecosystem as a prey species, and (4) since 0.4 (40%) is used as the threshold in the Falkland Islands fishery.

PFMC
03/14/02

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
AMENDMENT 10

Dr. Kevin Hill of the Coastal Pelagics Species Management Team (CPSMT) presented an overview of the proposed Amendment 10 to the CPS fishery management plan (FMP).   The draft amendment addresses two separate issues in the FMP: (1) establishing a capacity goal and permit transferability provisions for the limited entry fleet, and (2) establishing a maximum sustainable yield (MSY) proxy for market squid.

The Scientific and Statistical Committee (SSC) has the following comments regarding the draft amendment:

CPS Limited Entry

The draft amendment identifies four capacity goal options (options A1-A4), three permit transfer options (options B1-B3), five options for adjusting permit transferability to maintain the capacity goal (options C1-C5) and four options for issuing new limited entry permits (options D1-D4).   The draft amendment combines a selected number of these options into two packages: (1) alternative 1, consisting of options A4, B1, C4 and D4 and designated the "status quo" or "no action" alternative, and (2) alternative 2, consisting of options A1, B3, C4 and D2 and designated the "proposed" action.   Alternative 2 is apparently a composite of prior Council and CPSMT decisions on preferred options.   As currently written, the narrative in the draft amendment is difficult to follow, as it requires the reader to move back and forth between alternatives and potential options.   However, as explained in Exhibit H.2 (Situation Summary), the Council and the public have greater flexibility in packaging the various options than the two alternatives presented in the draft amendment. To improve clarity and to facilitate the ability of the Council and the public to consider alternative ways of combining management options, the SSC suggests that the narrative first lay out all options and describe which options can feasibly be combined into management alternatives before getting into any detailed analysis of options and alternatives.

The draft amendment should clarify whether the proposed options for issuing new limited entry permits (options D1-D4) pertain to the issuance of temporary or permanent permits.   The SSC notes that, if the size of the limited entry fleet falls below the capacity goal, issuance of new permanent permits may be a plausible way to increase fleet size until the capacity goal is reached.   However, if the point of issuing new permits is to increase capacity above the goal (for instance, to allow greater access to harvest under unusually high stock abundance conditions), the SSC strongly recommends that any such permits be temporary, as the issuance of additional permanent permits under such circumstances would compromise the purpose of having a capacity goal.

The analysis of limited entry options and alternatives focuses largely on effects on producer surplus, consumer surplus and fishing community economic activity.   These effects are largely asserted rather than demonstrated with empirical information.   The assertions regarding effects on producer surplus and fishing communities are plausible in terms of their consistency with economic theory. (For instance, theory generally supports the notion that increases in efficiency associated with capacity management have positive effects on producer surplus and potentially negative effects on fishing communities.)   However, the assertions made regarding effects on consumer surplus cannot be supported by merely appealing to consistency with theory.   The size and direction of changes in consumer surplus depend on a number of factors, such as the extent to which the economic benefits associated with more efficient capacity management are passed on to consumers, whether the flexibility provided by permit transferability necessarily results in higher quality fishery products, and whether the markets for CPS products are domestic or foreign.   The confounding nature of such factors makes it difficult to definitively evaluate the effects of the various options and alternatives on consumer surplus.   The SSC recommends that all assertions regarding consumer surplus effects be either substantiated with empirical evidence or deleted from the draft amendment.

Squid MSY

The proposed egg escapement (EE) approach (alternative 4) establishes a practical and informative annual monitoring scheme for the current market squid fishery and appears to be a workable solution to addressing the MSY deficiency in the current plan.   The credibility of the EE approach depends critically on existing information regarding population productivity, growth and maturation of the stock within the current range of the fishery and on the assumption that the fishery targets the spawning population only.   If the fishery expands to new areas or begins to target squid before they spawn, more active management of the squid resource will likely be warranted (e.g., inseason catch or effort control).

The EE method is described in the draft amendment as "risk averse" (p. 9). The SSC notes that it is premature to characterize the EE method in this manner. Market squid is currently a monitored-only species in the CPS FMP and the EE approach is intended to serve as an effective monitoring technique. Whether this approach is actually risk averse cannot be known without applying and further evaluating the approach.   Concurrent with using the EE method, the SSC therefore supports continuation of the State of California's weekend fishery closure and establishment of an annual cap on landings.   The SSC reiterates its November 2001 recommendation regarding the need to periodically review the egg escapement approach and supports the idea of convening another Stock Assessment Review Panel in 2004.

PFMC
03/14/02

DRAFT
LIMITED ENTRY FLEET CAPACITY MANAGEMENT AND A MARKET SQUID MSY CONTROL RULE

AMENDMENT 10 TO THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

INCLUDING
ENVIRONMENTAL ASSESSMENT / REGULATORY IMPACT REVIEW AND DETERMINATION OF THE IMPACT ON SMALL BUSINESSES

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MARCH 2002

ACKNOWLEDGMENTS

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List of Acronyms and Abbreviations

CDFG	California Department of Fish and Game
Council	Pacific Fishery Management Council
CPS	Coastal Pelagic Species
CPSMT	Coastal Pelagic Species Management Team
CZMA	Coastal Zone Management Act
DEA	data envelopment analysis
EA	environmental assessment
EE	egg escapement method
EFH	essential fish habitat
EIS	Environmental Impact Statement
ENSO	El Niño Southern Oscillation
E.O.	Executive Order
FMP	fishery management plan
GRT	gross registered tonnage
LE	limited entry
Magnuson-Stevens Act or MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSY	maximum sustainable yield
mt	metric tons
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NS	National Standards (per by the Magnuson-Stevens Act)
PDO	Pacific Decadal Oscillation
PRA	Paperwork Reduction Act
RFA	Regulatory Flexibility Act
RIR	Regulatory Impact Review
Secretary	U.S. Secretary of Commerce
SSC	Scientific and Statistical Committee
STAR	Stock Assessment Review

1.0 INTRODUCTION – PURPOSE AND NEED FOR ACTION

1.1   How This Document is Organized

This FMP amendment contains two distinct, unrelated elements that address deficiencies in the CPS FMP. The first pertains to establishing a capacity goal and permit transferability for the limited entry fleet. The second element addresses the need for a Maximum Sustainable Yield (MSY; or proxy) for the market squid resource, as required by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). While unrelated, these two elements are embodied in a single plan amendment in order to minimize redundancy of elements common to all Environmental Assessments and Regulatory Impact Reviews.

This section discusses the purpose and need for these two actions. Section 2 describes the proposed action and other alternatives that the Council considered to address management objectives. Section 3 is a description of the affected environment. Section 4 contains an analysis of the environmental consequences of each alternative, including a rationale for the proposed action. Section 5 summarizes the proposed action's consistency with FMP objectives and the Magnuson-Stevens Act. Section 6 addresses other laws, besides the Magnuson-Stevens Act, that apply to the development of fishery management actions. Section 7 contains reference material including a list of preparers. Appendix A is the Finding of No Significant Impact.

Extensive background information is provided in the appendices of this document. Appendix B is a copy of the approval letter for Amendment 8, outlining reasons for disapproving the market squid MSY portion of the plan. Appendix C (PFMC, 2001a) contains the CPSMT's detailed analysis of the fleet's harvesting capacity and serves as the basis for options considered for a capacity goal and conditions for the transfer of existing permits. Appendices D, E, F and G comprise various analyses and recommendations pertinent to developing management alternatives for market squid MSY. Appendix H contains the amendatory language for this FMP [to be completed].

1.2   Establishing a Capacity Goal and Related Limited Entry Measures

Proposed action: Establish a capacity goal for the limited entry (LE) fishery, provide for LE permit transferability to achieve and maintain the capacity goal, and establish a process for considering new limited entry permits.

Purpose: Ensure that fishing capacity in the CPS limited entry fishery is in balance with resource availability.

1.2.1   Problems for Resolution

The limited entry program established under Amendment 8 was implemented to prevent overcapitalization of the CPS fleet. Permits were transferable without restrictions during the first year of the program (2000). As of 2001, permits were made non-transferable except when the permitted vessel is totally lost, stolen or scrapped and the permit is placed on a replacement vessel of the same or less net tonnage. These restrictions where intended to place a cap on the harvesting capacity of the fleet pending the establishment of a capacity goal. The Coastal Pelagic Species Advisory Subpanel (CPSAS) and the public have expressed concern about the transferability restrictions and whether the number of permits initially issued reflects optimal capacity in the fishery. To address these concerns, the Council directed the Coastal Pelagic Species Management Team (CPSMT) to analyze several issues related to capacity and permit transferability: 1) establish a goal for the CPS finfish fishery (i.e., what should the fishery "look like" in terms of the number of vessels and the amount of capacity); 2) develop mechanisms for achieving the goal; 3) establish mechanisms for adjusting permit transferability to maintain the capacity goal; and 4) establish a procedure for issuing new permits once the goal is attained.

1.2.2 Background

In November 2000, the CPSMT provided a range of scenarios under which a capacity goal could be established: 1) maintain a diverse CPS finfish fleet (similar to current number of vessels), which also relies on other fishing opportunities such as squid and tuna; 2) determine the size of a smaller fleet of vessels with certain characteristics (e.g., small number of larger, "efficient" vessels or smaller number composed of CPS finfish "specialists"); or 3) base the fleet size on expectations of long-term expected yields from the combined CPS finfish species and the number of vessels physically capable of harvesting that yield. The Council directed the CPSMT to continue work on establishing a capacity goal and addressing other capacity related issues such as permit transferability. Alternative capacity goals were to be constructed following the three options outlined by the CPSMT.

The CPSMT and CPSAS discussed these issues at their February 2001 and March 2001 meetings. At the April 2001 Council meeting, the CPSMT reported the results of their capacity analysis and recommended several alternatives for setting a capacity goal and addressing permit transferability (Appendix C). The CPSMT was subsequently directed to develop mechanisms for adjusting permit transferability in the event the fleet should exceed the capacity goal, and establish criteria for issuing new permits. The CPSMT further developed options for these permit sub-issues, presenting them to the CPSAS and Council at the November 2001 meeting. Fleet capacity goal and permit transferability alternatives presented in this amendment represent the range of options developed by the CPSMT and CPSAS—with review and input from the Council, SSC and the public—and agreed to by the Council.

1.3 Establishing an MSY Proxy for Market Squid

Proposed action: Establish an MSY (or proxy) for market squid that will bring the FMP into compliance with the Magnuson-Stevens Act requirement that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry."

Purpose: Bring the CPS FMP into compliance with Magnuson-Stevens Act, and provide a means to minimize the likelihood of overfishing.

1.3.1 Problems for Resolution

Two of the topics required by the Magnuson-Stevens Act to be included in all FMPs were disapproved in Amendment 8, which required action to correct these deficiencies. One topic, bycatch provisions for the CPS fishery, was addressed and approved in Amendment 9 (66*FR*44896). Optimum yield for market squid was disapproved because Amendment 8 did not provide an estimate of maximum sustainable yield (MSY) (Appendix B). At its meeting in June 1999, the Pacific Fishery Management Council (Council) directed the CPSMT to develop a revision to the FMP and report to the Council the following September.

1.3.2 Background

In response to the Council's request for a revision the CPSMT held a public meeting in La Jolla, California on August 3 and 4, 1999, and on August 24, 1999, a meeting was held between the CPSMT and the CPSAS. At its September meeting, the Council gave further direction to the CPSMT regarding MSY for squid. At its March 2000 meeting, the Council asked the CPSMT for a more thorough analysis of the alternatives proposed for establishing MSY for squid and for bycatch. At a public meeting in La Jolla, California on April 20 and 21, 2000, the CPSMT reviewed comments from the Council, the Council's Scientific and Statistical Committee (SSC) and prepared additional material for establishing MSY for squid based on spawning area. These preliminary options and analyses were included in an early draft of Amendment 9 (Appendix D).

Based on testimony presented regarding draft Amendment 9, the Council decided to exclude squid MSY alternatives from the Amendment and wait until new stock assessment analyses for squid could be

completed. At the November 2000 Council meeting, the SSC recommended the CPSMT work with the National Marine Fisheries Service (NMFS) and California Department of Fish and Game (CDFG) to organize a stock assessment workshop to review ongoing squid research and integrate new approaches into the FMP. A squid stock assessment review (STAR) was held May 14-17, 2001, and the STAR panels' report (Appendix F; PFMC, 2001c) and recommendations were presented to the CPSMT on August 14-15, 2001, and the CPSAS and Council in November 2001. Based on the squid STAR panel report, the CPSMT drafted recommendations for squid management and research and presented their report to the CPSAS and Council in November 2001 (Appendix G). The market squid MSY alternatives presented in this amendment represent the range of options developed by the CPSMT and CPSAS—with review and input from the Council, SSC and the public—and agreed to by the Council.

1.4   Scoping Summary

The Council process offers many opportunities to determine the scope of the action and the likely environmental consequences that merit analysis and disclosure. This work is carried out by advisory bodies and at Council meetings, which are open to the public. The preceding background discussion describes how the proposed actions analyzed in this document evolved with direction from the Council and development by various advisory bodies, but in particular the CPSMT and CPSAS.

Previous FMP amendments can be used to narrow the scope of the analysis if they have discussed impacts equivalent to the likely impacts of the proposed action, and the status of the affected resources has not changed substantially. An EIS accompanied Amendment 8, which implemented the limited entry program that this amendment modifies. The analysis in that document can be used to narrow the scope of the analysis in this document. The EIS found that the limited entry program impacts "are primarily socioeconomic although some environmental effects may arise if the tendency to overfish in open access fisheries is reduced by limited entry fisheries" (PFMC 1998, p. EIS-17). The capacity management measures described in this amendment would not affect harvest levels, which are determined by other FMP management measures. In addition, the status of the target resources have not changed substantially since the EIS was completed. For these reasons, the impact analysis for capacity management focuses on socioeconomic impacts.[1] Any method chosen for setting market squid MSY would not have direct impacts on the resource. Further, at this time squid are not an actively managed species, so MSY estimates are only used to monitor their status. The analysis of management alternatives, therefore, focuses on the reliability of different approaches for estimating biomass and MSY. The Amendment 8 EIS notes that "There is not enough information available to evaluate impacts of the default MSY control rule for market squid because squid are not well understood" (PFMC 1998, p. EIS-18). These constraints also apply to the analysis in this document. In practical terms, the proposed action for squid management provides an approach to evaluate the effects of fishing mortality on the spawning potential of the stock and in particular, to examine the relation between the stock's reproductive output and candidate proxies for the fishing mortality that results in MSY (F_{MSY}). However, it is important to note that this approach does not provide estimates of historical or current total biomass and thus, a definitive yield (i.e., quota or Acceptable Biological Catch) cannot be determined at this time. Ultimately, the EE approach can be used to assess whether the fleet is fishing above or below an a priori-determined sustainable level of exploitation and in this context, can be used as an effective management tool.

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[1] In addition to satisfying NEPA requirements, the analysis addresses requirements under the Regulatory Flexibility Act and Executive Order 12866, which focus on economic impacts.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1   Capacity Management in the CPS Limited Entry Fleet

The Council devised the proposed action (or Preferred Alternative) by choosing elements from four sets of options: A) establishing a capacity goal, B) specific conditions for transferring permits from one vessel to another, C) mechanisms to adjust these conditions in order to maintain the capacity goal, and D) procedures for issuing new limited entry permits. It is important to note that the choice of a particular option may be contingent on choosing another. For example, any mechanism for adjusting permit conditions depends on which option is chosen for permit transferability, which in turn depends to some extent on the capacity goal that is chosen.

This subsection first presents the No Action and Preferred Alternatives. (The No Action Alternative, a required element of an EA, makes it possible to evaluate the effects of the Preferred Alternative with respect to conditions that would prevail if no actions were taken and the current management regime continued without these changes.) Other alternatives could be developed besides these two alternatives, based on the four "option sets" (labeled A through D) that represent different elements of capacity management. These options sets are presented to show the range of alternatives that could be possible. For the purposes of analysis, several scenarios (representing different combinations of the options) are presented and discussed in Section 4.1.4.[2]

2.1.1   Alternative 1 (the No Action Alternative or Status Quo)

Capacity Goal (Option A.4): Under the current management regime the fleet is fixed at 65 vessels, with no capacity goal or limits on fleet GRT.

Conditions for Transfer of Existing Permits (Option B.1): Under the current management regime permits cannot be transferred except 1) if the permitted vessel is totally lost, stolen or scrapped, such that it cannot be used in a federally regulated commercial fishery, provided the application for the permit originates from the vessel owner who must place it on a replacement vessel of the same or less net tonnage within one year of disability of the permitted vessel, or 2) the permit is placed on a replacement vessel of the same or less net tonnage provided the previously permitted vessel is permanently retired from all federally managed commercial fisheries for which a permit is required. Provisions to adjust permit transferability to maintain the capacity goal would not be applicable under the status quo.

Procedures for Issuing New Limited Entry Permits (Option D.4): Under the current management regime there are no provisions for issuing new permits

2.1.2   Alternative 2 (the Proposed Action)

Capacity Goal (Option A.1): Maintain a larger, diverse CPS finfish fleet, which also relies on other fishing opportunities such as squid and tuna, with normal harvesting capacity equal to the long-term expected aggregate finfish target harvest level, approximately 110,000 mt, and with physical capacity available to harvest peak period amounts of finfish, 275,000 mt. The current fleet of 65 vessels would satisfy this goal. Estimated normal harvesting capacity for the current fleet ranged from 60,000 mt to 111,000 mt per year; physical harvesting capacity ranged from 361,000 to 539,000 mt per year. Total calculated Gross Registered Tonnage (GRT) for the current fleet is 5,642 mt. Under this option, 5,642 mt of GRT will therefore represent the fleet capacity goal.

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[2] In contrast to an Environmental Impact Statement, an EA focuses on the proposed action. Other reasonable alternatives need only be briefly described and discussed briefly. Because the proposed action was developed by considering different sets of partially contingent options, describing these option sets demonstrates the range of alternative courses of action considered by the Council.

Conditions and effects of transferability should be reevaluated periodically in conjunction with achievement of the capacity goal, and objectives of the FMP. The Council recommends setting a trigger for reevaluation based on an overall change in fleet GRT of 5%. The CPSMT will evaluate capacity in the CPS finfish fishery relative to the capacity goal every two years starting in 2003, this would include a report to the Council with recommendations regarding the capacity goal and permit transferability.

Conditions for Transfer of Existing Permits (Option B.3): Allow CPS finfish limited entry permits to be transferred with restrictions on the harvesting capacity of the vessel to which it would be transferred to: 1) full transferability of permits to vessels of comparable capacity (vessel GRT +10% allowance), and 2) allow permits to be combined up to a greater level of capacity in cases where the vessel to be transferred to is of greater harvesting capacity than the one from which the permit will be transferred.

Adjusting Permit Transferability to Maintain the Capacity Goal (Option C.4): Restore fleet capacity to target fleet GRT (5,642 mt) by restricting conditions for permit transfer when the upper threshold of fleet GRT (fleet GRT plus 5% (+282 mt), or 5,924 mt) is reached. Under this mechanism, once the trigger point is met or exceeded, permits could only be transferred to vessels with equal or smaller GRT and the 10% vessel allowance would be removed. The 10% allowance could be reconsidered once total fleet GRT is reduced to the 5,642 mt target.

Procedures for Issuing New Limited Entry Permits (Option D.2): Use qualifying criteria originally established in Amendment 8 for issuance of new CPS finfish limited entry permits. This would probably entail continuing down the list of vessels having landings during the 1993-97 window period in order of decreasing window period landings. In this case, the next permit awarded would go to the 71st of the 640 vessels with window period finfish landings if this vessel were to apply. Each vessel on the list would need to have its harvest capacity evaluated so that in aggregate the new capacity target was not exceeded.

2.1.3   Other Options Considered in Formulating Alternatives

A. Capacity Goal Options

Option A.1: This option is described above as part of Alternative 2, the Proposed Action.

Option A.2: Work the fleet down to a smaller number of vessels with certain characteristics (e.g., smaller number of larger, "efficient" vessels; or smaller number composed of CPS finfish "specialists"), with normal harvesting capacity equal to average total finfish landings over the 1981-2000 period, approximately 57,676 mt.

Option A.3: Base the fleet size on our expectations of long-term expected yields from the combined CPS finfish species and the number of vessels physically capable of harvesting that yield, 110,000 mt annually, without an excess capacity reserve.

Option A.4: This option is described above as part of Alternative 1, No Action.

B. Existing Permit Transfer Options

Option B.1: This option is described above as part of Alternative 1, No Action.

Option B.2: Allow CPS finfish limited entry permits to be transferred without constraints.

Option B.3: This option is described above as part of Alternative 2, the Proposed Action.

C. Options for Adjusting Permit Transferability to Maintain the Capacity Goal

These options would be applicable only if Option B.3 is chosen. Option B.3 allows permit transfer with restrictions on the harvesting capacity of the vessel receiving the permit and is part of the Proposed Action.

Option C.1: There would be no provisions for adjusting transferability. This option includes only the conditions for permit transfer described under Option B.3, which is part of the preferred alternative. A CPS limited entry permit would be transferable on a 1-for-1 basis to a vessel with a harvesting capacity not in excess of 110% of that of the transferring vessel; if in excess of 110%, additional permits would have to be combined with the original permit to match the harvesting capacity of the vessel to which the permits will be transferred.

Option C.2: Restore fleet capacity to target fleet GRT (5,642 mt) by restricting conditions for permit transfer when the upper threshold of fleet GRT(fleet GRT plus 5% (+282 mt), or 5,924 mt) is reached. Under Alternative 2, once the trigger point is met or exceeded, permits could only be transferred by combining-up on a 2-for-1 basis. Transfer restrictions could be repealed once fleet GRT is reduced back down to the 5,642 mt target.

Option C.3: Restore fleet capacity to target fleet GRT (5,642 mt) by restricting conditions for permit transfer when the upper threshold of fleet GRT(fleet GRT plus 10% (+564 mt), or 6,206 mt) is reached. Under Alternative 3, once the trigger point is met or exceeded, permits could only be transferred by combining-up on a 2-for-1 basis. Transfer restrictions could be repealed once fleet GRT is reduced back down to the 5,642 mt target.

Option C.4: This option is described above as part of Alternative 2, the Proposed Action.

Option C.5: Restore fleet capacity to target fleet GRT (5,642 mt) by restricting conditions for permit transfer when the upper threshold of fleet GRT(fleet GRT plus 10% (+564 mt), or 6,206 mt) is reached. Under Alternative 5, once the trigger point is met or exceeded, permits could only be transferred to vessels with equal or smaller GRT and the 10% vessel allowance would be removed. The 10% allowance could be reconsidered once total fleet GRT is reduced to 5,642 mt target.

D. Options for Issuing New Limited Entry Permits

Option D.1: The FMP does not specify qualifying criteria for additional or new limited entry permits. Under this option permits could be issued on a first come first served basis (e.g., through lottery or auction). Each vessel applying for a permit would have to have its harvest capacity evaluated so that in aggregate the new CPS finfish harvesting capacity target was not exceeded. This option is probably not feasible unless none of the vessels applying have a history in the fishery.

Option D.2: This option is described above as part of Alternative 2, the Proposed Action.

Option D.3: Establish new qualifying criteria. This would involve establishing a new window period, minimum landings, etc. This would probably be desirable if there were reasons to extend the window period further back in time to qualify vessels whose history in the fishery pre-dated the original window period. Each vessel applying for a permit would have to have its harvest capacity evaluated so that in aggregate the new CPS finfish harvesting capacity target was not exceeded. This option would require an amendment to the FMP.

Option D.4: This option is described above as part of Alternative 1, No Action.

2.2 Market Squid MSY Control Rule

As discussed in Section 1, the second, separate management measure considered in this EA is the implementation of an MSY control rule for market squid. The Council considered four alternatives for this measure.

Alternative 1 (No Action): Do not set MSY.

Alternative 2: Set a MSY proxy based on evaluation of historical landings. Determine a proxy for MSY

based on recent average catches from time periods when there is no qualitative or quantitative evidence of declining abundance. This Alternative is generally based on methods discussed in Restrepo et al. (1998) for determining MSY proxies in data-poor situations, i.e., when insufficient sample data are available for classical MSY calculations. Additionally, see section 5.2.1 in PFMC (2000) for squid-related analysis conducted by the CPSMT in support of this Alternative (Appendix D). The SSC did not support this Alternative.

Alternative 3: Set MSY proxy based on evaluation of historical catch by spatial block, along with measures of coastwide (potential) spawning area determined from research trawl survey data. This Alternative is generally based on ad hoc "area expansion" techniques, whereby documented catch statistics are expanded using total, "potential" fishing areas and/or squid spawning habitat as the expansion factor(s) and subsequently, assuming MSY is roughly equivalent to average, expanded catch statistics over an extended time period. See sections 5.2.2 and 5.2.3 in PFMC (2000) for squid-related analysis conducted by the CPSMT in support of this Alternative (Appendix D). The SSC did not support this Alternative.

Alternative 4 (the Proposed Action):. Set fishing mortality that results in a MSY (F_{MSY}) proxy, based on evaluation of female squid spawning success determined through port sampling programs, coupled with per-recruit analysis theory. This Alternative, referred to as the Egg Escapement Method (EE), generates necessary statistics for determining the relationships between important equilibrium-based fishery descriptors and biological attributes of the population. In practical terms, the EE can be used to evaluate the effects of fishing mortality (F) on the spawning potential of the stock and in particular, to examine the relationship between the population's reproductive output and candidate proxies for F_{MSY}. However, it is important to note that this approach does not provide estimates of historical or current total biomass and thus, a definitive yield (i.e., quota or Acceptable Biological Catch) cannot be determined at this time. Ultimately, the EE can be used to assess whether the fleet is fishing above or below an a priori-determined sustainable level of exploitation and in this context, can be used as an effective management tool. See Maxwell (2001) for technical details regarding analysis involved in the EE (Appendix E) and PFMC (2001b) for management-related issues associated with implementation of the EE (Appendix G). This Alternative was supported by the SSC, the CPSMT, and the CPSAS.

Table 2.1 Summary of Impacts for Amendment 10 Issues and Alternatives. Alternatives are evaluated relative to the status quo/no action, and solely in terms of CPS finfish fishing operations; no action suggests what will happen without an alternative action being taken. Socioeconomic effects include: 1) changes in net economic benefits (producer and consumer surplus), and; 2) economic impacts, i.e., changes in economic activity (business transactions, income and employment) in fishing communities. A complete evaluation of the impacts of each action is given in section 4.0.

Option / Alternatives	Environmental Effects	Socioeconomic Effects
No Action Alternative		
Capacity Goal for the CPS Limited Entry Fleet (Option A.4)	None	Long-term: increase in consumer and producer surplus; increased economic activity in CPS fishing communities
Conditions for Transfer of Existing Permits (Option B.1)	None	Long-term: slight increase in producer and consumer surplus; no change in fishing community economic activity
Adjusting Permit Transferability to Maintain the Capacity Goal	N/A	N/A
Procedures for Issuing New Limited Entry Permits (Option D.4)	N/A	N/A
Proposed Action		
Capacity Goal for the CPS Limited Entry Fleet (Option A.1)	None	Long-term: increase in consumer and producer surplus; increased economic activity in CPS fishing communities
Conditions for Transfer of Existing Permits (Option B.3)	None	Long term: increase in producer and consumer surplus; no change in fishing community economic activity
Adjusting Permit Transferability to Maintain the Capacity Goal (Option C.4)	None	Intermediate to long-term: increase in producer surplus, no change in consumer surplus; no change in fishing community economic activity
Procedures for Issuing New Limited Entry Permits (Option D.2)	None	Short to long term: increase in producer and consumer surplus; no change in fishing community economic activity
A. – Capacity Goal for the CPS Limited Entry Fleet		
Option A.2	None	Long-term: decrease in consumer surplus; reduction in fishing community economic activity
Option A.3	None	Long-term: decrease in consumer surplus; reduction in fishing community economic activity
B – Conditions for Transfer of Existing Permits		
Option B.2	None	Long-term: no change or slight decrease in producer surplus; increase in consumer surplus; increased fishing community economic activity

Option / Alternatives	Environmental Effects	Socioeconomic Effects
C – Adjusting Permit Transferability to Maintain the Capacity Goal		
Option C.1	None	Long-term: decrease in producer and consumer surplus; no change in fishing community economic activity
Option C.2	None	Short-term: decrease in producer surplus, no change in consumer surplus; no change in fishing community economic activity
Option C.3	None	Short to intermediate-term: decrease in producer surplus, no change in consumer surplus; no change in fishing community economic activity
Option C.5	None	Long-term: increase in producer surplus, no change in consumer surplus; no change in fishing community economic activity
D – Procedures for Issuing New Limited Entry Permits		
Option D.1	None	Short-run: decrease in producer surplus, no change in consumer surplus; increase in fishing community economic activity
Option D.3	None	Short-term: no change in producer and consumer surplus; increase in fishing community economic activity

Market Squid MSY Control Rule		
Alternative 1 (No Action)	A 'risk prone' approach that could jeopardize the population's ability to maintain long-term abundance levels, i.e., not considered precautionary management	Long-term: relatively high potential for decrease in producer and consumer surplus, as well as economic activity of the overall fishing community
Alternative 2	A 'risk prone' approach that could jeopardize the population's ability to maintain long-term abundance levels, i.e., not considered precautionary management	Long-term: relatively high potential for decrease in producer and consumer surplus, as well as economic activity of the overall fishing community
Alternative 3	A 'risk prone' approach that could jeopardize the population's ability to maintain long-term abundance levels, i.e., not considered precautionary management	Long-term: relatively high potential for decrease in producer and consumer surplus, as well as economic activity of the overall fishing community
Alternative 4 (Proposed Action)	A 'risk averse' approach that includes measures that generally protect the population's ability to maintain long-term abundance levels, i.e., considered precautionary management	Long-term: relatively high potential for increase in producer and consumer surplus, as well as economic activity of the overall fishing community

3.0 AFFECTED ENVIRONMENT

Comprehensive information on the affected environment may be found in Appendix A and Appendix D to the CPS FMP[3/]. The California Current is the eastern boundary of the North Pacific great subtropical anticyclonic gyre. At the northern extreme, subarctic water is entrained to flow equatorward. The great shifts in ocean climate at the decadal to century scale control the eastern boundary along the coasts of Washington, Oregon, California and Baja California. The California Current and the subarctic entrained waters are known as the "Transition" zone. The mixing of these waters with the seasonal coastal wind driven upwelling yield highly structured waters with patches of high nutrient and high productivity. High nutrient levels result from a winter buildup of regenerated nutrients and new nutrients from a shoaling thermocline, an influx of high-nutrient, subarctic water and small coastal intrusions of newly upwelled water. Pelagic fish species dominate the exploitable biomass of the system, with major concentrations of anchovy and squid close to the coastline ranging offshore to the habitats of sardine and jack mackerel. The California Current ecosystem is essentially a region of transport, coastal jets, divergence and upwelling.

Seasonal and interannual environmental variability within the California Current ecosystem are associated with variations in the Pacific Basin atmospheric pressure systems, which control the local winds and Ekman transport, and affect flows of the equatorward California Current, the poleward undercurrent, and the inshore countercurrent. Variations on time scales of several years to decades are associated with alterations in the tropical and Aleutian pressure systems, (i.e., the El Niño / Southern Oscillation (ENSO) phenomenon and the Pacific Decadal Oscillation (PDO)). ENSO and PDO events markedly alter flow and temperature of currents in the California Current.

Anchovy, sardine, hake, jack mackerel, and Pacific mackerel achieve the largest populations in the California current region as well as in other major eastern boundary currents. These populations are key to the trophic dynamics of the entire California Current ecosystem. Anchovy and sardines are the only fish in the ecosystem that consume large quantities of primary production (phytoplankton), all five of the species are significant consumers of zooplankton. All five species of fish, particularly mackerels and hake, and also squid are important predators of the early stages of fish. The juvenile stages of all squid and all five species, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans, and other fish.

Trophic interactions between CPS and higher-trophic-level fish are poorly understood, and it is unknown if populations of individual predaceous fish are enhanced or hindered by large populations of CPS. It is not known if the value of CPS as forage to adult predators outweighs the negative effects of predation by CPS on larvae and juveniles of predator fish species plus competitive removal of phytoplankton, zooplankton, and other fish.

3.1   Essential Fish Habitat

A complete description of CPS essential fish habitat (EFH) may be found in Appendix D of the CPS FMP. In determining EFH for CPS, the estuarine and marine habitat necessary to provide sufficient production to support MSY and a healthy ecosystem were considered. Using presence/absence data, EFH is based on a thermal range bordered within the geographic area where a managed species occurs at any life stage, where the species has occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by the species. The specific description and identification of EFH for CPS finfish accommodates the fact the geographic range of all species varies widely over time in response to the temperature of the upper mixed layer of the ocean, particularly in the area north of 39° N latitude. This generalization is probably also true for market squid, but few data are available. Adult CPS finfish are generally not found at temperatures colder than 10° C or warmer than 26° C, and preferred temperatures and minimum spawning temperatures are generally above 13° C. Spawning is most common at 14° C to 16° C.

[3/] Unless stated, appendices cited in Section 3 refer specifically to appendices to the CPS FMP, not the current EA/RIR document.

3.1.1 Market Squid

Market squid (*Loligo opalescens*) along the west coast of North America were studied extensively during 1960 through 1980 (Recksiek and Frey 1978; Symposium of the 1978 CalCOFI Conference[4]), but little research applicable to fisheries management has been carried out since then. Recent increases in squid landings have stimulated a variety of new research projects but results have not yet been published.

Adult and juvenile market squid (Dickerson and Leos 1992) are distributed throughout the California and Alaska current systems from the southern tip of Baja California, Mexico (23° N latitude) to southeastern Alaska (55° N latitude). They are most abundant between Punta Eugenio, Baja California and Monterey Bay, central California. Market squid are harvested near the surface and generally considered pelagic, but are actually found over the continental shelf from the surface to depths of at least 800 meters. They prefer oceanic salinities and are rarely found in bays, estuaries, or near river mouths (Jefferts 1983). Adults and juveniles are most abundant between temperatures of ten degrees Celsius and 16°C (Roper et al. 1984).

Spawning squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood. Spawning occurs over a wide depth range, but the extent and significance of spawning in deep water is unknown. Known major spawning areas are shallow semi-protected near shore areas with sandy or mud bottoms adjacent to submarine canyons where fishing occurs. In these locations, egg deposition is between five meters (Jefferts 1983) and 55 meters (Roper and Sweeney 1984), and most common between 20 meters and 35 meters. Off California, squid and squid eggs have been taken in bottom trawls at depths of about 800 meters near Monterey (Bob Leos, California Department of Fish and Game, pers. comm.) and have been observed at 180 meters near the Channel Islands (Roper and Sweeney 1984). Factors that determine spawning grounds have not been precisely identified. Hatchlings (called "paralarvae") are presumably dispersed by currents. Their distribution after leaving the spawning areas is largely unknown, but maps of market squid incidence from recent and historical surveys may be found in Appendix D of this document (Amendment 10 – EA/RIR). Attempts to differentiate squid stocks using anatomical and genetic characters have been inconclusive. Thus, the number of market squid stocks or subpopulations along the Pacific coast is unknown.

Spawning occurs year-round (Jefferts 1983). Peak spawning usually begins in southern California during the fall-spring season. Off central California, spawning normally begins in the spring-fall season. Squid spawning has been observed off Oregon during May through July. Off Washington and Canada, spawning normally begins in late summer. Year-round spawning likely reduces effects of poor temporary local conditions for survival of eggs or hatchlings. Year-round spawning suggests that stock abundance is not dependent on spawning success during a single short season or a single spawning area.

3.2   Predators

Like northern anchovy and Pacific sardine, market squid are probably important as forage to a long list of fish, birds, and mammals including threatened, endangered, and depleted species (Morejohn et al. 1978). Some of the more important squid predators are king salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lions, sea otters, elephant seals, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet, and common murre.

CPS are eaten by a number of marine mammals, dependence on CPS varying by age from predator to predator. A great deal of information is available about the diets of adult marine mammals, and the total amount of CPS eaten per year has been estimated for a few. It is not currently possible, however, to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem or the size of CPS populations necessary to sustain predator populations. Some of the species, such as the Pribilof population of the northern fur seal, are listed as depleted but a local stock at San Miguel Island is not depleted.

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[4]   See papers by various authors published during 1979 *in*: Calif. Coop. Oceanic Fish. Invest. Rep. 20: 21-71.

Pelagic schooling fish are key components of marine food webs and primary prey of many seabirds. CPS are important to seabirds because of their abundance near the sea surface, relatively small size, fusiform shape, and dense concentration. Seabird populations of the California Current ecosystem and other eastern boundary currents are large relative to areas not driven by large-scale coastal upwelling.

CPS are consumed by a large number of seabirds off the coasts of California, Oregon, and Washington. Availability of anchovies is known to directly affect the breeding success of pelicans, terns, gulls, and auks. It is likely that many predators of anchovies will also eat sardines as the population increases. Owing to their size and occurrence near the surface, Pacific mackerel are likely to be important to seabirds, especially in southern California. Pacific mackerel have been observed in the diet of pelican. Adult jack mackerel are probably less important to seabirds, because of their large size and relatively deep schooling habits. Studies of seabird diet during autumn, however, when small jack mackerel are near shore and more available, may indicate their seasonal importance as forage. Recent increased abundance of sardines off southern California was followed by increased breeding success and abundance of brown pelicans.

4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION AND ALTERNATIVES

4.1 CPS Fleet Capacity Management

The management actions in Amendment 10 pertaining to the harvesting capacity goal, permit transferability, adjusting permit transferability to maintain the capacity goal, and procedures for issuing new limited entry permits relate solely to the limited entry CPS finfish fishery. Therefore, the analysis of the alternatives under these issues is limited to the potential impacts on the limited entry CPS finfish fleet, consumers of CPS finfish landed by the limited entry fleet, and the fishing communities in which the limited entry fleet makes its finfish landings. In examining the socioeconomic effects of management alternatives, benefits, costs and economic impacts are evaluated at the margin, i.e., changes when moving from the status quo to another alternative.

The types of socioeconomic effects that will be considered in the discussions that follow include: 1) changes in net economic benefits within a benefit-cost framework, and; 2) economic impacts, i.e., changes in income and employment in fishing communities. Both are important measures of the socioeconomic effects of management, however they are different and subject to misuse. Misuse of these two measures often leads to inappropriate comparisons of the "values" of various fisheries and/or fishery user groups.

The net economic benefit from the commercial CPS finfish fishery primarily consists of producer surplus, which on an individual vessel basis is the difference between gross exvessel revenues and all fishing costs, including labor costs for captain and crew and a return to the vessel owner. The net economic benefit also includes consumer surplus, which is the net value of CPS finfish products to the consumer. The net benefit to the consumer is the difference between what the consumer actually pays and what they are willing to pay, i.e., the value over and above the purchase price. Producer surplus can increase through decreases in unit harvesting costs (improved economic efficiency), or an increase in exvessel prices received. Consumer surplus can increase through a decrease in prices paid, increases in the quantities consumed, or improvements in product quality.

Table 4.1. Limited entry fleet CPS finfish landings and exvessel revenues by county for the 1995-2000 period.

Area	1995-2000 Landings (in metric tons)	1995-2000 Revenues (in 2000 dollars)
Los Angeles/Orange County/San Diego Counties	317,023	$60,307,095
Santa Barbara/Ventura County/San Luis Obispo Counties	153,509	$42,018,657
Monterey County	91,212	$12,311,883
Other California Areas	5,041	$3,932,009
Total	566,785	$118,569,644

Economic impacts relate to income and employment effects of alternative management actions. Economic impact analyses provide measures of the changes in economic activity by locale, not measures of net benefits. Regional economic models can be used to estimate economic impacts by evaluating the extent to which growth or decline in fishing affects production, trade and employment throughout the regional economy, as fishers make purchases and as the fish are processed, distributed, and marketed. Revenues from these expenditures filter through local, state, and regional economies. Economic multipliers can be used to calculate change in income and employment resulting from a change in the level or the success of fishing. Details on fisheries contributions to the economic well-being of coastal communities is provided in the Council's draft "Community Descriptions" document. The most important locales for fishing activity by the CPS finfish LE fleet, in the context of potential economic impacts associated with the proposed actions are shown in Table 4.1.

The socioeconomic effects of establishing a limited entry program and establishing a target fleet size for the CPS finfish fishery have previously been discussed in the Regulatory Impact Review of Amendment 8. See the sections on Alternatives for Management of Fishing Effort (RIR, pp. 4-5), and on Target Fleet Size (RIR, pp. 6-7). An earlier analysis of the CPS finfish fishery capacity goal/target fleet alternatives is presented in Appendix A to the CPS FMP. The discussion of capacity goal alternatives that follows focuses on the potential environmental and socioeconomic impacts associated with the capacity goal alternatives. It assumes that a permit can only be transferred to a vessel, of the same or less harvesting capacity, which is replacing one that was lost, stolen, scrapped, or permanently retired from all federally managed commercial fisheries, (i.e., the no action, *status quo*, transferability alternative).

New permits may be necessary in the future to address significant changes in market conditions, resource availability, or CPS fleet activity. If such conditions were to occur, industry could raise a point-of-concern under the FMP's socioeconomic framework. The Council could direct the CPSMT to reassess the capacity goal, estimate latent capacity in the fleet, evaluate market conditions and resource availability, and make recommendations as to the number of new permits to issue. The Council could consider placing some restrictions on the new permits, such as making them temporary or non-transferable to accommodate subsequent contractions in the fishery. Exemption from government buyback programs could also be considered.

The Magnuson-Stevens Act requires that a limited entry system take into account:
(A)   present participation in the fishery,
(B)   historical fishing practices in, and dependence on, the fishery,
(C)   the economics of the fishery,
(D)   the capability of fishing vessels used in the fishery to engage in other fisheries,
(E)   the cultural and social framework relevant to the fishery and any affected fishing communities, and
(F)   any other relevant considerations.

These requirements, where applicable, would presumably pertain to the issuance of additional (new) permits as well. Requirement B seems most relevant in this regard.

Given that the decision to admit "X" number of new/additional vessels into the CPS LE fishery has not been made, the discussion of alternative procedures for issuing new permits focuses on how the choice of procedure will effect fleet economic performance and benefits accruing to consumers of CPS finfish products. Under any alternative, temporary status and non-transferability of new permits would address long-term concerns of over-capitalization.

4.1.1   Impacts of No Action (the Status Quo)

For a description of the No Action Alternative, see page 4

A. Capacity Goal

Currently there is no capacity goal and fleet size is fixed at 65 vessels. The No Action Alternative would result in similar environmental, net economic benefit and fishing community effects as expected from the Preferred Alternative in terms of fleet size and structure, but without the harvesting capacity goal. Without any action affecting fleet capacity there is likely to be an increase in CPS finfish landings by the LE fleet in the near future, primarily due to the resurgence of the sardine biomass, and strengthening markets for sardine. The established LE fleet will have ample harvesting capacity to take the long-term expected aggregate finfish quota with an adequate reserve for periods of exceptionally high biomass and most favorable market conditions. Expansion of CPS fishery activity should stimulate economic activity in CPS-related fishing communities.

In the absence of management action to change the criteria for transferring permits, some vessel modernization is expected to occur over time through upgrading of an existing vessel, or through vessel replacement by one of the same or less harvesting capacity. This would promote specialization in CPS finfish, leading to increased harvesting efficiency and improved product quality, which would raise producer and

consumer surplus. Through either means, fish harvesting capacity would be curbed at its existing level, which is deemed to be adequate in the long term. Because the number of vessels in the CPS finfish fishery and their corresponding harvesting capacities would be locked in, this would foster stability within existing fishery segments and fishing communities. Although this alternative would seem to be most compatible with attaining a finfish limited entry fleet consisting of a small number of larger, "efficient" CPS finfish "specialists", it would not allow combining up of permits to replace more than one small vessel with a larger vessel. This could be overly constraining in terms of allowing the industry to respond to changing conditions within alternative fisheries, thus, negating the potential increase in net benefits accruing from finfish specialization.

4.1.2 Impacts of the Proposed Action (Preferred Alternative)

For a description of the proposed action see page 4

A. Capacity Goal

The current finfish limited entry fleet of 65 vessels is sufficient to meet the capacity goals of the Preferred Alternative. Under what might be considered typical or normal operating conditions—harvesting capacity based on average finfish landings per trip and average number of finfish trips per year—the current finfish limited entry fleet would provide sufficient capacity to harvest the expected long-term average aggregate finfish harvest target level (see Appendix C, Table 3). This fleet would also have the physical capacity—harvesting capacity based on maximum finfish landings per trip and maximum number of finfish trips taken per year—to harvest the maximum potential amount of finfish, that amount associated with peak period availability of fish, environmental conditions which are most favorable to stock production, and peak demand for output. This "excess capacity" could otherwise be directed towards the harvest of squid and tuna. In this regard, it is important to note that the ability of vessels participating in the CPS finfish fishery to harvest alternate species lessens the need to reduce the size of the limited entry fleet. CPS finfish purse seine fisheries off California are flexible and accommodate significant changes in resource availability and market demand. When CPS finfish are unavailable or market conditions for CPS finfish are not favorable, CPS purse seine vessels tend to switch to alternative species, primarily market squid, tunas, and herring. There is likely to be growth in CPS finfish landings in the future, mainly due to continued resurgence of the sardine resource and expanded market opportunities for sardine. This means existing harvesting capacity would be more fully utilized, increasing fleet efficiency, and in turn increasing net benefits to harvesters and consumers of sardines. Growth in CPS fishing activity in itself will generate additional economic activity in the CPS fishing communities.

B. Conditions for Transfer of Existing Permits

Option B.3, selected by the Council as part of the Preferred Alternative, would restrict transferability by not allowing permit transfers on a 1-for-1 basis except in cases of comparable harvesting capacity as measured by vessel GRT. Transfers from a smaller vessel to a larger vessel would require combining the smaller permit with another permit for placement on the larger vessel (i.e., 2-for-1). This option represents a compromise between the more restrictive transferability that would prevail if Option B.1 were chosen and full transferability as per Option B.2. Under the Preferred Alternative, harvesting capacity would be fixed at some desired level, but the number of vessels corresponding to that capacity level and initially awarded permits would only be a maximum. By allowing permits to be combined up, the number of vessels initially issued permits could be reduced.

This situation could arise when vessels seek to optimize their operations across the alternative fisheries in which they are capable of participating, market squid being the most likely species in terms of joint optimization. By allowing transferability with the restrictions that are part of the Preferred Alternative, the emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of joint harvesting opportunities without compromising the desired CPS finfish harvest capacity goal.

The permit transfer mechanism (Option B.3) will probably be most satisfactory in terms of harmonizing the CPS finfish limited entry program and California's pending squid limited entry program. At this point, CDFG

is recommending full transferability of permits to vessels of comparable capacity (defined as within 5% of the transferor vessel's GRT) as an element of California's squid limited entry program. In addition, for vessels wishing to increase capacity, CDFG is considering a 2-for-1 program which involves surrendering a permit if the vessel to be transferred to is in excess of the 5% capacity allowance and lower than 135% of the original vessel's GRT. If the replacement vessel's GRT exceeds 135% of the original vessel's GRT, two permits must be surrendered (i.e. 3-for-1) to upgrade. CDFG's proposed scheme for combining permits is designed to decrease capacity of the initial squid fleet through a reduction in the number of vessels. Since the proposed action under Amendment 10 is to maintain the CPS finfish fleet at it's current capacity, *Option B.3* could contain less restrictive exchange rates. For example, a 2-for-1 program for CPS finfish could require surrendering a permit if the vessel to be transferred to is in excess of 110% of the original vessel's GRT. A variation of the 2-for-1 program would require that the permit being surrendered be from a vessel with a GRT equal to the net increase in GRT of the replacement vessel less the comparable GRT allowances. For example, replacing a 50 GRT vessel with a 100 GRT vessel would require an additional permit from a 40 GRT vessel when the comparable GRT allowance is 10% (i.e. comparable GRT is 110% of the transferor vessel's GRT). Allowing permits to be combined up in this manner would enable a fleet to develop that is best suited for participation in both fisheries.

In terms of the CPS physical and normal capacity frontiers shown in Figure 18 of Appendix C, the proportional change in harvesting capacity for a given proportional change in gross tonnage (elasticity of harvesting capacity) is less than one over the range of observed gross tonnages. This means that a 100% increase in a vessel's gross tonnage will result in a less than 100% increase in its harvesting capacities. In the case of physical capacity the corresponding increase in capacity is about 90%, and in the case of normal capacity about 75%. Therefore, a 10% gross tonnage allowance is not expected to result in a substantial increase in harvest capacity. Additionally, this would allow combining up of a permit that is 10% less than the replacement GRT.

The permit transfer mechanism (*Option B.3*) would leave decisions about harvest capacity levels and transferability of permits within the policy arena, but given harvest capacity and transferability parameters, allows industry to determine what the fishery should "look like" in terms of the number of vessels and their corresponding harvesting capacities. *Option B.3* would not impose any restrictions on vessel physical attributes, but would require permits to have a gross registered tonnage endorsement. The CPS finfish harvesting capacity analysis establishes a linkage between a vessel's GRT and its harvesting capacity. Therefore, as is being considered for California's squid limited entry program, a vessel's finfish limited entry permit should carry a GRT endorsement that denotes its harvesting capacity.

From the capacity analysis, vessels greater than or equal to 115 GRT, have a physical harvesting capacity greater than or equal to 125 metric tons per trip (Appendix C, Figure 18). Therefore, we would not expect to see permits being transferred to vessels with a GRT greater than 115, unless vessels of this size are optimum across all fisheries in which they participate.

By allowing permits to be combined up, the number of vessels initially issued permits could be reduced. Increased efficiency would result through reduced fixed costs and variable (operating) costs associated with fewer vessels competing for a fixed harvest. The replacement vessels would be larger and presumably able to operate more efficiently not only in the CPS finfish fishery but in alternative fisheries as well. This would mean an increase in producer surplus. Price-wise, CPS finfish consumers would benefit from equal or increased landings at lower harvesting costs. If vessels seek to optimize their operations across the suite of fisheries in which they are capable of participating, greater quantities of higher quality fishery products could be made available to consumers, increasing consumer surplus. Vessel owners selling permits in combining up situations are presumably better off through the permit sale, or it would not be sold. Thus, through the sale of a permit, all parties are presumably better off which represents a net gain in social welfare. By allowing transferability within the confines of *Option B.3* the emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of the full range of harvesting opportunities without compromising the desired CPS finfish harvest capacity goal. This aspect of the Preferred Alternative is not expected to have any effect on fishing communities.

C. Adjusting Permit Transferability to Maintain the Capacity Goal

The Preferred Alternative, by incorporating *Option C.4*, provides a means of arresting capacity creep, which could occur if there were no provisions for adjusting transferability (*Option C.1*).[5/] It also avoids a potential misallocation of harvesting resources in the CPS finfish fishery. The adjustment process would probably result in a more gradual return to the capacity goal, compared to the 2-for-1 adjustment process under Options C.2 and C.3. Also, because it would allow for continued transfer to vessels of equal or lesser capacity, it would be less restrictive on the industry. Since no two vessels are likely to have the exact same calculated GRT, some decrease in GRT could be expected upon each transfer. Therefore, one possible negative outcome of this component of the Preferred Alternative is that removing the 10% transfer allowance could result in a net decrease in average vessel size (GRT) and corresponding harvesting capacity. The original GRT endorsement would remain attached to the permit, but smaller average vessel size could result in a less efficient fleet relative to the original fleet. This component of the Preferred Alternative is not expected to lead to a decrease in CPS finfish landings, so CPS finfish consumers should not experience any change in economic benefits. However, it could affect the efficiency of harvesting operations in alternative fisheries. Therefore, the adjustment process (*Option C.4*) could have an indirect effect on consumer and producer benefits associated with the full range of fishing opportunities for CPS finfish vessels. This component of the Preferred Alternative is not expected to affect fishing communities.

D. Procedures for Issuing New Limited Entry Permits

The Preferred Alternative (incorporating *Option D.2*) takes into account historical participation during the original window-period for the limited entry program in its criteria for issuing new limited entry permits. It would be the most expedient set of criteria for issuance of new permits if the need should arise in the immediate future. Vessels below 70th rank had only landed a relatively small volume of CPS finfish during the 1993-1997 window period, so they are either inefficient at harvesting CPS, or not interested in doing so actively. If the need for new permits should arise five to ten years from now, the original qualifying list could become outdated, resulting in permits being issued to inactive vessels. The fishing industry would not benefit from the addition of inefficient or inactive vessels to the fleet.

This alternative would weight experience in the CPS finfish fishery higher than the *status quo* alternative, in that it would assure that the opportunity to participate in the expanded fishery would be offered to those next in line behind the original qualifiers. If the original ranking of finfish vessels in terms of their window period landings has any semblance to their relative operating efficiencies, then this alternative is more likely to generate greater net economic benefits compared to the status quo. To the extent that it would alleviate the need for new vessel construction, there could be significant savings in investment costs under alternative 2. While such a reduction in costs would translate into increased net economic benefits from the expansion, it would also mean a foregone increase in fishing community economic activity (employment and income) associated with new vessel construction. There would be some additional administrative expenses incurred in issuing new permits, and qualifying new participants. Since this alternative would weight experience in the fishery more highly, there is less chance of unmet expectations concerning increased landings in the fishery. Thus, consumers are more likely to realize the benefits of increased supplies if this alternative is adopted.

4.1.3   Analysis of Other Options Considered in Developing Alternatives

A. Capacity Goal Options

Under *Option A.2*, the CPS limited entry fleet would be reduced to a smaller number of "efficient" or "specialist" vessels based on vessel characteristics and ranked past performance in the CPS fishery. A

[5/] As described in Section 2, five options were considered for adjusting permit transferability. Because these options are closely related, an assessment of their impacts is best done comparatively. The reader is directed to Section 4.1.3 for this comparative analysis because Option C.4, which is incorporated into the Preferred Alternative is also analyzed there.

substantially reduced fleet consisting of the 12 vessels identified as finfish specialists and 14 non-specialists ranked in descending order of capacity utilization (as described in Appendix C, Table 3, Option 2-A) would have sufficient normal harvesting capacity to satisfy Capacity goal 2, and have physical capacity to harvest approximately 264,000 mt annually. Instead of including only those vessels considered specialists, the fleet could be reduced along a number of different dimensions (e.g., harvesting efficiency) to match capacity with 20-year average landings. Based on decreasing technical efficiency, increasing age and increasing gross tonnage, a fleet of 33 vessels would have sufficient normal harvesting capacity to satisfy Capacity goal 2, and enough physical capacity to harvest 275,000 mt annually (Appendix C, Table 3, Option 2-B). There could be substantial spillover effects in alternative fisheries for CPS finfish vessels. Assuming that at least some of the vessels losing their permits under *Option A.2* would cease fishing, this option would probably severely limit the amount of harvest capacity that would remain for tuna, and would probably increase the need for squid specialists.

There would probably be increased harvest volumes for the reduced number of specialized, more efficient, CPS finfish vessels improving their profitability, i.e., an increase in producer surplus. However, with a significantly reduced fleet there is the potential that the sardine and Pacific mackerel quotas would not be fully utilized, and there could be significant shortfalls in finfish landings in the event of extremely favorable resource and market conditions. Reduced landings could result in higher prices which translates into a decline in benefits to consumers, i.e., reduced consumer surplus. There would likely be a decrease in regional economic activity due to a smaller number of vessels utilizing fishery support services and infrastructure. Fewer fishermen and support employees involved in the CPS finfish fishery would likely have a negative impact on economic activity on fishing communities. Income and employment would likely decrease, and probably become more concentrated in specific communities if the fishery contracts. Assuming that at least some of the vessels losing their permits under this alternative would cease fishing, it would probably diminish the amount of harvest capacity that would be available for tuna, and would probably increase the need for vessels that are squid specialists.

Option A.3 would result in a reduced fleet with physical capacity—harvesting capacity based on maximum finfish landings per trip and maximum number of finfish trips taken per year—equal to the expected long-term average aggregate finfish harvest target level, 110,000 mt annually. This fleet would consist of the 12 finfish specialists when vessels are ranked by speciality and decreasing technical efficiency (Appendix C, Table 3, Option 3-A). This 12 vessel fleet would not have the capacity to take peak period amounts of finfish (275,000 mt) unless it made more finfish trips during the year than its observed maximum. If additional trips were made this would likely diminish the ability of these vessels to participate in other fisheries. This option would limit the amount of harvest capacity that would remain for tuna, and would probably increase the need for squid specialists. This fleet would have normal harvesting capacity of about 26,000 mt annually (Appendix C, Table 3, Option 3-A). Alternatively, when vessels are ranked by decreasing technical efficiency, increasing age and increasing gross tonnage, a fleet of 11 vessels would have sufficient physical capacity to harvest the expected long-term average aggregate finfish harvest target level, 110,000 mt annually. This fleet would have normal harvesting capacity of 23,000 mt annually (Appendix C, Table 3, Option 3-B). The environmental and socioeconomic effects under alternative 3 would be quite similar to those expected under *Option A.2*, since it also proposes to reduce the size of the fleet. However the potential landings shortfalls under *Option A.3* could be much greater than under *Option A.2*, since it results in a greater capacity reserve.

B. Conditions for Transfer of Existing Permits[6/]

Option B.2, an option that was not incorporated into the Preferred Alternative and does not describe the status quo, would allow full permit transferability by which market forces would determine optimum harvesting capacity and fleet configuration taking into account alternative opportunities for CPS vessels. Unrestricted transferability would be incompatible with maintaining a specified harvest capacity goal for CPS finfish because it would allow a replacement vessel to be of greater harvesting capacity than the originally permitted vessel on a one-for-one permit transfer basis. By allowing a replacement vessel to be of greater harvesting capacity than the originally permitted vessel on a one-for-one permit transfer basis, there would not be any

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[6/] See Appendix C, pages 31-32 for additional analysis of permit transferability options.

constraint on vessel-level finfish harvesting capacity. A fleet of larger vessels could result, with harvesting capacity exceeding the capacity goal. Even though this alternative could result in a sub-optimal fleet with respect to a long-term CPS finfish harvest capacity goal, it would not preclude overall efficiency gains during periods of extremely favorable CPS finfish resource and market conditions. Moreover, this option would promote overall efficiency gains for the fleet by allowing vessel owners to optimize harvesting capacity over the full array of fishing opportunities available to CPS vessels. The emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of multiple harvesting opportunities. Increases in efficiency can result in benefits to consumers through lower prices—an increase in consumer surplus—or increases in profits to fishermen through reduced costs, which is an increase in producer surplus. Unconstrained transferability would also maximize the asset value of a LE permit, which would increase the wealth of the fishing community. Also, to the extent that unconstrained transferability results in more vessel transactions, vessel construction and vessel operations, the fishing community benefits from the increase in economic activity.

C. Adjusting Permit Transferability to Maintain the Capacity Goal

Limited entry programs are primarily designed to address economic problems associated with excess harvest capacity in open access fisheries. Implementation of a capacity goal for the CPS fleet has the advantage of preventing overcapitalization and insuring the long-term economic stability of the fleet. There are social, income distributional, or other benefits of greater importance that can be realized by maintaining the capacity goal. The proposed conditions of permit transfer as provided by *Option B.3*, which was incorporated into the Preferred Alternative, may result in an accumulation in fleet capacity (total fleet GRT) over time. Therefore, mechanisms to adjust permit transferability and maintain the capacity goal are part of option set C, as are trigger points for implementing these mechanisms. These options represent a range of possible responses that could have been incorporated into the Preferred Alternative

Under *Option C.1* no mechanism would exist for adjusting permit transferability once fleet capacity exceeds the goal. In the short term, this option would have no positive or negative impacts on the fishing industry. In the long-term, it could result in overcapacity of the CPS limited entry fleet, through a creeping up of capacity, ultimately leading to socioeconomic hardship in the event of diminished resource availability or unfavorable market conditions. This option would not be consistent with the objective of preventing overcapacity in the CPS limited entry fleet.

Without mechanisms to adjust permit transferability in order to maintain the capacity goal capacity creep is likely to occur since vessels are allowed to transfer permits, on a 1-for-1 basis, to another vessel that is within 110% of the transferring vessel's capacity. Over time the capacity goal in the CPS finfish fishery would be exceeded. This would be inefficient from an economic standpoint in that it represents a wasteful mis-allocation of harvesting resources in the fishery. As the fleet's harvesting capacity expanded beyond the harvesting capacity goal there would be a corresponding decrease in net benefits. On the other hand, it could led to greater efficiency in alternative fisheries, if they were experiencing insufficient harvesting capacity that was not being alleviated by entry of vessels from outside the LE CPS finfish fishery. This would result in greater producer surplus through reduced harvesting costs and increased consumer surplus through increased landings. No impacts on the environment or fishing communities would be expected if this option were part of the proposed action.

The trigger point for adjusting permit transferability differs among the options. *Options C.2* and *C.4* (*Option C.4* is incorporated in the Preferred Alternative) would establish a trigger of 5% over target fleet GRT, whereas *Options C.3* and *C.5* are based on a trigger of 10% over fleet GRT. The two trigger levels can be evaluated with respect to the amount of time it may take to accumulate that amount of excess capacity, and how long the transfer restrictions would need to be in place before the fleet returns to the capacity goal. Take the case where the fleet is at the capacity goal (5,642 mt) and a 10% allowance is allowed for each permit transfer. Given an average vessel GRT of 87 mt, a one-time maximum of 8.7 mt of GRT would accrue with each transfer. If a 10% GRT increase were realized with each transfer, it would take at least 32 transfers for the fleet to accumulate 282 mt of excess GRT (5% trigger; *Options C.2* and *C.4*), and approximately 64 transfers to accrue 564 mt of GRT (10% trigger; *Options C.3* and *C.5*). It is unlikely that every permit transfer will be 10% over the original GRT endorsement, and some transfers will likely be to smaller vessels, so it could take

a number of years for the fleet to attain the 5% "overcapacity" trigger. If the 10% fleet trigger were to be implemented (*Option C.3* or *C.5*) and the fleet were to accumulate 564 mt of excess capacity, it would take twice as long to return to target fleet capacity goal.

Alternatives under option set C offer two different mechanisms for returning fleet capacity to the fleet goal (target fleet GRT of 5,642 mt) when that goal has been exceeded by the specified amount. *Options C.2* and *C.3* would return the fleet to the capacity goal by requiring the combining of permits ("2-for-1 options") for a transfer to occur. *Options C.4* and *C.5* would return fleet capacity to the goal by removing the 10% GRT allowance on vessel-to-vessel transfer. Under *Options C.4* and *C.5*, a single permit could only be transferred to another vessel of the same or lesser GRT, which is a less restrictive process than the combining-up requirement of 2-for-1 options. This 2-for-1 mechanism could result in more rapid return of the fleet to the capacity goal target fleet GRT. Conversely, it might be ineffective if permit prices on the open market are prohibitively high. High permit prices could result in fewer transfers, consequently taking longer to return to the goal. This scenario could place undue burden on the fleet.

The 5% trigger *(Options C.2 and C.4)* would minimize the amount the harvest capacity goal in the CPS finfish fishery would be exceeded before corrective measures were initiated. Compared to no mechanism for adjusting transferability (*Option C.1*) there would be less chance of a significant mis-allocation of harvesting resources in the fishery, and consequently not as great a reduction in net benefits associated with excess capacity. Under a 10% trigger, the expected duration of the adjustment process would be proportionately longer.

The 2-for-1 options (*C.2* and *C.3*), would quickly put the brakes on capacity creep, and could rapidly return the fleet to the desired capacity level, perhaps through only two permit transactions (which results in net retirement of one vessel). However, this requirement is likely to inflate the price of available permits and slow recovery to the desired capacity level. This is because in the course of the capacity buildup some permits would be transferred to new vessels which would be less inclined to subsequently offer them for sale. Thus, there would be fewer permits available for transfer, driving up the price of those that remain procurable. The 2-for-1 adjustment mechanism is not expected to significantly affect the quantity of CPS finfish landed, so consumers of CPS finfish should not be affected. However, by reducing the number of CPS finfish vessels, this type of adjustment process could affect the efficiency of harvesting operations in alternative fisheries. Therefore, this type of adjustment process could have indirect effects on consumer and producer benefits associated with the full range of fishing opportunities for CPS finfish vessels. No significant impacts on fishing communities would be expected from this type of adjustment process.

The adjustment mechanism under *Option C.5* is the same as *Option C.4*, which is incorporated into the Preferred Alternative, except that the trigger is set at 10% rather than 5%. The reader is directed to the discussion of the impacts of the adjustment mechanism described under the Preferred Alternative because *Option C.5* would have equivalent effects.

D. Procedures for Issuing New Limited Entry Permits

With respect to issuing new permits, *Option D.1* probably allows the fishing industry the freest hand in responding to positive changes in CPS finfish resources or market conditions. The option may allow new participants into the fishery that do not have a history of CPS fishing, but are strongly interested. But it may not comply with the Magnuson-Stevens Act, because it does not take into account historical participation.

Without qualifying criteria in place it is difficult to foresee what the expanded CPS finfish limited entry fleet would look like in terms of the new additions. At one end of the range, new participants might not have any experience in the fishery which could introduce short-run inefficiencies. This would be counterproductive in terms of meeting the objectives of fishery expansion, and result in a decrease in net economic benefits. At the other end, new participants might include CPS vessels with experience in the open-access fishery north of 39° N, or those with experience in the fishery who failed to qualify for, or otherwise obtain, a permit during the initial offering (i.e. latent capacity with respect to vessels that have been inactive in the fishery), in which case there might not be any reduction in net benefits from the fishery. Any impact on consumers from the choice of qualifying criteria would be through foregone benefits attributable to inexperienced vessels failing

to fulfill the expected expansion in landings. Fishing communities could be impacted differently in terms of changes in economic activity, depending on the makeup of new participants in the CPS, LE finfish fishery. If the expansion is made up of primarily inexperienced fishermen, there could be a net increase in economic activity in fishing communities as these participants gear up for participation. If the expansion is comprised of experienced fishermen the community impacts may be more in the form of a redistribution of economic activity along the coast. There would be some administrative expenses related to issuing permits, but none related to establishing qualifying criteria, and qualifying additional vessels.

Option D.3, an option that was not incorporated into the Preferred Alternative and does not describe the *status quo*, would allow consideration of new participants into the fishery. Open-access vessels landing smaller volumes of CPS or working outside of the limited entry zone (i.e., Pt. Arena to the U.S.-Canada border) could theoretically qualify if they could demonstrate CPS finfish landings during the new window period. It would require more time to implement than the mechanism for issuing new permits incorporated into the Preferred Alternative (*Option D.2*). Decisions would need to be made regarding a new control date and length of the window period.

This option would differ from *Option D.1* by requiring vessels to have some experience in the fishery based upon historical landings (from what is now the LE fishery, or from the open-access fishery) and, as per the Preferred Alternative (*Option D.2*), would be more likely to achieve greater economic benefits in the fishery. However, the economic benefits associated with prior experience in what is now the LE fishery may not be as great as those expected from the Preferred Alternative, since the experience would be further removed in time, and potentially outmoded. Alternatively, the window period and minimum landings level could also be structured to allow open-access CPS finfish vessels currently participating in the fishery off Washington and Oregon to qualify for the expanded LE fishery. This option may not reduce the need for new vessel construction as much as under the Preferred Alternative, but there could still be significant savings in investment costs under this option. While such a reduction in costs would translate into increased net economic benefits from the expansion, it would also mean a foregone increase in fishing community economic activity (employment and income) associated with new vessel construction. There would be significant additional administrative expenses incurred in designing new qualifying criteria, issuing new permits, and qualifying new participants. Because fleet expansion may not encompass the degree of prior experience in the fishery envisioned under the Preferred Alternative, this option might not yield as great an increase in consumer benefits from the expansion as expected under that alternative.

4.1.4 Linking Capacity Goal and Permit Transferability Alternatives to Evaluate Possible Management Scenarios

Given the range of issues and alternatives for a CPS finfish LE fleet harvesting capacity goal and permit transferability, the following possible and reasonable management scenarios are evaluated. These scenarios allow a more direct comparison of the effects of No Action, the Preferred Alternative, and other alternatives representing different combinations of capacity management measures.

Without a capacity goal it is still reasonable to consider the full range of permit transferability alternatives, although there would be no need for adjusting permit transferability to correct for overshooting the capacity goal (option set C). With a capacity goal, it seems unreasonable to allow full transferability which would greatly increase the likelihood of exceeding the capacity goal. However, it is reasonable to consider a capacity goal without permit transferability, which would negate the need for any transferability adjustment mechanism. With a capacity goal, the most reasonable scenario includes the proposed actions for permit transferability and adjusting transferability to account for capacity creep.

Scenario 1:   No Action scenario. No capacity goal (*Option A.4*), and no permit transferability (except to vessels of equal or lesser harvesting capacity under extremely limited circumstances) (*Option B.1*) .

Without any action affecting fleet capacity there is likely to be an increase in CPS finfish landings by the LE fleet in the near future, primarily due to the resurgence of the sardine biomass, and strengthening markets for sardine. The existing LE fleet will have ample harvesting capacity to take the long-term expected

aggregate finfish quota with an adequate reserve for periods of exceptionally high biomass and most favorable market conditions. Without any action affecting permit transferability some vessel modernization is expected to occur over time through upgrading of an existing vessel, or through vessel replacement by one of the same or of less harvesting capacity. This would tend to promote specialization in CPS finfish, leading to increased harvesting efficiency and improved product quality, which would raise producer and consumer surplus. Through either means, fish harvesting capacity would be curbed at its existing level, which is deemed to be sufficient in the long term. Because the number of vessels in the CPS finfish fishery and their corresponding harvesting capacities would be locked in, this would foster stability within existing fishery segments and fishing communities. Economic activity in fishing communities would expand with increased landings of CPS finfish. This scenario could be overly constraining in terms of allowing industry to respond to changing conditions within alternative fisheries. Thus, negating the potential increase in net benefits accruing from finfish specialization.

Scenario 2:   No capacity goal (Option A.4), and full permit transferability (*Option B.2*)

There is no difference from Scenario 1 in terms of a capacity goal, but if permits are freely transferable, there is likely to be some significant fleet restructuring. This will occur as vessel owners strive to optimize harvesting capacity over the full array of fishing prospects available to CPS vessels, and adjust to whatever management regime California establishes for market squid. The emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of multiple harvesting opportunities. Increases in efficiency can result in benefits to consumers through lower prices—an increase in consumer surplus—or increases in profits to fishermen through reduced costs, which is an increase in producer surplus. Unconstrained transferability would also maximize the asset value of a LE permit , which would increase the wealth of the fishing community. Also, to the extent that full transferability results in more vessel transactions, vessel construction and vessel operations, the fishing community benefits from the increase in economic activity.

Scenario 3:   No capacity goal (*Option A.4*), with proposed action for permit transferability (*Option B.3*).

There is no difference from *Scenarios 1 or 2* in terms of a capacity goal. Limited permit transferability would allow permits to be combined up, and therefore the number of vessels initially issued permits could be reduced over time. Increased efficiency would result through reduced fixed costs and variable (operating) costs associated with fewer vessels competing for a fixed harvest. The replacement vessels would be larger and presumably able to operate more efficiently not only in the CPS finfish fishery but in alternative fisheries as well. This would mean an increase in producer surplus. Price-wise, CPS finfish consumers would benefit from equal or increased landings at lower harvesting costs. If vessels seek to optimize their operations across the suite of fisheries in which they are capable of participating, greater quantities of higher quality fishery products could be made available to consumers, increasing consumer surplus. Vessel owners selling permits in combining up situations are presumably better off through the permit sale, or it would not be sold. Thus through the sale of a permit, all parties are presumably better off which represents a net gain in social welfare. The emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of the full range of harvesting opportunities without compromising the desired CPS finfish harvest capacity goal. This alternative is not expected to have any effect on fishing communities different from that under the no action alternative.

Scenario 4:   Proposed Capacity goal (*Option A.1)* and no permit transferability (except to vessels of equal or lesser harvesting capacity under extremely limited circumstances)(Option B.1) .

Since the preferred capacity goal alternative maintains the existing LE fleet, the expected impacts under this scenario are those predicted for *Scenario 1.* There would be no need to consider a transferability adjustment alternative under this scenario.

Scenario 5:   Preferred Alternative: Proposed Capacity goal (*Option A.1),* proposed limited permit transferability (*Option B.3*), and proposed adjustment for exceeding the capacity goal (*Option C.4*).

There is likely to be growth in CPS finfish landings in the near future, mainly due to continued resurgence of the sardine resource and expanded market opportunities for sardine. Under the proposed harvesting capacity goal, equivalent to that of the existing 65 vessel fleet, capacity appears more than adequate to accommodate this expected growth. This means existing harvesting capacity would be more fully utilized, increasing fleet efficiency, and in turn increasing net benefits to harvesters and consumers of sardines. Growth in CPS fishing activity in itself will generate additional economic activity in the CPS fishing communities.

The proposed limited permit transferability action would allow permits to be combined up. Thus, the number of vessels initially issued permits could be reduced, in which case increased efficiency would result through reduced fixed costs and variable (operating) costs associated with fewer vessels competing for a fixed harvest. The replacement vessels would be larger and presumably able to operate more efficiently not only in the CPS finfish fishery but in alternative fisheries as well. This would mean an increase in producer surplus. Pricewise, CPS finfish consumers would benefit from equal or increased landings at lower harvesting costs. If vessels seek to optimize their operations across the suite of fisheries in which they are capable of participating, greater quantities of higher quality fishery products could be made available to consumers, increasing consumer surplus. Vessel owners selling permits in combining up situations are presumably better off through the permit sale, or it would not be sold. Thus through the sale of a permit, all parties are presumably better off which represents a net gain in social welfare. By allowing transferability within the confines of *Option B.3*, the emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of the full range of harvesting opportunities without compromising the desired CPS finfish harvest capacity goal. This alternative is not expected to have any effect on fishing communities.

The proposed transferability adjustment mechanism, incorporating a 5% overshoot trigger, would minimize the amount the harvest capacity goal in the CPS finfish fishery would be exceeded before corrective measures were initiated. There would be less chance of a significant mis-allocation of harvesting resources in the CPS finfish fishery, and consequently not as great a reduction in net benefits associated with excess capacity. The proposed transferability adjustment action is not expected to lead to a decrease in CPS finfish landings, so CPS finfish consumers should not experience any change in economic benefits. However, the adjustment process proposed could affect the efficiency of harvesting operations in alternative fisheries. Therefore the proposed adjustment process could have an indirect effect on consumer and producer benefits associated with the full range of fishing opportunities for CPS finfish vessels. There are not expected to be any impacts on fishing communities from the proposed adjustment process.

4.2   Market Squid MSY Control Rule

The four alternatives for setting market squid MSY described in Section 2.2 represent the culmination of over two years of focused research and subsequent peer review, associated with the market squid resource off southern California. The following discussion presents more details about the merits and drawbacks of each alternative than is presented in Section 2.2. However, readers interested in full documentation concerning particular analysis or management-related decisions should refer to the complete reports (Appendices D-G). Positions taken by the Council-related bodies (SSC, CPSMT, and CPSAS) regarding each Alternative are presented in Section 2.2.

4.2.1   Alternative 1 (No Action)

Alternative 1 is essentially a "no action" approach, whereby no MSY or MSY-based proxy is considered, i.e., simply allow the fishery to operate under existing conditions as stipulated by the CDFG. An Alternative based on only monitoring the landings of a targeted species and further, ignoring the biological potential of an animal population, could jeopardize the long-term welfare of this resource. That is, although the abundance of the squid population is generally believed to fluctuate primarily based on environmental variation, researchers are uncertain how fishing pressure during unfavorable ocean conditions will impact the long-term abundance of this species. Alternative 4 below provides additional data regarding the population dynamics of this species, and along with the landing time series, provides a management approach that is clearly more precautionary than this Alternative. Given squid abundance, and subsequent landings, are generally believed to be strongly influenced by the inherent variation of the environment, it is likely that landings will continue to fluctuate based

on oceanographic conditions, as well as market conditions and related fishing pressure. Subsequently, shifts in net economic benefits and related impacts to the fishing industry would be expected to follow the trends observed in the actual landings. As stated previously, this Alternative provides no management-related infrastructure for ensuring the squid population is exploited wisely and more importantly, does not include procedures for identifying or reacting to potential problems that may detrimentally impact long-term, as well as short-term population abundance.

4.2.2   Alternatives 2 and 3

Alternatives 2 and *3* represent initial work conducted by the CPSMT from late 1999 to early 2000 following directions from the Council to evaluate MSY-based analysis and management for the squid fishery operating off southern California within the Exclusive Economic Zone (EEZ) along the U.S. Pacific coast. The analyses applicable to these Alternatives are documented in Appendix D. Both *Alternatives 2* and *3* are efforts to utilize primarily landings information from the fishery for determining sustainable exploitation strategies for this population. The major advantage of using such alternatives is that the approaches are fairly straightforward and relatively easy to carry out (e.g., in a monitoring context). That is, when assessing the status of fisheries in "data-poor" situations, it may be reasonable to use historical average catch as a proxy for MSY. In the initial stages of the overall squid research, time constraints precluded thorough investigations of relevant sample data and analysis applicable to the squid fishery and, thus, researchers examined the most accessible, accurate time series available, i.e., catch statistics archived in a centralized database. The Alternatives represent "first attempts" at developing MSY guidelines for the fishery. However, because the Alternatives require only basic fishery data, they necessarily produce results that are subject to a great deal of uncertainty that is often only assessed qualitatively (see Alternative 1 above). Given that dynamics of the squid population itself, as well as more detailed fishery data are not objectively considered in *Alternatives 2* and *3*, the approaches should be considered strictly baseline monitoring strategies.

Alternative 2 is simply an examination of historical landings from the squid fishery over an extended time period, whereby: (1) year-to-year fluctuations are examined, with particular attention to increasing or decreasing trends across time—the current fishery is regulated primarily by market conditions and not management regulations that would severely constrain fishing pressure; (2) qualitatively assess "rebound" potential of the population by examining the magnitude of the catches during, or immediately following, unfavorable oceanographic periods (e.g., ENSO events); and finally, (3) if the catch time series indicates no continued downward trend in the catches (i.e., keeping in mind relatively stable market demands) and that catches following unfavorable environmental conditions do rebound to levels observed during favorable conditions, then it is reasonable to use (i.e., assume) an average catch over the time period as a proxy for MSY. *Alternative 3* is an extension of *Alternative 2*, whereby: (1) estimates of catch are expanded to include all areas that have been fished historically in efforts to determine the total, "potential" fishing area for the California squid fishery in any given season; (2) estimates of catch can be expanded to even broader areas based on coastwide spawning habitat determined through research trawl survey studies; (3) assuming annual values of MSY are a function of the expanded catch (using the ratio of exploited to unexploited fishing areas and/or potential spawning habitat); and finally, (4) determining an average MSY from the extended time series that is based on expanded catch statistics. As stated previously, both *Alternatives 2* and *3* inherently are based on rather simple assumptions concerning the relationship between squid population abundance and observed catches and "potential" catches as derived through simple, but possibly, unrealistic expansion methods. Although both *Alternatives 2* and *3* are products of rigorous examination of catch sample data, investigations that also consider the biology of the population, as well as more detailed fishery information are likely to generate more realistic results and ultimately, more accurate information for developing management strategies for this, or any other fishery.

The socioeconomic and environmental impacts associated with these Alternatives are similar to those generally discussed for Alternative 1 above. That is, management based solely on evaluations of landings, expanded or otherwise, is not typically considered an effective strategy for optimizing yield, particularly, when the goal is viewed on a long-term scale. For example, during an ENSO event the squid become unavailable to the fishery, the fishery essentially shuts down, and landings are substantially reduced. The historical record, albeit limited time series information, has shown a marked rebound in squid landings immediately following an ENSO event. Consequently, an MSY proxy/control rule based on average recent landings in the fishery,

including ENSO years, would significantly understate the amount of squid available for harvest under normal environmental conditions, and impose an unreasonably low limit on annual landings. Relative to the *status quo*, this could result in a significant reduction in net economic benefits from the fishery—both to fishers and consumers, and in fishing community economic activity. Fishers' would experience a decrease in exvessel revenues, while fixed costs are unlikely to change, leading to a reduction in producer surplus. A decrease in landings would put upward pressure on prices to consumers, reducing their surplus. On the otherhand, attempts to determine a MSY based on evaluations of historical catches that did not include ENSO-related years would likely generate an unsubstantiated, elevated MSY proxy/control rule that would at best provide short-term economic gains, but given the paucity and uncertainty in available data, could compromise the population's ability to successfully rebound following periods of unfavorable oceanographic conditions.

4.2.3   Alternative 4 (The Preferred Alternative)

Of the four Alternatives, *Alternative 4* takes advantage of the most sample data, both biological- and fishery-related information. The foundation of *Alternative 4* is a reproductive escapement model generally referred to as the Egg Escapement (EE) method. The EE method is generally based on a modeling approach that addresses the squid's life history, with a focus on the mortality and spawning rates of sexually mature females. Specifically, per-recruit analysis theory is used to generate stock parameter estimates, such as mean standing stock of eggs per harvested female, eggs per recruit, and egg escapement; all of the estimates are evaluated across a range of fishing mortality (F). To gauge the fishery's impact on the squid population, the estimated reproductive output of the harvested population is compared to the population's output in the absence of fishing. In practical terms, the EE approach can be used to evaluate the effects of F on the spawning potential of the stock and in particular, to examine the relation between the stock's reproductive output and candidate proxies for the fishing mortality that results in MSY (F_{MSY}). However, it is important to note that this approach does not provide estimates of historical or current total biomass and thus, a definitive yield (i.e., quota or Acceptable Biological Catch) cannot be determined at this time. Ultimately, the EE approach can be used to assess whether the fleet is fishing above or below an a priori-determined sustainable level of exploitation and in this context, can be used as an effective management tool. The EE method offers advantages for squid fishery management. First, it allows for "real-time" management of the fishery, without an unnecessarily large investment in personnel or regulations. Secondly, the method clarifies the role and importance of sample data on age, reproductive anatomy, and fishing effort, which collectively, allow researchers to conduct the most thorough assessment at this time. In summary, the current port sampling program implemented by the CDFG, along with newly developed laboratory and analysis procedures conducted by the NMFS (Southwest Fisheries Science Center, SWFSC), can provide an objective method for establishing MSY-based management goals for the squid resource.

Alternative 4 would most likely produce a reliable and stable MSY proxy/control rule that would allow for landings at or above their current levels. Compared to the status quo there would not be any significant changes in net economic benefits and fishing community economic activity if the MSY proxy under this Alternative is at current landing levels. If the MSY proxy under this Alternative is greater than current landings, then a proportionate increase in consumer and producer surplus and fishing community economic activity, above those anticipated under the status quo, is expected. There are not any expected environmental effects.

Finally, the following discussion addresses pertinent decisions made by the CPSMT to develop a workable monitoring/management plan for the squid fishery based on the EE method, i.e., the STAR Panel (see STAR 2001, Appendix F) provided general recommendations regarding analytical methods and left determination of specific model configurations and other management-related parameters to the CPSMT. Four areas of the EE method needed further review and are presented in the following four paragraphs, for 1-4, respectively: (1) selection of a "preferred" model scenario; (2) selection of a "threshold" level of egg escapement (EE value) that can be considered a warning flag when tracking the status of the population; (3) fishery operations in (and after) ENSO events; and finally, (4) necessary management-related constraints.

The CPSMT largely relied on researchers familiar with squid biology to identify a "preferred" (i.e., most plausible) model scenario from the suite proposed in the overall analysis. First, given that *model version 1* was the more general of the two proposed versions and adequately captured what is currently known regarding the maturation schedule of this species, the CPSMT recommended that this version be focused on

when deriving final estimates. Further, two important areas of squid biology that were treated in sensitivity analysis during modeling exercises included hypothesized rates of natural mortality (M) and egg laying (v). The CPSMT recommended that the preferred model scenario be based on $M = 0.15$ and $v = 0.45$ (both are daily rates), given: (1) data on the energetics of egg production and longevity of sexually mature adults indicate higher values of M are more likely than lower values; and (2) anatomical examinations of reproductive organs of young spawning females support egg-laying rates that are roughly equivalent to $v = 0.45$.

A "threshold" level of egg escapement can be practically interpreted as a level of "reproductive" (egg) escapement that is believed to be at or near a minimum level that is considered necessary to allow the population to maintain its level of abundance into the future (i.e., allow for "sustainable" reproduction year after year). It is important to note that a threshold level of egg escapement applicable to this species is not known in strict terms at this time (and likely not a fixed value on an annual basis), but rather, determined from evaluating general patterns of harvest observed in the squid fishery off California, as well as examining similar reference points relied upon in other squid fisheries as approximate guidelines. The CPSMT recommended that a threshold value of 0.3 (30%) be used initially, given: (1) a reproductive escapement threshold of roughly 0.4 (40%) has been used effectively in other squid fisheries (e.g., Falkland Islands fishery)–keeping in mind that the Falkland Island fishery harvests primarily juveniles; (2) not all of the squid spawning grounds off the California coast are subject to fishing pressure; (3) an existing weekend closure allows two days per week for spawning in the absence of fishing; and (4) the daily mortality of females during spawning is likely quite high. Given the reasons above, it is certainly possible that a more appropriate threshold level is even lower than 0.3; however, the CPSMT does not recommend a lower level of egg escapement, given: (1) this is a new approach that should be monitored for some time before adopting a lower threshold; (2) there are some uncertainties about the retention of eggs in the females after capture; (3) there may be unevaluated fishery-dependent sources of mortality after spawning, such as fishing gear destruction of egg beds; (4) squid are members of a lower animal trophic level of the marine ecosystem and thus, play an important role as a forage species utilized by animals at higher trophic levels; and (5) sample data indicate that it is not likely that the recommended threshold will hamper the operations of the fishery as observed since the mid 1990s.

The CPSMT deferred consideration of the effects of ENSO conditions on the squid population and ultimately, the fishery itself, until studies that focus on the influence of such oceanographic phenomena on squid abundance and distribution generate useful management advice. A consistent observation during such events is a temporary cessation of availability to the fishery. Although researchers generally believe this "disappearance" is due to both reduced reproduction by the population and movement out of the established spawning grounds and into favorable habitat, the extent and magnitude of each response are not clearly defined at this time. Most importantly, there is no indication from the post-ENSO landings of long-term detrimental damage to the population's ability to sustain itself, i.e., the population has recovered relatively quickly following El Niño events. Although catches by the fleet dramatically decline during such periods and in effect, "self-regulate" the fishery, the CPSMT cautioned that further restrictions on catch may be warranted in the future, given the broad impact that these oceanographic conditions have on many marine animal populations distributed along the U.S. Pacific coast.

The Management Team concurred with the STAR Panel that the present squid fishery needs to be closely monitored using the state-coordinated port sampling programs. Fishery monitoring should be especially attentive to the possible future development of a juvenile fishery. Further, it is recommended that regulatory-related issues applicable to the current squid fishery off California remain under the jurisdiction of the California Department of Fish and Game through consultation with the Management Team itself –keeping in mind the federal-based policies inherently in place for all U.S.-based fisheries. In this context, the Management Team supports the annual landings cap on the total harvest of squid that has been recently proposed by the state of California. The EE method (which is the Preferred Alternative) should be considered a joint effort between CDFG and NMFS. Were squid fisheries to expand into Oregon or Washington, the assumptions underlying the EE approach would have to be reviewed to ensure they were applicable. That is, to make certain the assumptions are valid in the northerly reaches of the habitat regarding population productivity, growth, and maturation in colder waters with stronger seasonality. Future involvement by Oregon Department of Fish and Wildlife (ODFW) and Washington Department of Fish and Wildlife (WDFW) would be critical to this evaluation, as well as development and implementation of the necessary monitoring programs of the northern fisheries.

5.0 CONSISTENCY WITH THE FMP AND MAGNUSON-STEVENS ACT

5.1   Consistency with the FMP

An FMP amendment is designed in part to change some function or intent of the FMP, which means that the amendment may not necessarily be consistent with the existing FMP. However, the FMP contains several basic goals and objectives that provide guidance for the entire structure of the FMP and implementing measures. Capacity management measures analyzed in this document are examined here for consistency with those goals and objectives. Goals and objectives for the CPS FMP, as listed in Amendment 8, are:

1.   Promote efficiency and profitability in the fishery, including stability of catch.
2.   Achieve Optimum Yield.
3.   Encourage cooperative international and interstate management of CPS.
4.   Accommodate existing fishery segments.
5.   Avoid discard.
6.   Provide adequate forage for dependent species.
7.   Prevent overfishing.
8.   Acquire biological information and develop long term research program.
9.   Foster effective monitoring and enforcement.
10.   Use resources spent on management of CPS efficiently.
11.   Minimize gear conflicts.

FMP goals 1, 2, and 4 would be addressed by setting a capacity goal for the fleet. Establishing and maintaining a capacity goal would promote efficiency and profitability in the fishery (Goal 1) by preventing overcapacity and providing for economical stability. Keeping the limited entry fleet at the current level of 65 vessels is also consistent with Goal 2 (achieving optimum yield), and Goal 4 (accommodate existing fishery sectors).

The Council's proposed conditions for permit transfer would allow CPS limited entry permits to be transferred with some restriction on the harvesting capacity of the vessel to which it would be transferred. Allowing permits to be transferred with some level of constraint would be consistent with FMP Goals 1 and 4. The proposed action would accommodate existing permit holders (Goal 4) by allowing them to transfer out of the limited entry program if they so desire, and would enable newer, more efficient vessels to enter the fishery, thus providing a higher quality more profitable product (Goal 1).

The proposed action would provide a mechanism for adjusting permit transferability in order to maintain the capacity goal. Gradual upward drift in total fleet capacity will be expected over time as transfers to slightly larger vessels occur. It would establish a capacity trigger point for the fleet, and would implement further restrictions on transfers in an effort to bring the fleet back to the capacity goal. This action is consistent with FMP Goal 1, as it will help to maintain the capacity goal and help prevent overcapacity.

One option considered by the Council for issuing new LE permits (*Option D.2*) establishes a procedure for issuing new limited entry permits and should satisfy FMP Goals 1, 2, and 4. New permits may be necessary in the future to address significant, positive, changes in market conditions or resource availability. Issuing additional permits will increase efficiency and profitability in the fishery (Goal 1), help achieve optimum yield (Goal 2), and accommodate existing fishery segments (Goal 4; in this case fish processors who need to meet market orders).

For the market squid MSY measure, the Council's proposes an MSY proxy for market squid based on evaluation of female spawning success through an existing port sampling program. The proposed measure would help prevent overfishing (Goal 7), foster effective monitoring (Goal 9), and use resources spent on management of CPS efficiently (Goal 10).

None of the proposed measures to manage limited entry fleet capacity will directly conflict with the goals of this FMP.

5.2 Consistency with the Magnuson-Stevens Act

The Magnuson-Stevens Act provides parameters and guidance for federal fisheries management, requiring that the Councils and NMFS adhere to a broad array of policy ideals. Overarching principles for fisheries management are found in the Act's National Standards. In crafting fisheries management regimes, the Councils and NMFS must balance their recommendations to meet these different national standards.

National Standards (NS) relevant to this FMP amendment include:

NS-1: "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry."

NS-2: "Conservation and management measures shall be based on best scientific information available."

NS-4: "Conservation and management measures shall not discriminate between the residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges."

NS-5: "Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose."

NS-6: "Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches."

NS-8: "Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practical, minimize adverse economic impacts on such communities."

The proposed action would provide a capacity goal for the CPS LE fleet, providing the Council a measure to gauge harvesting capacity and prevent overcapitalization. The proposed capacity goal and fleet composition takes into account variations in CPS finfish fisheries and resources (NS-6), provides a fleet with adequate capacity to achieve OY (NS-1), takes into account efficiency in utilization of CPS resources (NS-5), while at the same time minimizing adverse economic impacts on the existing fleet (NS-8).

The proposed action would allow CPS limited entry permits to be transferred with some restriction on the harvesting capacity of the vessel to which it would be transferred, and would provide a mechanism for returning the fleet to the capacity goal should capacity exceed the specified tolerance level (or "trigger") of fleet GRT plus 5%. Allowing permits to be transferred with some level of constraint would be consistent with NS-8 (minimizing adverse economic impacts). The proposed action would accommodate existing permit holders by allowing them to transfer out of the limited entry program if they so desire, and would enable newer, more efficient vessels to enter the fishery (NS-4), thus, providing for increased efficiency (NS-5) and a higher quality, more profitable product.

The proposed action would provide a mechanism for adjusting permit transferability in order to maintain the capacity goal. Gradual upward creep in total fleet capacity will be expected over time as transfers to slightly

larger vessels occur. The proposed action would establish a capacity trigger point for the fleet, and would implement further restrictions on transfers in an effort to bring the fleet back to the capacity goal. Maintaining the capacity goal is consistent with the same National Standards cited above in the discussion of capacity goals.

The proposed action establishes a procedure for issuing new limited entry permits. New permits may be necessary in the future to address significant, positive, changes in market conditions or resource availability. Issuing additional permits will increase efficiency and profitability in the fishery (NS-5), help achieve optimum yield (NS-1), accommodate existing fishery segments (NS-4), and account for variation in the resource (NS-6).

The Council also proposes to establish an MSY proxy for market squid based on evaluation of female spawning success through an existing port sampling program. The proposed measure would help prevent overfishing (NS-1 and NS-8), and is based on the best scientific information available (NS-2).

6.0 OTHER APPLICABLE LAW

6.1   National Environmental Policy Act

An environmental assessment (EA) is required by the National Environmental Policy Act (NEPA) of 1969 to determine whether the action considered will result in significant impact on the human environment. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact would be the final environmental documents required by NEPA.   An environmental impact statement (EIS) need only be prepared for major federal actions significantly affecting the human environment. It contains elements consistent with an EA. An EA must include a brief discussion of the need for the proposal, the alternatives considered, a list of document preparers, and the impacts of the alternatives on the human environment. The purpose and need for the proposed action was discussed in Section 1.0 of this document, the proposed action and alternatives are found in Section 2, the management alternatives and the potential environmental and socio-economic effects of those alternatives were discussed in Section 4. A list of agencies and persons consulted during preparation of the EA, found in Section 7. The results of the analysis of the proposed action and its alternatives are summarized in Appendix A, which is the Finding of No Significant Impact (FONSI). The FONSI is a determination that the impacts stemming from the proposed action are not significant and therefore preparation of an EIS is unnecessary.

6.2   Regulatory Impact Review and Regulatory Flexibility Act Determination

None of the proposed changes to the FMP would be a significant action according to E.O. 12866. This action will not have a cumulative effect on the economy of $100 million or more, nor will it result in a major increase in costs to consumers, industries, governmental agencies, or geographical regions. No significant adverse impacts are anticipated on competition, employment, investments, productivity, innovation, or competitiveness of U.S.-based enterprises (see RIR below in Section 6.2.1).The Small Business/Entities analysis addresses requirements of the Regulatory Flexibility Act. In addition to the information presented in the EA above, a basic economic profile of the fishery is provided in the Council's annual CPS SAFE document.

6.2.1   Executive Order 12866 - Regulatory Impact Review (Elements Beyond Those Considered in the Environmental Assessment

The purpose of an RIR is to determine whether any of the proposed actions could be considered "significant regulatory actions" according to E.O. 12866. This analysis has many aspects in common with an EA. Much of the information required for RIR analysis is contained in the EA. Table 6.2 provides references for those required elements of RIR analysis that have already been addresses above.

Table 6.2. Regulatory Impact Review - Elements of Analysis

RIR Elements of Analysis	Corresponding Sections in EA
Description of management objectives	1, 4
Description of the fishery	see Appendix A of Amendment 8
Statement of the problem	1
Description of each alternative	2, 4
Economic analysis of the expected effects of each selected alternative relative to *status quo*	4

The key elements of an RIR have been thoroughly addressed in the EA above. From that discussion, we conclude that proposed actions in this amendment would not have any significant adverse economic effects

on consumers and producers of CPS finfish—contrarily, economic effects are expected to be either neutral or positive—relative to the status quo (No Action Alternative).

Establishing a Capacity Goal: Because it would maintain the size and structure of the existing fleet, the economic effects associated with the proposed capacity goal alternative are expected to be no different than those anticipated under the no action alternative. Under the no action alternative there is likely to be an increase in CPS finfish landings in the near future, primarily due to the resurgence of the sardine biomass, and strengthening markets for sardine. The established LE fleet will have ample harvesting capacity to take the long-term expected aggregate finfish quota with an adequate reserve for periods of exceptionally high biomass and highly favorable market conditions. Under these conditions, harvesting capacity in the CPS finfish fishery is expected to be more fully utilized which in turn, should lead to efficiency gains in the fishery. There should not be any impact on the operations of vessels landing less than 5 mt of CPS finfish per trip since they are exempted from the LE program.

Conditions for Transfer of Existing Permits: The Proposed action would have significant positive economic effects, i.e. an increase in net economic benefits compared to the no action alternative. By allowing transferability within the limits of the proposed action, the emerging fleet would represent the future expectations of industry members concerning multi-purpose vessels best suited to take advantage of joint harvesting opportunities across the suite of fisheries in which finfish vessels participate, without compromising the desired CPS finfish harvest capacity goal. Because this alternative would allow more flexibility across all vessel operations, the expected increase in net benefits would be greater than that potentially realized by a fleet of finfish specialists, which would be encouraged under the no action alternative.

Adjusting Permit Transferability to Maintain the Capacity Goal: The proposed action provides a means of arresting harvesting capacity creep, and of avoiding a potential over allocation of harvesting resources in the CPS finfish fishery compared with the no action alternative. By allowing for a continued 1-for-1 transfer this alternative would be least disruptive in terms of the transferability process, and would result in gradual return to the fleet capacity goal. Since no two vessels are likely to have the exact same calculated GRT, some lowering of GRT could be expected with each transfer. Unlike the options that would require two permits being transferred to an entering vessel, this alternative would not artificially inflate the price of permits. This is favorable to permit buyers, but would eliminate potential windfalls to permit sellers.

Establishing Procedures for Issuing New Limited Entry Permits: By adopting the original permit qualifying criteria to accommodate additional vessels in the CPS finfish fishery, the proposed action would weight experience in the CPS finfish fishery higher than under the no action alternative. It would assure that the opportunity to participate in the expanded fishery would be offered to those next in line behind the original permit qualifiers. Because it is likely that the original ranking of finfish vessels, in terms of their window period landings, reflects their relative operating efficiencies then this alternative should yield greater net economic benefits compared to the no action alternative. To the extent that it would favor existing vessels, it would alleviate the need for new vessel construction. This could mean significant savings in investment costs relative to the no action alternative.

Establishing an MSY Control Rule for Market Squid: The egg escapement-based squid MSY proxy alternative would most likely produce a reliable and stable MSY proxy/control rule that would allow for market squid landings at or above their current levels. Compared to the No Action Alternative there would not be any significant changes in net economic benefits if the MSY proxy under this alternative is near current landings levels. If the MSY proxy under this alternative is greater than current landings then a proportionate increase in net economic benefits, above those anticipated under the no action alternative, is expected.

Table 6.3 summarizes the analyses of the proposed regulatory actions in terms for the RIR evaluation factors.

Table 6.3. RIR Tests of "Significant Regulatory Actions"

E.O. 12866 Test of "Significant Regulatory Actions"	Capacity Goal	Permit Transfer	Adjusting Permit Transferability	Issuing New Permits	Squid MSY
Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs or the environment, public health or safety, or State, local, or tribal governments or communities?	NO	NO	NO	NO	NO
Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency?	NO	NO	NO	NO	NO
Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof?	NO	NO	NO	NO	NO
Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in E.O. 12866?	NO	NO	NO	NO	NO

6.2.2 Impacts on Small Entities

The Regulatory Flexibility Act (RFA) requires government agencies to assess the effects that various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those effects. A fish-harvesting business is considered a "small" business by the Small Business Administration (SBA) if it has annual receipts not in excess of $3.0 million. For related fish-processing businesses, a small business is one that employs 500 or fewer persons. For marinas and charter/party boats, a small business is one with annual receipts not in excess of $5.0 million. While there are some fish processors operating in the West Coast CPS finfish fishery that would not be considered small businesses, the vast majority of CPS finfish fishery participants are considered small businesses under the SBA standards. The small entities that could be effected by the regulatory actions being considered under Amendment 10 would consist exclusively of fish-harvesting businesses, i.e., fishing vessels. Effects on fishing vessels of the regulatory actions under consideration are expected to be neutral or positive in consequence.

Characterization of the degree to which the 65 vessels that currently make up the CPS LE finfish fleet depend on CPS finfish resources and could be potentially affected by regulatory changes in the fishery is provided in Table 6.4.

Table 6.4. Exvessel revenue and total CPS finfish landings summaries for the period 1995 through 2000, for the 65 vessels with a limited entry permit as of 31 December, 2000.

Number of Vessels*	Dependence on CPS Finfish (fin rev/tot rev)	Annual Ave CPS Finfish Landings (mt/vessel)	Annual Ave Revenues ($1,000/vessel)				
			CPS Finfish	Squid	Tuna	Other	All Species
2**	0%	0	$0	$0	Unknown	Unknown	Unknown
12	<5%	46	$3,742	$225,860	$29,184	$21,090	$279,876
5	5-10%	216	$19,563	$197,378	$47	$17,391	$234,379
14	11-25%	795	$74,352	$286,735	$56,671	$12,976	$430,734
17	26-50%	1,668	$157,644	$200,014	$62,721	$7,982	$428,362
7	51-75%	1,286	$134,220	$58,174	$30,051	$691	$223,136
8	76-100%	301	$41,740	$2,768	$1	$94	$44,604

Source: California Department of Fish and Game, C-Master Database
*The fleet now consists of 65 vessels. Forty-five of these vessels initially qualified under the window period and the other 20 vessels were permit transfers.
**There were two permits transferred to vessels without any prior landings history in the CPS finfish and market squid fisheries.

Establishing a Capacity Goal: The proposed action is expected to have no effect on small businesses since it represents essentially no change from the No Action Alternative in terms of fish harvesting capacity. Options A.2 and A.3 could effect small vessels—retire them from the fishery—since both alternatives would work the fleet down in numbers to achieve a harvesting capacity level below the No Action Alternative.

Conditions for Transfer of Existing Permits: The proposed action would require permits to be combined up in cases where the harvesting capacity of the vessel to which a permit was being transferred exceeded by more than 10% the capacity of the vessel from which the permit was being transferred. Under these circumstances there could be a number of small vessels retired from the fishery whose permits were purchased to make up a harvesting capacity deficit for larger incoming ones. However, vessels selling their permits would be bought out of the fishery at a price which would presumably match or exceed the expected value of their discounted future net earnings. Therefore, the effects of this regulatory action on small vessels would be neutral or positive at best.

Adjusting Permit Transferability to Maintain the Capacity Goal: None of the options for adjusting permit transferability to maintain the capacity goal are expected to adversely effect the vessels that comprise the CPS finfish fleet at the time such action would be necessary. All adjustment mechanisms being proposed would rely on permit transfers to reduce harvesting capacity to the desired level. If a permit were sold to help attain the desired level, the payment to the seller would presumably at least reflect the worth of that permit remaining with the transferring vessel.

Establishing Procedures for Issuing New Limited Entry Permits: None of the options for issuing new CPS finfish LE permits would effect the existing fleet. Expansion of the fishery would only occur when economic conditions were favorable for the entry of additional vessels. The procedures for qualifying new vessels would therefore not have an impact on the existing fleet, but the options for issuing new permits could have disproportionate effects on vessels vying for entry.

Establishing an MSY Control Rule for Market Squid: Only Alternative 2, an MSY proxy based on historical landings, could potentially have an adverse effect on CPS vessels. This alternative to the others poses the greatest risk of substantially reducing landings below levels typically experienced during years when squid are available. By down-weighting the MSY proxy by landings levels in years when squid were not available, vessel profitability in the fishery could be substantially although not disproportionately reduced. The other MSY proxies being considered are likely to enhance vessel profitability.

6.3   Coastal Zone Management Act

Section 307(c)(1) of the Federal Coastal Zone Management Act (CZMA) of 1972 requires all federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. The Council believes the proposed action is consistent to the maximum extent practicable with applicable State coastal zone management programs. The NMFS has corresponded with the responsible state agencies under Section 307 of the Coastal Zone Management Act to obtain their concurrence in this finding.

6.4   Listed Species

6.4.1   Endangered Species Act

An informal consultation was initiated with the Protected Resources Division, Southwest Region, on January 12, 1999, with regard to the effects of Amendment 8 on endangered and threatened marine mammals and salmon under the jurisdiction of the NMFS. On June 3, 1999, a determination was made that Amendment 8 would not likely adversely affect listed species under NMFS jurisdiction.

On June 8, 1999, NMFS provided the Fish and Wildlife Service with background information on the harvest strategies in Amendment 8 and their potential impact on other species, and requested that the agency concur with the determination that Amendment 8 would not likely adversely affect any threatened or endangered birds under the jurisdiction of the Fish and Wildlife Service. On June 10, 1999, the Fish and Wildlife Service responded, stating that Amendment 8 would not adversely affect endangered or threatened birds under its jurisdiction.

Consultation was reinitiated with the Protected Resources Division, Southwest Region, following the publication of additional listed species, and on September 2, 1999, a determination was made that the FMP was not likely to adversely affect Central Valley spring-run chinook and coastal California chinook. The fishery has since expanded to Oregon and Washington; therefore, in accordance with the conditions established in the previous determination, consultation was reinitiated on April 19, 2000. This consultation has not been completed.

6.4.2   Marine Mammal Protection Act (MMPA)

Amendment 10 is not anticipated to have an adverse impact on marine mammals.

6.4.3   Migratory Bird Treaty Act

The Migratory Bird treaty Act of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished populations of many native bird species. The Act states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico and Russia to protect a common migratory bird resource.

The Migratory Bird Treaty Act prohibits the directed take of seabirds, but the incidental take of seabirds does occur. Only limited information exits quantifying the incidental take of seabirds in west coast CPS fisheries. However, none of the proposed management alternatives are likely to affect the incidental take of seabirds protected by the Migratory Bird Treaty Act.

6.5   Paperwork Reduction Act (PRA)

This amendment does not necessitate additional reporting requirements.

6.6   Executive Order 13132

None of the proposed changes to the FMP would have federalism implications subject to E.O. 13132.

6.7   Executive Order 13175

Executive Order 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

The Secretary of Commerce recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. At Section 302(b)(5), the Magnuson-Stevens Act reserves a seat on the Pacific Fishery Management Council for a representative of an Indian tribe with Federally recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinalt) have treaty rights to fish for CPS. In general terms, the quantification of those rights is 5% of the harvestable surplus of CPS available in the tribes' usual and accustomed (U and A) fishing areas (described at 50 CFR 660.324). Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. Accordingly, tribal allocations and regulations have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

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7.2   List of Public Meetings

Schedule of Events in Developing Amendment 10

- August 3-4, 1999. Coastal Pelagic Species Management Team (CPSMT) public meeting (preliminary work on squid maximum sustainable yield [MSY]).

- August 24, 1999. Coastal Pelagic Species Advisory Subpanel (CPSAS) public meeting (preliminary work on squid MSY).

- September 1999. Council meeting. The Council directed the CPSMT to evaluate thoroughly the MSY alternatives presented in the CPSMT report; and address the recommendations of the Scientific and Statistical Committee (SSC), notably use of the default MSY control rule that sets acceptable biological catch (ABC) equal to 25% of the total biomass estimate.

- March 2000. Council meeting. A majority of the CPSAS urged the Council to amend the provisions of the limited entry plan to allow for the free transferability of permits. The Council asked the CPSMT to analyze several issues related to CPS limited entry and permit transferability.

- April 20-21, 2000. CPSMT public meeting.

- June 8, 2000. CPSMT and CPSAS public meetings.

- June 2000. Council meeting. The CPSMT recommended an extension of the transferability provisions in the CPS fishery management plan (FMP) for two years from the current closing date (12/31/00). The CPSAS recommended making permits transferable without time constraint. However, the Council reaffirmed its position that permit transferability should not be extended at this time. The Council preferred to wait to address permit transferability after a capacity goal and other procedures are established for the CPS limited entry fishery.

- September 14, 2000. CPSAS public meeting.

- September 2000. Council meeting. Based on the advice of the SSC, CPSMT, and CPSAS, the Council opted to withdraw squid MSY provisions from Amendment 9 and requested a squid STAR panel be convened. The Council deferred action on alternatives for determining a proxy MSY value for market squid. There are several reasons why the Council deferred action on market squid MSY: (1) the opinion of the SSC and others that the concept of MSY may not be practical for market squid; (2) efforts to date to develop a proxy value for MSY have fallen short, largely due to lack of scientific data; and (3) current research on squid life history and stock status by the state of California, which should provide an improved basis for determining a MSY proxy for market squid. The results of this research should be available in April 2001, with the Council possibly taking preliminary action on squid MSY in June 2001. The Council also supported the SSC recommendation for a squid stock assessment workshop to review the results of California's cooperative research project and consider incorporating this information into the CPS FMP.

- October 18, 2000. CPSAS public meeting.

- October 17-18, 2000. CPSMT public meeting.

- November 2000. Council meeting. The CPSMT presents their capacity analysis to the Council. The Council directed the CPSMT to continue work on establishing a capacity goal for the limited entry finfish fishery and addressing other capacity related issues such as permit transferability. Alternative capacity goals should be constructed following the three options outlined in the CPSMT report. The analysis should include advice on the most preferred option; why it is most preferred; and how permit transferability would help achieve the goal.

- February 1, 2001. CPSAS public meeting.

- January 30-31, 2001. CPSMT public meeting.

- March 9, 2001. CPSMT and CPSAS public meetings.

- April 2001. Council meeting. The Council and SSC reviewed the CPSMT's capacity analysis. CPSAS reported on their March 9, 2001 review. The Council also received an update on squid STAR panel. The Council adopted the capacity goal and transferability provisions recommended by the CPSMT for inclusion in Amendment 10. The Council directed the CPSMT to develop an amendment to the CPS FMP. The FMP amendment will include the capacity goal, provisions for permit transferability, a process for monitoring fleet capacity relative to the goal, and a framework for modifying transferability provisions as warranted by increases or decreases in fleet capacity. The FMP amendment will include an alternative that would allow transfer of limited entry permits. Under this alternative, transferability would be restricted to prevent a significant increase in total fleet capacity as measured by the total gross registered tonnage of the fleet.

- June 2001. Council meeting. Council received preliminary reports about the squid STAR panel. The Council requested the CPSMT and CPSAS work together to develop recommended management alternatives for market squid MSY based on the workshop results. These would be completed in time for SSC and Council review in September 2001. At that time, the Council will determine if market squid MSY should be included in Amendment 10. If the Council decides to include squid MSY in Amendment 10, it is possible a public review draft could be prepared by the November meeting, with final action in March 2002.

- August 14-15. 2001 CPSMT public meeting.

- October 10, 2001. CPSMT and CPSAS public meetings.

- October 31, 2001. CPSAS public meeting.

- November 2001. Council meeting. The Council received reports from the squid STAR panel, CPSMT, and CPSAS. The Council endorsed the egg escapement approach as a proxy for squid MSY, as recommended by the market squid STAR Panel and CPSMT. The Council also directed the CPSMT to continue with their analysis of management alternatives related to capacity and permit transferability in the CPS limited entry fishery. The Council scheduled consideration of adopting Amendment 10 for public review at the March 2002 Council meeting.

7.3   List of Preparers

Dr. Paul Crone
National Marine Fisheries Service

Mr. Brian Culver
Washington Department of Fish and Wildlife

Dr. Christopher Dahl
Pacific Fishery Management Council

Dr. Samuel Herrick
National Marine Fisheries Service

Dr. Kevin Hill
California Department of Fish and Game

Ms. Jean McCrae

Oregon Department of Fish and Wildlife

Mr. Jim Morgan
National Marine Fisheries Service

Dr. Paul Smith
National Marine Fisheries Service

Mr. Dan Waldeck
Pacific Fishery Management Council

Ms. Marci Yaremko
California Department of Fish and Game

APPENDIX A: CONCLUSIONS OR FINDING OF NO SIGNIFICANT IMPACT

NOAA Administrative Order 216-6, which provides guidance on NEPA specific to line agencies within NOAA, lists nine factors that should be used to test the significance of fishery management actions (NAO 216-6 §6.02). These factors form the basis of the analysis presented in Section 4, Environmental Consequences. The results of that analysis are summarized here for each factor.

The Pacific Fishery Management Council has developed proposed measures to (1) manage capacity in the limited entry fishing fleet managed under the Coastal Pelagic Species Fishery Management Plan and (2) to establish an MSY control rule for market squid.

a. The proposed action will not jeopardize the sustainability of the target resources species or any related non-target stocks that may be affected by the action.
b. The proposed action will not cause substantial damage to ocean or coastal habitat or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs.
c. The proposed action will not have an adverse impact on public health or safety.
d. The proposed action will not have an adverse affect on endangered or threatened species marine mammals or critical habitat of these species.
e. The proposed action will not result in cumulative adverse impacts that could have a substantial effect on the target resources species or any related stocks that may be affected by the action.
f. The proposed action will not have a substantial impact on biodiversity and ecosystem function within the affected area.

g. The measures proposed in this amendment are not considered controversial in that they have not generated public concern or opposition.

Based on the information contained in Environmental Assessment for Limited Entry Fleet Capacity Management and a Market Squid MSY Control Rule and summarized here, I have determined that the proposed alternative would not significantly affect the quality of the human environment, and therefore, preparation of an environmental impact statement is not required under the National Environmental Policy Act or its implementing regulations. Therefore, a finding of no significant impact is appropriate.

_____   _____
William T. Hogarth   Date
NOAA Assistant Administrator for Fisheries

APPENDIX B: AMENDMENT 8 APPROVAL LETTER

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

JUN 10 1999   F/SWR2:JJM

PFMC

Mr. Jerry Mallet, Chair
Pacific Fishery Management Council
2130 SW Fifth Avenue, Suite 224
Portland, Oregon 97201

Dear Jerry,

I am pleased to inform you that I have approved Amendment 8 to the Northern Anchovy Fishery Management Plan except for the specification of optimum yield (OY) for market squid and the bycatch provisions. The OY specification for squid was disapproved because the amendment does not provide an estimate of maximum sustainable yield (MSY), the theoretical concept on which optimum yield and overfishing is based under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The bycatch provisions were disapproved because Amendment 8 does not contain a standardized reporting methodology to assess the amount and type of bycatch in the fishery and because there is no explanation of whether additional management measures to minimize bycatch and the mortality of unavoidable bycatch are practicable at this time. I have approved all other elements of Amendment 8.

The Magnuson-Stevens Act requires that optimum yield be based on MSY. There may be sufficient protections in the current management of the fishery to prevent overfishing of squid, but MSY needs to be determined to establish a foundation for management. The Council should provide such an estimate accompanied by whatever qualifiers are necessary. Guidance has been furnished in the past, and we can work with the Council to meet the requirements.

I have disapproved the bycatch provisions. Landing records do not indicate a notable bycatch; however, there are no data to show what happens during fishing operations. There is a potential to capture salmon, striped bass, yellowtail and other species prohibited by State and Federal regulations, but there are no provisions to minimize potential bycatch. The two exempted fishing permits recommended by the Council to allow a small anchovy reduction fishery in a closed area off San Francisco may provide important information; however, the Council needs to develop a reporting system to assess the amount and type of bycatch. Only by properly assessing the bycatch in the fishery, can the Council meet its other responsibility to minimize bycatch and to minimize the mortality of unavoidable bycatch.
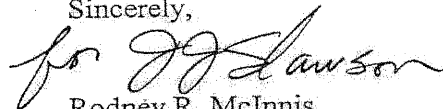
I have approved the overfishing definitions for the other species. Experience with coastal pelagic stocks around the world indicates that overfished low biomass conditions usually occur when unfavorable environmental conditions and high fishing mortality rates occur at the same time. The measures in Amendment 8 do not depend on whether low biomass is due to excess fishing or unfavorable environmental conditions. Reductions in fishing mortality are required in either case.

I have approved the fishing communities provisions. The harvest strategies, besides protecting the resources and ensuring forage for dependent species, are designed to provide maximum benefit to the Pacific coast. The limited entry scheme, besides preventing overcapitalization, is designed to protect historic participation in the fishery while providing maximum benefits to all users. Nevertheless, a more deliberative search for fishing communities, especially social and cultural aspects that might play a role in fisheries, would help ensure that a complete analysis has been completed. A proposed project to develop profiles of ports along the Pacific coast may help us better define communities and measure impacts. We can work with the Council to obtain better information so that the impacts can be measured more effectively.

I have approved the essential fish habitat provisions. Essential fish habitat (EFH) for coastal pelagics is defined by a temperature range bordered within the geographic area where a coastal pelagic species occurs at any life stage, where a species has occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by the species. More is known about the requirements for finfish than squid. Although spawning areas of squid are generally known to be shallow semi-protected near-shore areas with sandy or mud bottoms adjacent to submarine canyons, exactly what squid require for spawning habitat is not known. Accordingly, benthic habitats of spawning squid have not been described and identified by the Council as EFH. The Southwest Region is cooperating with the California Department of Fish and Game in research to determine these requirements. The Council should closely follow the research currently underway so that protection can be provided to squid stocks by amending the fishery management plan to add spawning squid EFH as soon as possible. This would enhance conservation of key habitat that may be adversely affected by human activity.

The Council has prepared an important response to the rapid increase in biomass of Pacific sardine following decades of low abundance. How this resource is managed will have significant effects on other coastal pelagic species, the species that depend on coastal pelagics for forage, and on the economics of fishing. I look forward to working with the Council to implement the provisions of the amendment.

Sincerely,

Rodney R. McInnis
Acting Regional Administrator

APPENDIX C: LIMITED ENTRY CAPACITY GOAL AND TRANSFERABILITY OPTIONS

Capacity Goal for the CPS Finfish Limited Entry Fishery

Background

At its November, 2000 meeting, the Pacific Fishery Management Council directed the CPSMT to continue its analysis on establishing a harvesting capacity goal for the limited entry (L.E.) finfish fishery and to address other capacity related issues such as permit transferability. Alternative capacity goals should be developed following the three options outlined in the CPSMT's statement on the CPS limited entry fishery issues, capacity goal and permit transferability, presented to the Council at its November, 2000 meeting:

Option 1.   Maintain a larger, diverse CPS finfish fleet (current size?) which also relies on other fishing opportunities such as squid and tuna;

Option 2.   Work the fleet down to a smaller number of vessels with certain characteristics (e.g., smaller number of larger, 'efficient' vessels; or smaller number composed of CPS finfish 'specialists');

Option 3.   Base the fleet size on our expectations of long-term expected yields from the combined CPS finfish species and the number of vessels physically capable of harvesting that yield.

The analysis should include advice on the most preferred option; why it is most preferred; and how permit transferability would help achieve and maintain that goal.

Progress to Date

Profile of the Current CPS Limited Entry Fleet

The window period for CPS permit transferability closed as of 31 December, 2000. The fleet now consists of 65 vessels. Forty-five of these vessels initially qualified under the window period and the other 20 vessels were permit transfers (Table 1). Fifty-five of these boats also hold permits to fish for market squid in California waters, and at least four vessels have been active in the CPS live-bait fishery since 1996. The vessels range in age from 4 to 64 years old, with an average age of 30 years (Figure 1). There are two general age groups in the fleet, with one ranging from 11-30 years, and the other in the 51-70 year old 'vintage' category.

CPS L.E. vessels range in length from 40 to 95 feet, with an average length of 62 feet (Figure 2). Vessel physical capacity can range widely within length categories depending upon breadth and depth of the hull design. For this reason, we calculated vessel gross tonnage and used this measure in the CPS finfish harvesting capacity analysis as the best proxy for each vessel's capital stock. The calculated gross tonnage incorporates a vessel's length, breadth and depth, which are consistent measures across vessel registration and Coast Guard documentation lists. Net tonnage is a more ambiguous vessel attribute and was not considered a good proxy for a vessel's capital stock.

As described in 46CFR69.209, gross registered tonnage (GRT) is defined:
$GRT=(2/3*length*breadth*depth)/100$. CPS L.E. vessel dimension data were obtained from the Coast Guard database. Gross tonnage for the current fleet ranges from 24 to 225 metric tons, with an average of 87 tons (Figure 3). Three general tonnage classes are apparent, with modes at 61-70 tons, 121-130 tons, and three vessels over 200 tons (Figure 3). This calculated GRT may not agree with a vessel's documented gross tonnage reported in Coast Guard documentation lists.

Data Revisions

Since the November Council meeting, a new capacity data set has been compiled which is comprised of comprehensive, individual landings data over the 1981-2000 period for the 65 vessels that acquired finfish limited entry permits. For each year a vessel had landings of any species, not just CPS, these landings and related information are captured in the data set. Because not all 65 vessels fished in each year of the

1981-2000 period, this is an unbalanced panel data set.

The landings data for the finfish limited entry fleet were compiled from vessel landings receipts (fish tickets) maintained in California's CMASTER data base. Each vessel's landings and corresponding ex-vessel revenues on a particular date were summarized and assumed to represent the landings and revenues for a unique trip. If a vessel had two or more fish tickets on the same date, this was considered a split load - - the catch from one trip was delivered to one or more buyers -- and counted as a single trip. Multiple tickets on the same date could actually reflect multiple trips on that date. Although this was deemed a rare event, a "common sense" filter was applied in instances where summarized landings per trip were anomalous (e.g. greatly exceeded the vessel's gross tonnage) to avoid a potential upward bias in landings per trip. The "common sense" filter was also used to deal with apparent fish ticket data entry errors.

The vessel landings data were used to demonstrate the high degree of variability that characterizes CPS fisheries, and to what extent vessels specialize in finfish fisheries compared to squid and fisheries for other species, primarily tuna.

To indicate the degree of variability in the finfish fisheries, plots of fleet-wide annual finfish landings (Figure 4) and annual weighted ex-vessel prices (Figure 5), as well as the relative number of annual finfish, squid and tuna trips per year (Figure 6) and trips per vessel (Figure 7) were generated for the limited entry fleet over the 1981-2000 period. Variability in resource availability is revealed by the pattern of annual landings and relative trips per vessel by species over the period. Variability attributable to fluctuations in market demand is reflected in the pattern of annual ex-vessel prices over the period.

Specialization in finfish was initially examined in terms of the share finfish trips comprised of a vessel's total annual trips. In this case, the greater finfish trips as a share of the vessel's total annual trips, indicates specialization in finfish (Figure 8).

To further indicate their degree of specialization in finfish, the proportion of each vessel's annual finfish revenue of their total ex-vessel revenue was calculated to show their economic dependency on finfish relative to other species, and how consistent the level of dependency on finfish was over the period (Figures 9-14 are shown as examples for each category).

Landings data were supplemented with vessel characteristics data from California fishing vessel registration and Coast Guard vessel documentation files. Vessel length, width and breadth data from these sources was used to calculate each vessel's gross tonnage. Overall, this data set provides a rich history of CPS and other species fishing activity for the limited entry fleet.

In addition to individual vessel data, a time series of CPS finfish biomass estimates was assembled for the 1937-2000 period (Figure 15). The current maximum sustainable yield and harvest target level control rules were applied to each species' annual biomass estimates for each year in the period to obtain harvest target levels (quota) in current time equivalents. These data were then used to project long-term, future aggregate finfish harvest target level (Figure 16).

Capacity Revisions

Background

Capacity is a short-run concept representing the maximum harvest that variable inputs (e.g. fuel and labor) are capable of producing given the observed capital stock. Changes in capacity come about from variations in the capital stock, and represent long-term investment decisions on the part of fishing firms.

A data envelopment analysis (DEA) was conducted using the landings and vessel characteristics data set to estimate finfish harvesting capacity and squid harvesting capacity for the limited entry finfish fleet. DEA is a means to estimate the per trip finfish and squid harvesting capacities for each vessel given its capital stock (fixed input) -- represented by its gross tonnage -- and observed output represented by volume of catch -- landings per trip. DEA determines which vessels, in terms of their gross tonnage, delineate a best-practice frontier. The best-practice frontier defines the maximum level of landings per trip that can be produced by a vessel, of distinct gross tonnage, when there is unrestricted availability and full utilization of

variable inputs (fuel, labor, gear, etc.). DEA also provides a measure of capacity utilization (CU): the ratio of observed landings per trip to capacity landings per trip (Figure 17). Dividing each vessel's observed output per trip by its CU measure gives its corresponding capacity output per trip.

Two measures of finfish harvesting capacity per trip and squid harvesting capacity per trip were derived for each vessel (Figure 18): 1) based on the maximum landing of finfish, and maximum landing of squid recorded for the 1981-2000 period; and 2) based on the average landing of finfish and average landing of squid over the period.

The measure of harvesting capacity based on the maximum recorded landing approximates the vessels physical capacity. Physical capacity is a pure technological or engineering measure of the maximum potential output per unit of time. In terms of fish harvesting, physical capacity typically corresponds to the vessel's hold volume. In this sense, physical capacity provides a benchmark, maximum harvesting potential for a given vessel or fleet of vessels. Physical capacity is a fixed measure that will only change with a change in the capital stock; i.e. a change in a particular vessel's physical structure or a change in fleet size or composition.

The second measure of harvesting capacity approximates output per unit of time under what are considered typical or normal operating conditions. This concept of capacity incorporates the fisher's expectations concerning variations in resource availability, environmental conditions, and output demand, and in this case is considered a technological-economic measure of capacity.

Physical capacity is appropriately associated with some peak availability of fish, unique environmental conditions which enhance effort production, or peak demand for output. Technological-economic capacity accounts for typical patterns of resource availability, environmental conditions, and output demand. In cases like CPS, where resource availability, environmental conditions and market conditions are highly variable, there is no such thing as typical conditions, and therefore technological-economic capacity is likewise highly variable.

A vessel's physical harvest capacity and normal harvest capacity is measured on a per trip basis. Annual capacity for each vessel is its per trip capacity multiplied by a measure of its number of trips per year. Therefore annual harvest capacity is dependent on the amount of effort each vessel is expected to generate during the year. As with physical and normal measures of harvest capacity per trip, the amount of effort a vessel produces during the year can be considered in terms of that which is possible from a purely technological or engineering standpoint, versus that which reflects variability in resource availability, environmental conditions and market conditions. The former can be thought of as physical effort, the latter normal effort.

In this analysis, each vessel's physical effort was the maximum number of annual finfish landings (trips) observed over the 1981-2000 period. Each vessel's normal effort was the average number of annual trips over the period. Therefore, each vessel's annual physical harvesting capacity was defined as its physical capacity per trip multiplied by its maximum number of annual trips (physical effort), and each vessel's annual normal harvesting capacity was defined as its normal capacity per trip multiplied by its average number of annual trips (normal effort).

Summing annual vessel capacities provides an estimate of annual capacity for the finfish limited entry fleet (Table 2).

Options

Consider four capacity goals: 1) Normal harvest capacity equal to the long-term expected aggregate finfish target harvest level, 108,306 mt, with physical capacity available to harvest peak period amounts of finfish, 273,507 mt; 2) normal harvest capacity equal to average total finfish landings over the 1981-2000 period, approximately 57,676 mt; 3) physical harvest capacity equal to the long-term expected target harvest level, 108,306 mt, without an excess capacity reserve; and 4) maintain fixed fleet of 65 vessels, with no capacity goal. These capacity goals are analyzed in conjunction with the fleet composition options described above.

Analysis

Option 1 - Capacity Goal 1 (CPSMT Preferred Option)

Maintain a larger, diverse CPS finfish fleet, which also relies on other fishing opportunities such as squid and tuna, with normal harvesting capacity equal to the long-term expected aggregate finfish target harvest level, approximately 110,000 mt, and with physical capacity available to harvest peak period amounts of finfish, 275,000 mt.

The current finfish limited entry fleet would satisfy Option 1, and capacity goal 1. Under what might be considered typical or normal operating conditions -- harvesting capacity based on average finfish landings per trip and average number of finfish trips per year -- the finfish limited entry fleet would provide sufficient capacity to harvest the expected long-term average aggregate finfish harvest target level (Table 3). This fleet would also have the physical capacity -- harvesting capacity based on maximum finfish landings per trip and maximum number of finfish trips taken per year -- to harvest the maximum potential amount of finfish, that amount associated with peak period availability of fish, environmental conditions which are most favorable to effort production, and peak demand for output. This "excess capacity" could otherwise be directed towards the harvest of squid and tuna. In this regard it is important to note that the ability of vessels participating in the CPS finfish fishery to harvest alternate species reduces the need to reduce the size of the limited entry fleet. CPS finfish purse seine fisheries off California are flexible and accommodate significant changes in resource availability and market demand. When CPS finfish are unavailable or market conditions for CPS finfish are not favorable, CPS purse seine vessels tend to switch to alternative species, primarily market squid, tunas, and herring.

Option 2 - Capacity Goal 2

Work the fleet down to a smaller number of vessels with certain characteristics (e.g., smaller number of larger, 'efficient' vessels; or smaller number composed of CPS finfish 'specialists'), with normal harvesting capacity equal to average total finfish landings over the 1981-2000 period, approximately 57,676 mt.

A substantially reduced fleet consisting of the 12 vessels identified as finfish specialists and 14 non-specialists ranked in descending order of capacity utilization (Table 3, Option 2-A) would have sufficient normal harvesting capacity to satisfy Capacity goal 2, and have physical capacity to harvest approximately 264,000 mt annually. Instead of including only those vessels considered specialists, the fleet could be reduced along a number of different dimensions (e.g. harvesting efficiency) to match capacity with 20-year average landings. Based on decreasing technical efficiency, increasing age and increasing gross tonnage, a fleet of 33 vessels would have sufficient normal harvesting capacity to satisfy Capacity goal 2, and enough physical capacity to harvest 275,000 mt annually(Table 3, Option 2-B). Assuming that at least some of the vessels losing their permits under Option 2 would cease fishing, this option would probably severely limit the amount of harvest capacity that would remain for tuna, and would probably increase the need for squid specialists.

Option 3 - Capacity Goal 3

Base the fleet size on our expectations of long-term expected yields from the combined CPS finfish species and the number of vessels physically capable of harvesting that yield, 110,000 mt annually, without an excess capacity reserve.

A reduced fleet with physical capacity -- harvesting capacity based on maximum finfish landings per trip and maximum number of finfish trips taken per year -- equal to the expected long-term average aggregate finfish harvest target level, 110,000 mt annually. This fleet would consist of the 12 finfish specialists when vessels are ranked by speciality and decreasing technical efficiency (Table 3, Option 3-A). This 12 vessel fleet would not have the capacity to take peak period amounts of finfish (275,000 mt) unless it made more finfish trips during the year than its observed maximum. If additional trips were made this would likely diminish the ability of these vessels to participate in other fisheries. This option would probably limit the amount of harvest capacity that would remain for tuna, and would probably increase the need for squid specialists. This fleet would have normal harvesting capacity of about 26,000 mt annually (Table 3, Option 3-A). Alternatively, when vessels are ranked by decreasing technical efficiency, increasing age and increasing gross tonnage, a fleet of 11 vessels would have sufficient physical capacity to harvest the expected long-term average aggregate finfish harvest target level, 110,000 mt annually. This fleet would

have normal harvesting capacity of 23,000 mt annually (Table 3, Option 3-B).

Option 1 - Capacity Goal 4
Maintain a fixed fleet of 65 vessels, with no capacity goal. This reflects the status quo where there is no harvest capacity goal. Under conditions of unconstrained permit transferability, this option could result in significant increases in harvesting capacity.

Permit Transferability

Background

Limited entry programs are primarily designed to address economic problems associated with excess harvest capacity or overcapitalization in open access fisheries. In most cases significant economic benefits (efficiency gains) are realized by allowing unconstrained transfer of limited entry permits if the the initial allocation of permits is sub-optimal. Under an open market for limited entry permits, permits would tend to be sold to fishers who use the most efficient harvesting techniques. Fishers who use the most efficient harvesting technology will be able to outbid less efficient competitors. Over time this should lead to efficiency gains and increased profitability through a reduction in fleet harvesting costs. A transferable permit can become a highly valued asset to its holder. Non-transferability can lead to ossification of the fleet if there are no opportunities to replace or sell vessels.

Increased efficiency is not the overriding objective of Amendment 8. The limited entry program for the CPS finfish fishery has multiple objectives. In some cases, there are social, income distributional, or other benefits that may be of greater importance than efficiency, that can be realized by constraining permit transfer to maintain the initial allocation. In the latter cases, the initial allocation may be optimal in terms of preserving a particular pattern of fishing operations, or fishing community structure. It was for these reasons that a 70 vessel fleet was chosen over a more efficient 41 vessel limited entry fleet as the target fleet size, which would best strike a balance between economic and social objectives.

The CPS finfish limited entry program in Amendment 8 qualified 70 vessels for finfish limited entry permits. Permits issued to qualifying vessels were transferable unconditionally for one year following implementation of the limited entry program, January 1, 2000. After one year, transferability is limited to situations where the original vessel is lost, stolen, or no longer able to participate in federal fisheries. The replacement vessel must be of equal or less net tonnage.

The window period for CPS permit transferability closed as of 31 December, 2000. The fleet now consists of 65 vessels. Forty-five of these vessels initially qualified under the window period and the other 20 vessels were permit transfers. These permit transfers may lead to improvements in economic efficiency and economic benefits from improved product quality, since permits would tend to be transferred to fishers who use more efficient or advanced harvesting and handling techniques.

These permit transfers may also reflect the dependency of CPS vessels on alternate species, particularly market squid, where under current conditions a California squid permit cannot be transferred to another vessel. In this case, there is likely to be an overall efficiency gain in terms of optimizing vessel operations over the suite of CPS fisheries opportunities. This is an important consideration in evaluating transferability options, i.e., the ability of vessels participating in the CPS finfish fishery to harvest alternate species when CPS finfish are unavailable, market conditions for CPS finfish are not favorable, or availability and market conditions for alternate species are more favorable. In this spirit, the Team has recommended that CPS finfish permits be freely transferable, and market forces (rather than policy decisions) be the guiding force in determining optimum harvesting capacity and fleet configuration across all CPS vessels' fishing opportunities.

Transferability Options

Option 1 No transferability of permits except 1) if the permitted vessel totally lost, stolen or scrapped, such that it cannot be used in a federally regulated commercial fishery, provided application for the permit originates from the vessel owner who must place it on a replacement vessel of the same or less harvesting capacity within one year of disability of the permitted vessel, or 2) the permit is placed on a replacement vessel of the same or less harvesting capacity provided the previously permitted vessel is

permanently retired from all federally managed commercial fisheries for which a permit is required.

Option 2 Allow CPS finfish limited entry permits to be transferred without constraints.

Option 3 (CPSMT Preferred Option) Allow CPS finfish limited entry permits to be transferred with restrictions on the harvesting capacity of the vessel to which it would be transferred to: 1) full transferability of permits to vessels of comparable capacity, and 2) allow permits to be combined up to a greater level of capacity in cases where the vessel to be transferred to is of greater harvesting capacity than the one from which the permit will be transferred.

Analysis

Option 1 represents the status quo. For a given CPS finfish harvesting capacity goal and corresponding target fleet this option allows some modernization to occur while limiting growth of fishing capacity in the long term. It is likely to lead to greater specialization in the CPS finfish fishery since replacement vessels may be relatively inefficient in alternative fisheries. Although this option would seem to be most compatible with fleet *Option 2 - Capacity Goal 2*, a finfish limited entry fleet consisting of a small number of larger, 'efficient' CPS finfish 'specialists', with normal harvesting capacity equal to average total finfish landings over the 1981-2000 period, it would not allow combining up of permits to replace more than one small vessel with a larger vessel. The number of vessels in the CPS finfish fishery and their corresponding harvesting capacity would be fixed.

Option 2 would allow full transferability by which market forces would determine optimum harvesting capacity and fleet configuration taking into account alternative opportunities for CPS vessels. Full transferability would likely be incompatible with a specified harvest capacity goal for CPS finfish. By allowing a replacement vessel to be of greater harvesting capacity than the originally permitted vessel on a one-for-one permit transfer basis, there would not be any constraint on vessel-level finfish harvesting capacity. A fleet of larger vessels could result in fleet harvesting capacity exceeding the capacity goal. Even with a trip limit in place, larger vessels could possibly make more trips so that the annual CPS finfish harvest would exceed the capacity goal. Although this might result in a sub-optimal fleet with respect to a CPS finfish harvest capacity goal, it would not preclude overall efficiency gains in the context of the full array of fishing possibilities available to CPS vessels.

Option 3 would restrict transferability by not allowing permit transfers on a one-for-one basis except in cases of comparable harvesting capacity. Transfers from a smaller vessel to a larger vessel would require combining the smaller permit with another permit for placement on the larger vessel. Option 3 represents a compromise between more restrictive transferability as per Option 1 and full transferability as per Option 2. Under Option 3, harvesting capacity would be fixed at some desired level, but the number of vessels corresponding to that capacity level initially awarded permits would only be a maximum. By allowing permits to be combined up, the number of vessels initially issued permits could be reduced.

This situation could arise when vessels seek to optimize their operations across the alternative fisheries in which they are capable of participating, market squid being the most likely species in terms of joint optimization. By allowing transferability within the confines of Option 3 the emerging fleet would represent the future expectations of industry members concerning vessels best suited to take advantage of joint harvesting opportunities without compromising the desired CPS finfish harvest capacity goal.

Option 3 will probably be most satisfactory in terms of harmonizing the CPS finfish limited entry program and California's pending squid limited entry program. At this point, California Department of Fish and Game (CDFG) is recommending full transferability of permits to vessels of comparable capacity (defined as within 5 percent of the transferor vessel's gross registered tonnage (GRT) as an element of California's squid limited entry program. In addition, for vessels wishing to increase capacity, CDFG is considering a '2-for-1' program which involves surrendering a permit if the vessel to be transferred to is in excess of the 5 percent capacity allowance and lower than 135 percent of the original vessel's GRT. If the replacement vessel's GRT exceeds 135 percent of the original vessel's GRT, two permits must be surrendered (i.e. '3-for-1') to upgrade. CDFG's proposed scheme for combining permits is designed to decrease capacity of the initial squid fleet through a reduction in the number of vessels. Since the CPSMT's preferred option is to maintain the CPS finfish fleet at it's current capacity, Option 3 could contain less restrictive exchange rates. For example, a '2-for-1' program for CPS finfish could require surrendering a permit if the vessel to

be transferred to is in excess of 110 percent of the original vessel's GRT. A variation of the 2-for-1 program would require that the permit being surrendered be from a vessel with a GRT equal to the net increase in GRT of the replacement vessel less the comparable GRT allowances. For example, replacing a 50 GRT vessel with a 100 GRT vessel would require an additional permit from a 40 GRT vessel when the comparable GRT allowance is 10 percent (i.e. comparable GRT is 110 percent of the transferor vessel's GRT). Allowing permits to be combined up in this manner would enable a fleet to develop that is best suited for participation in both fisheries.

In terms of the CPS physical and normal capacity frontiers shown in figure 18, the proportional change in harvesting capacity for a given proportional change in gross tonnage is less than one over the range of observed gross tonnages. This means that a 100 percent increase in a vessel's gross tonnage will result in a less than 100 percent increase in its harvesting capacities. In the case of physical capacity the corresponding increase in capacity is about 90 percent, and in the case of normal capacity about 75 percent. Therefore, a 10 percent gross tonnage allowance is not expected to result in a substantial increase in harvest capacity. Additionally, this would allow combining up of a permit that is 10 percent less than the replacement GRT.

Option 3 would leave decisions about harvest capacity levels and transferability of permits within the policy arena, but given harvest capacity and transferability parameters, allows industry to determine what the fishery should "look like" in terms of the number of vessels and their corresponding harvesting capacities. Option 3 would not impose any restrictions on vessel physical attributes, but would require permits to have a gross tonnage endorsement. The CPS finfish harvesting capacity analysis establishes a linkage between a vessel's GRT and its harvesting capacity. Therefore, as is being considered for California's squid limited entry program, a vessel's finfish limited entry permit could carry a GRT endorsement that denotes its harvesting capacity.

<u>125 Metric Ton Trip Limit</u>

From the capacity analysis, vessels greater than or equal to 115 GRT, have a physical harvesting capacity greater than or equal to 125 metric tons per trip (Figure 18). Therefore, we would not expect to see permits being transferred to vessels with a GRT greater than 115, unless vessels of this size are optimum across all fisheries in which they participate.

Reevaluation of the Capacity Goal

For whichever transferability option that the Council adopts, it is advisable that conditions and effects of transferability be reevaluated periodically in conjunction with achievement of the capacity goal, and objectives of the FMP. The CPSMT recommends setting a trigger for reevaluation based on an overall change in fleet GRT of five percent.

Table 1. Coastal Pelagics Limited Entry Permit Vessel Listing

Vessel Name	Vessel Owner	CG #	LE #
Misty Moon	Misty Moon, Inc.,	578511	1
Paloma	Boat Anna Maria	236642	2
St. George II	St. George II Fishing, Inc., Frank Vuoso	238969	3
Barbara H*	David A. Haworth	643518	4
San Antonio	Mazara Inc., Antonino Ingrande	236947	5
Annie D	St. Teresa Fishing, Inc., Stanley DiMeglio	246533	6
San Pedro Pride	San Pedro Pride, Inc., Ercole (Joe) Terzoli	549506	7
Ferrigno Boy	Ferrigno Enterprises Inc., Nicolina Ferrigno	602455	8
King Philip*	King Philip, inc., Sal Tringali	1061827	9
Sea Wave	Sea Wave, Inc., Sal Tringali	951443	10
Mary Louise	Sea Lanes II, Inc., Tony Mattera	247128	11
Bainbridge	Bainbridge Inc., Richard Mirkovich	236505	12
Pioneer	JCJC Incorporated	246212	13
Maria	Brothers C	236760	14
St. Joseph	St. Joseph, Inc., Robert Cigliano	633570	15
Sea Scout	Sea Scout, Inc., Isidoro Amalfitano	248454	16
Retriever*	William Ford Hargrave and John Aiello	582022	17
Atlantis	F/V Atlantis, L.L.C., Christopher C. Peterson	649333	18
G. Nazzareno	Nazzareno, Inc.	246518	19
Sea Queen	Boat Sea Queen, Inc.	582167	20
Pacific Leader	Southern California Bait Co, Inc.	643138	21
Chovie Clipper	Southern California Bait Co., Inc.	524626	22
Tribute	Stanley J. Nelson	613318	23
Ocean Angel I	Ocean Angel I, LLC	584336	24
Maria T	Maria T., Inc.	509632	25
Manana	Manana Bait Co., Inc.	253321	26
Miss Juli	Stephen L. Lovejoy	548223	27
Mineo Bros.	Domenic Mineo	939449	28
Sea Queen	Sea Queen Corporation	583781	29
Little Joe II	Bella Lea, Inc.	531019	30
Caitlin Ann*	Caitlin Ann General Partnership	960836	31
Eldorado	Gaspare F. Aliotti	690849	32
Kristen Gail*	Bruce E. Joyce	618791	33
Fiore D'Mare*	Fiore Enterprises, Inc.	550564	34
Endurance*	Gaspare Aliotti	613302	35
New Sunbeam	Pacific Live Bait, Inc.	284470	36
Calogera A*	John, Nick R, & Anthony J. Alfieri	984694	37
Eileen	South Sound Fisheries, Inc.	252749	38
Pamela Rose	Pamela Rose, Inc., Stephen Greyshock	693271	39
New Stella	Sal Boy, Inc., Richard Aiello	598813	40
Traveler	Baitall Inc., Lawrence Vernand	661936	41
Lucky Star	Nick Jurlin Jr.	295673	42
Ocean Angel II	Ocean Angel II, LLC	622522	43
Mello Boy*	Arthur Mello	1061917	44
Trionfo	Aniello Guglielmo	625449	45
Jenny Lynn*	Vito Terzoli	541444	46
Heavy Duty*	Heavy Duty LLC, C.D. Franklin	655523	47
Aliotti Bros	Joseph D. Aliotti	685870	48
Lady J	Noto Corporation, Francesco Noto	647528	49
Anna's	Matteo M. Sardina	253402	50

Vessel Name	Vessel Owner	CG #	LE #
Endeavor*	SBA Corporation	971540	51
Antoinette W	Oceanside Bait Co., Inc., James Gardner	606156	52
Donna B*	James A. Bunn	648720	53
Papa George*	Volcano Bay, Inc.	549243	54
Mercurio Bros	Sam Mercurio	650376	55
Kathy Jeanne*	Pacific Broadbill, Inc.	507798	56
Merva W	Merva W, Inc., Michael McHenry	532023	57
Santa Maria	Santa Maria Fishing, Inc.	236806	58
Buccaneer	David Crabbe, Sal Tringali	592177	59
Midnight Hour*	William Ford Hargarve and John Aiello	276920	60
Nancy B II*	Nancy B, LLC.	542513	61
Miss Kristina	Joe Fernandez	580843	62
Emerald Sea*	SRS Incorporated	626289	63
Connie Marie*	Kavon Incorporated	624240	64
Theresa Marie*	Harry D. Hofland	629721	65

* permit transfer

Table 2. Annual capacity estimates for vessels with CPS limited entry permits.

A. CPS Finfish Capacity

| | | Number of Trips | |
		Maximum[3]	Average[4]
Capacity	Maximum[1]	538,804	282,121
Output Per Trip	Average[2]	213,251	111,395

B. Squid Capacity

| | | Number of Trips | |
		Maximum[3]	Average[4]
Capacity	Maximum[1]	391,616	184,104
Output Per Trip	Average[2]	176,273	82,721

[1]Based on the maximum recorded landings per trip, per vessel over the period,1981-2000.
[2]Based on the average recorded landings per trip annually, per vessel, 1981-2000.
[3]Based on the maximum number of annual trips per vessel over the period, 1981-2000.
[4]Based on the average number of trips annually per vessel, 1981-2000.

Table 3. Number of vessels and corresponding capacity parameters for capacity goals and options.

Option	# Vessels	Physical Capacity	Normal Capacity
1	65	538,804	111,395
2-A[1]	26	263,663	58,652
2-B[2]	33	274,939	59,515
3-A[1]	12	107,368	25,682
3-B[2]	11	113,176	22,644

[1]Vessels primarily ranked by finfish specialists, generalists; secondarily by decreasing technical efficiency.
[2]Vessels primarily ranked by decreasing technical efficiency; secondarily ranked by increasing age; tertiary ranked by increasing gross tonnage.

Appendix Table 1. CPS Limited Entry Fleet supplemental information.

Total CPS Permit Holders:	**65**
Original Qualifiers Remaining:	45
New Vessels from Transfers:	20
Vessels with Squid Permits:	55

Vessels by Category		**Comments:**
CPS "Specialists"	12	5 are transfers; 5 hold squid permits; 3 are CPS 'purists'
Generalists	23	3 are CPS permit transfers; 22 hold squid permits
Squid "Specialists"	26	8 are CPS permit transfers; all hold squid permits
Tuna "Specialists"	3	3 are CPS permit transfers; 2 hold squid permits
Undetermined	1	

Appendix Table 2. Number of vessels taking 95% and 99% of the CPS finfish landings, 1981-2000.

		Number of Vessels	
YEAR	CPS Landings (mt)	95% of harvest	99% of harvest
1981	105,507	37	52
1982	97,833	39	52
1983	55,727	45	61
1984	56,119	45	59
1985	46,279	37	51
1986	54,790	36	50
1987	56,572	36	48
1988	58,596	32	45
1989	61,759	35	49
1990	48,210	38	51
1991	45,311	34	52
1992	38,859	27	41
1993	30,795	26	39
1994	26,145	26	42
1995	52,566	27	40
1996	48,750	32	51
1997	68,522	36	52
1998	65,750	30	42
1999	74,083	38	52
2000	61,343	38	52
Average:	57,676	35	49

Appendix Table 3. Number of vessels and corresponding capacity parameters based on observed maximum and average landings, and observed maximum and average trips per year, 1981-2000.

Option	# Vessels	Physical Capacity[1]	Normal Capacity[2]
1[3]	65	360,520	60,416
-A[4]	41	328,127	58,067
3-A[5]	7	120,127	16,735

[1]Physical capacity based on each vessel's observed maximum finfish trips per year and observed maximum finfish landing per year, 1981-2000.
[2]Normal capacity based on vessel's average of observed finfish trips per year and average of observed finfish landing per year, 1981-2000.
[3]Capacity estimates for all 65 permitted vessels.

[4]Normal capacity equal to average total finfish landings over the 1981-2000 period,58,000 mt per year. Vessels ranked by descending normal harvest capacity per year.
[5]Physical capacity equal to long-term expected target harvest level,110,000 mt per year. Vessels ranked by descending physical harvesting capacity per year.

Figure 1. CPS Limited Entry Fleet - Vessel Age
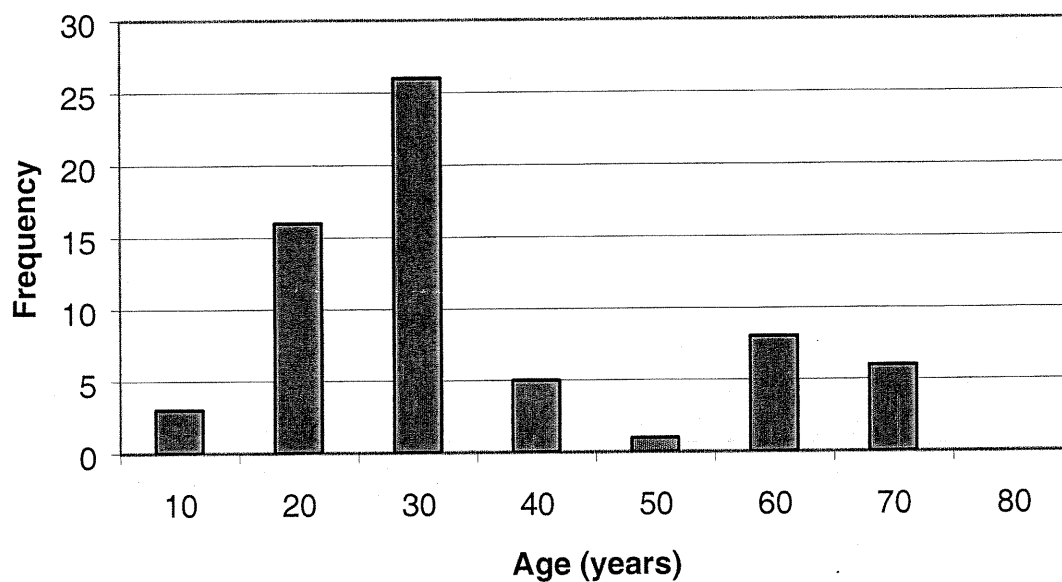
Figure 2. CPS Limited Entry Fleet - Vessel Lengths
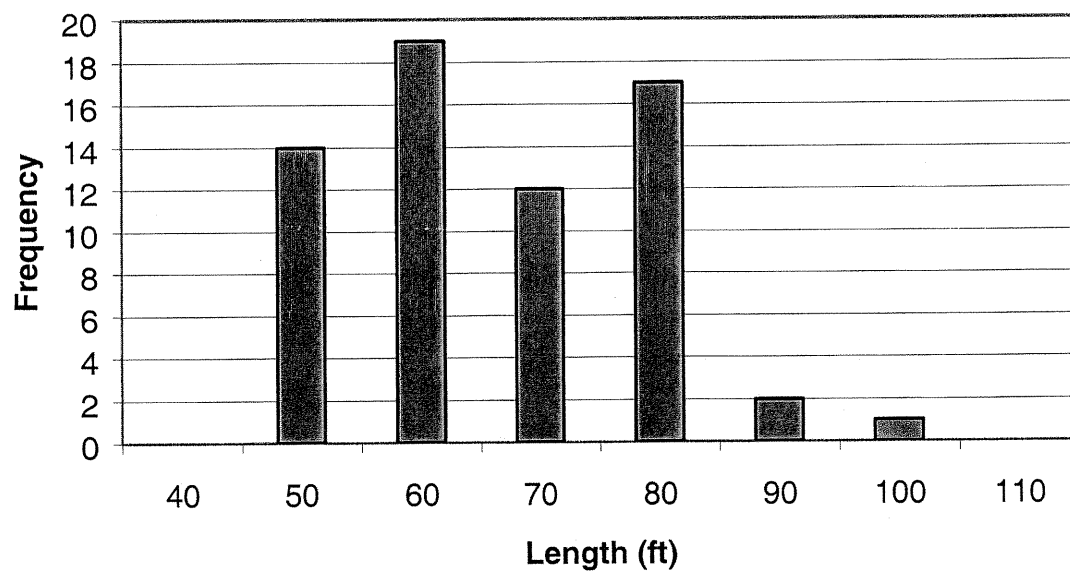
Figure 3. CPS Limited Entry Fleet - Gross Tonnage

Frequency vs. Calculated Gross Tonnage (mt)
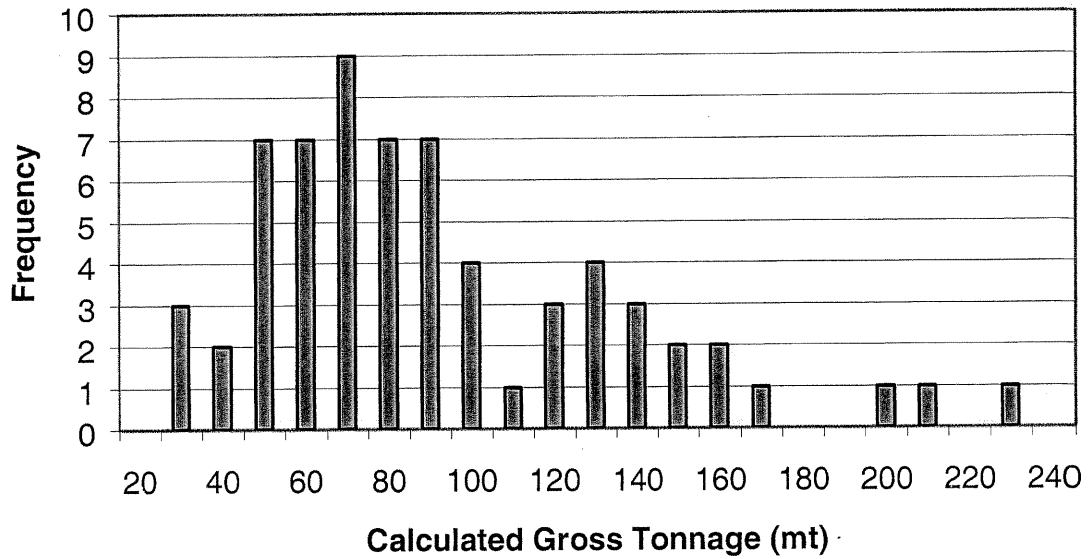
Figure 4.   Annual aggregate finfish landings for limited entry fleet, 1981-2000.
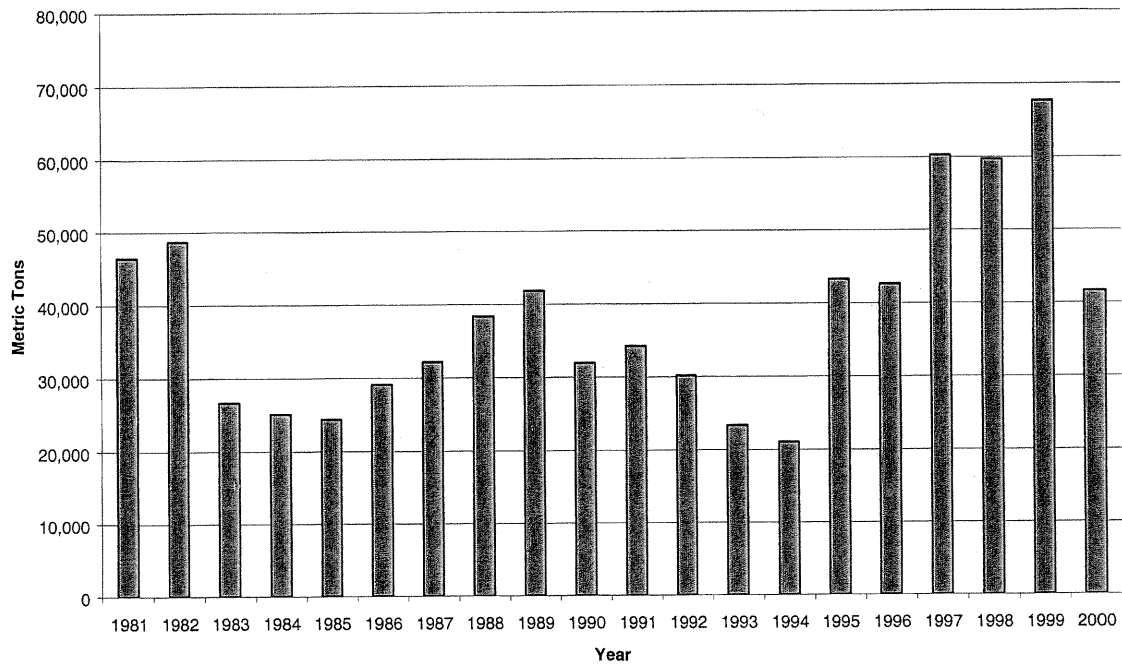

Metric Tons vs. Year

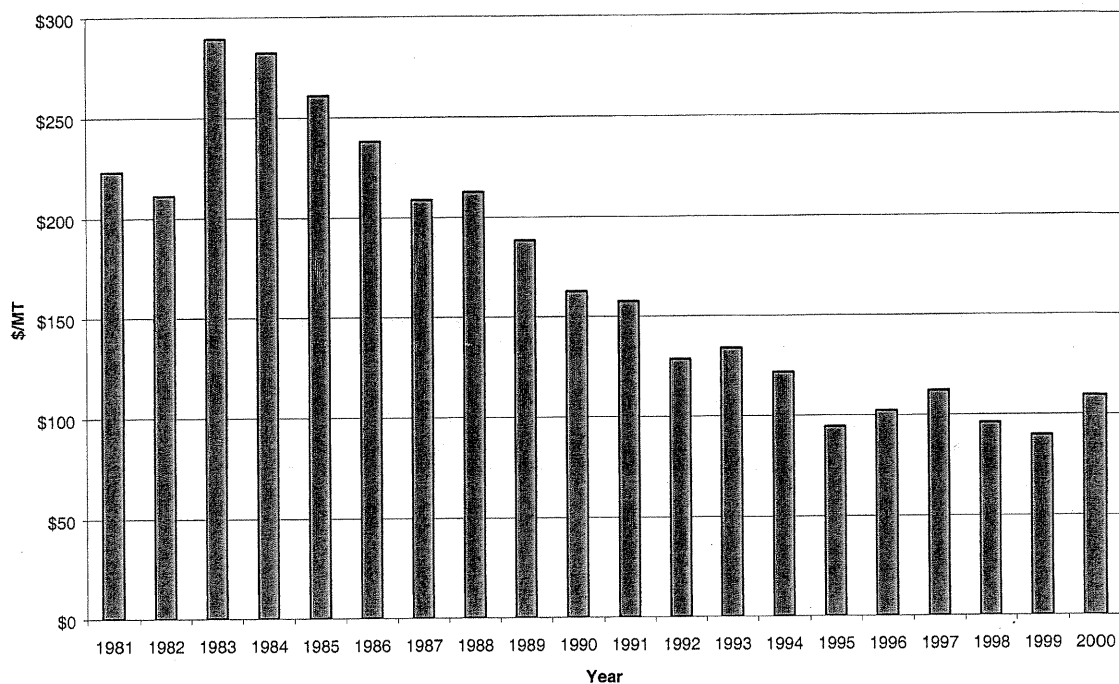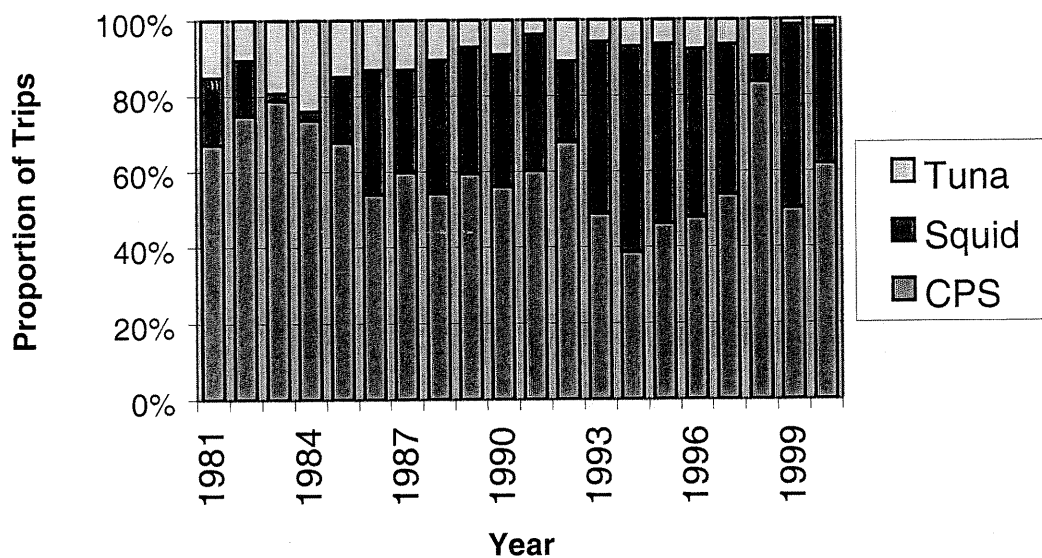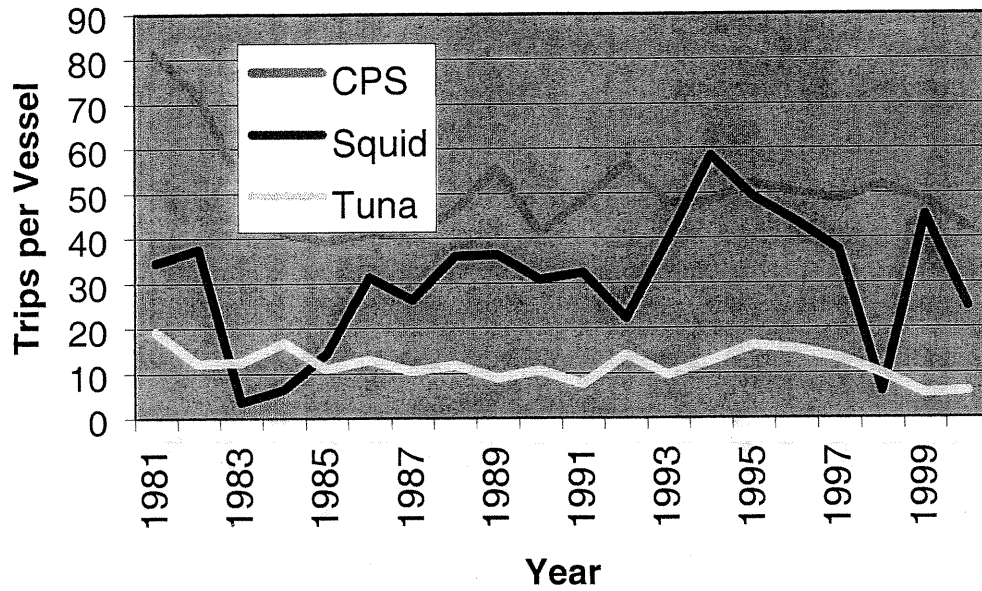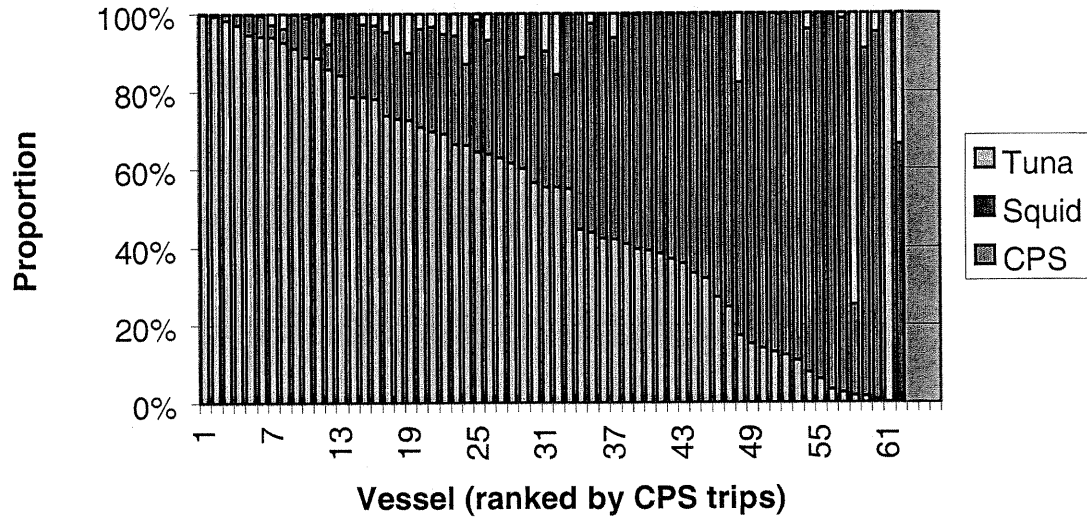Figure 5. Average weighted price all finfish species in 1999 dollars, 1981-2000.

Figure 6. Relative Proportion of Trip Types
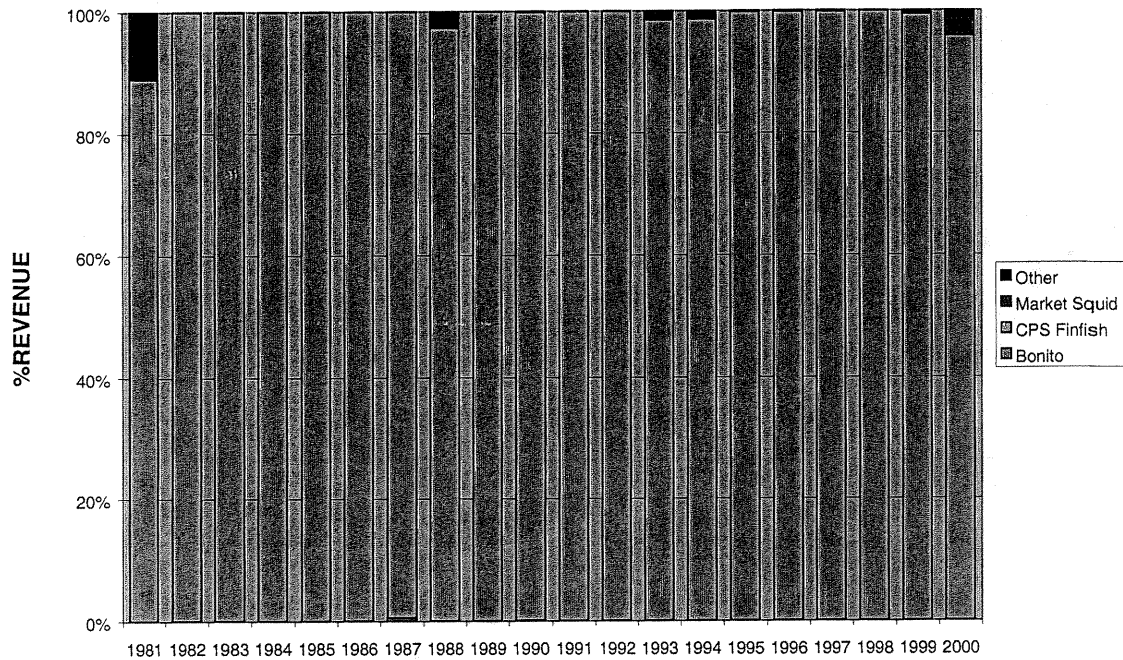
Figure 7. CPS Fleet Trip Types per Vessel

Figure 8. Proportion of Vessel Trips by Species

Figure 9. Vessel "AY" - CPS specialist

%REVENUE

Legend:
- Other
- Market Squid
- CPS Finfish
- Bonito

1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

Figure 10. Vessel "BG" - CPS specialist

% REVENUE

Legend:
- Yellowfin tuna
- Skipjack tuna
- Other tunas
- Other
- Market Squid
- Herring
- CPS Finfish
- Bonito
- Bluefin tuna
- Albacore

1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

Figure 11. Vessel "A" - Squid specialist
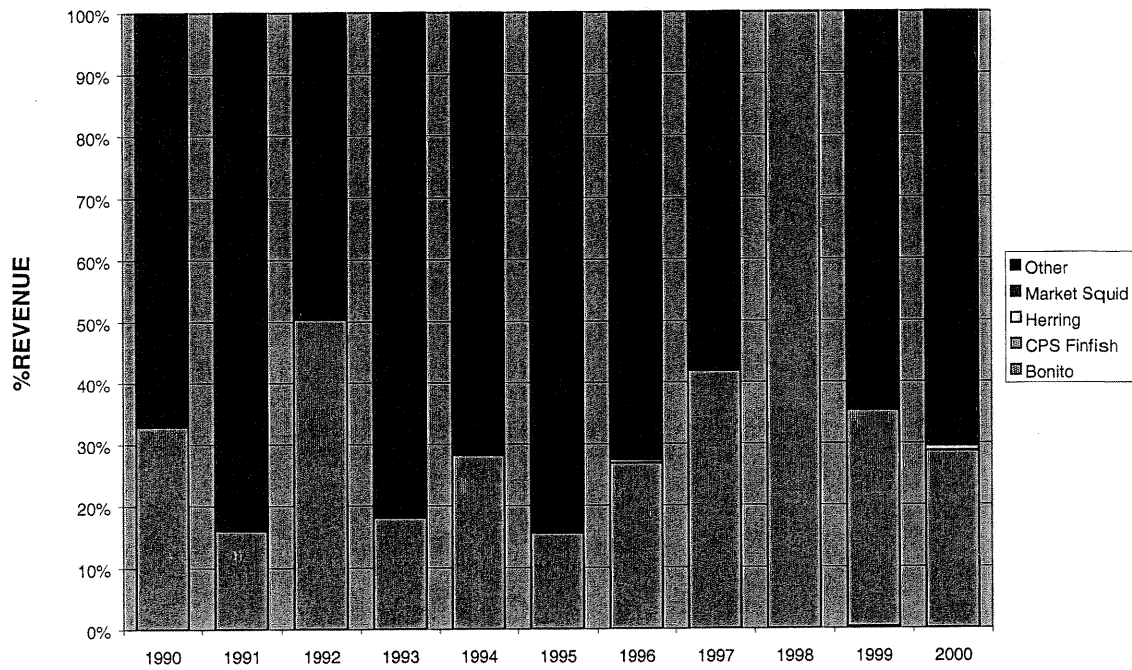
Figure 12. Vessel "BB" - Squid specialist
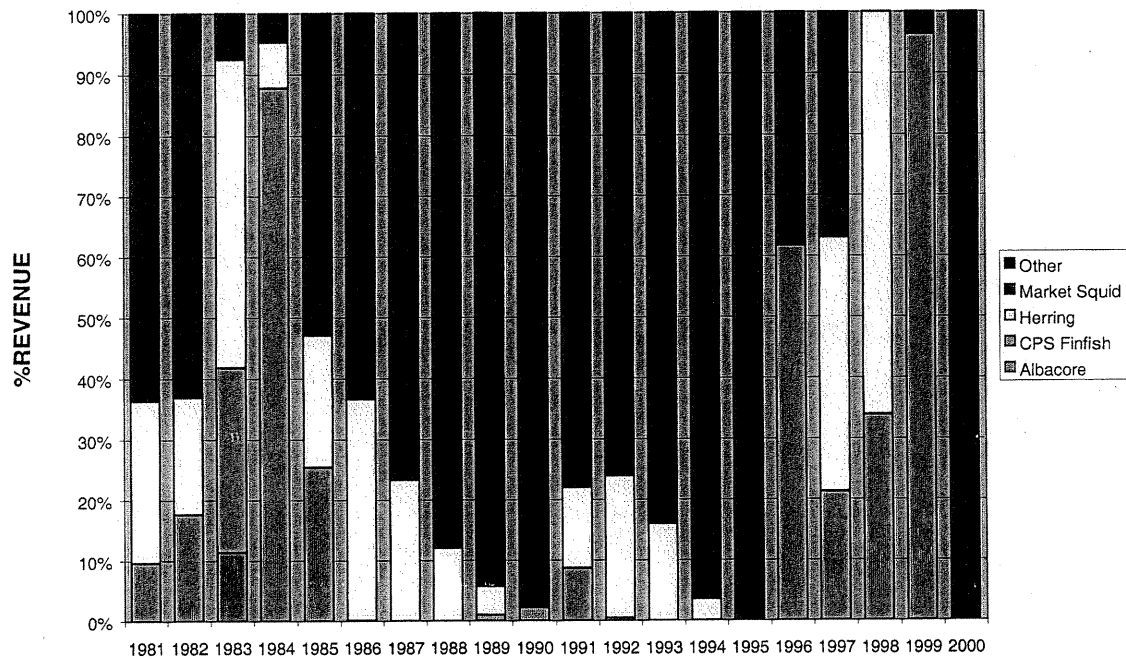
Figure 13. Vessel "AG" - Generalist
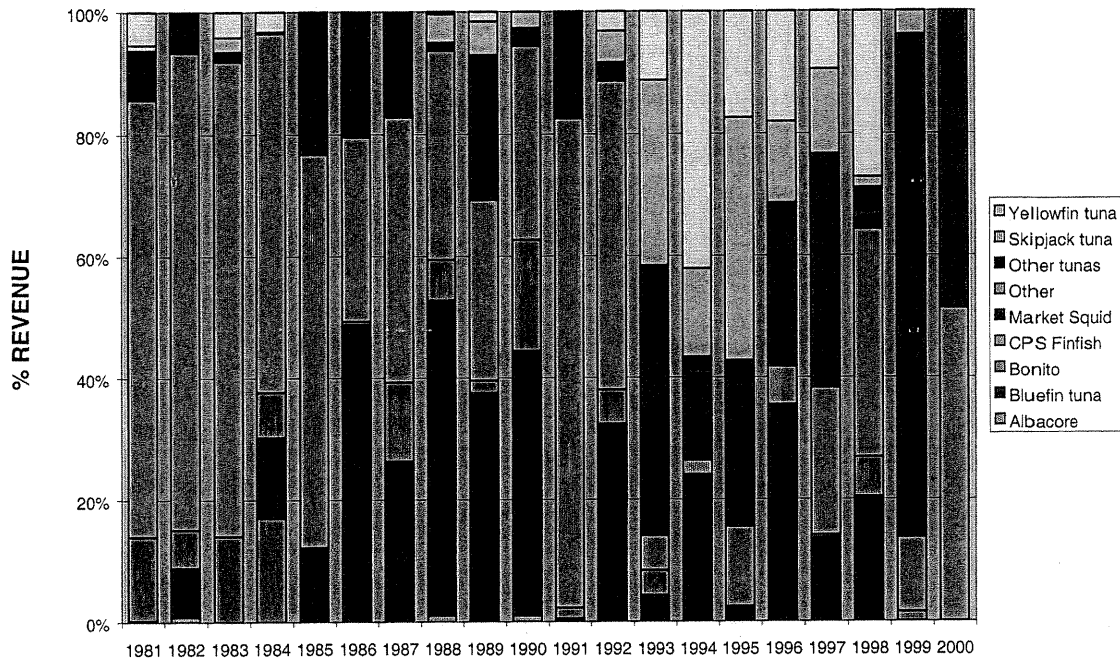
Figure 14. Vessel "J" - Generalist
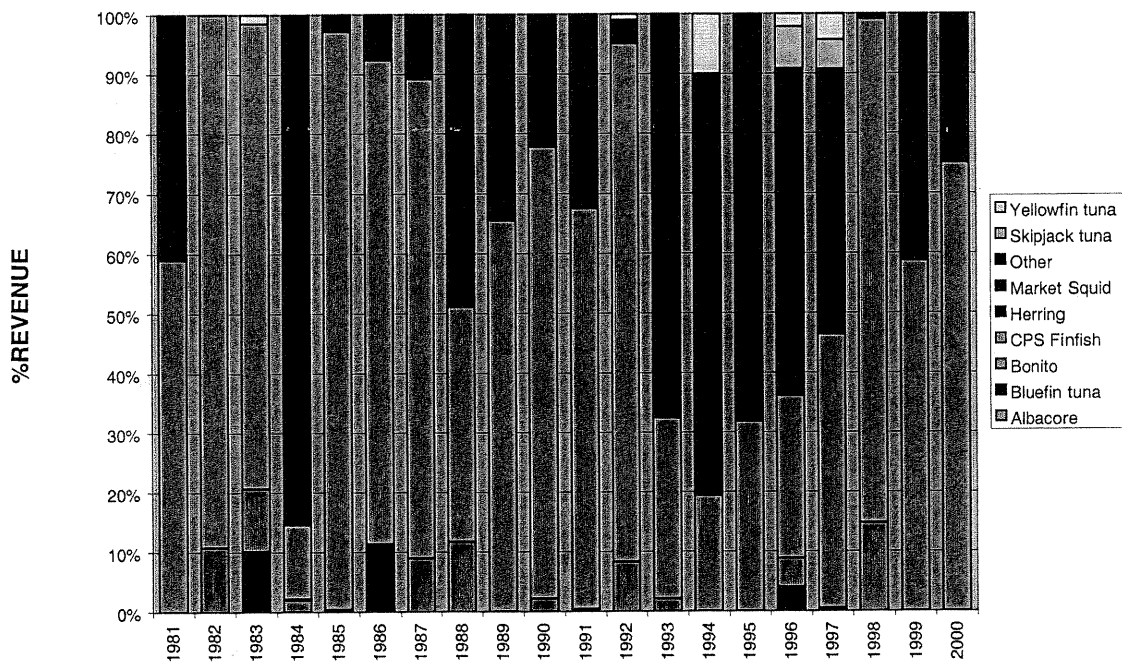
Figure 15. CPS Biomass Estimates

Legend:
- Pacific Sardine
- Pacific Mackerel
- Northern Anchovy

Y-axis: Millions of metric tons (0.0 to 4.0)
X-axis: Year (1932 to 1998)
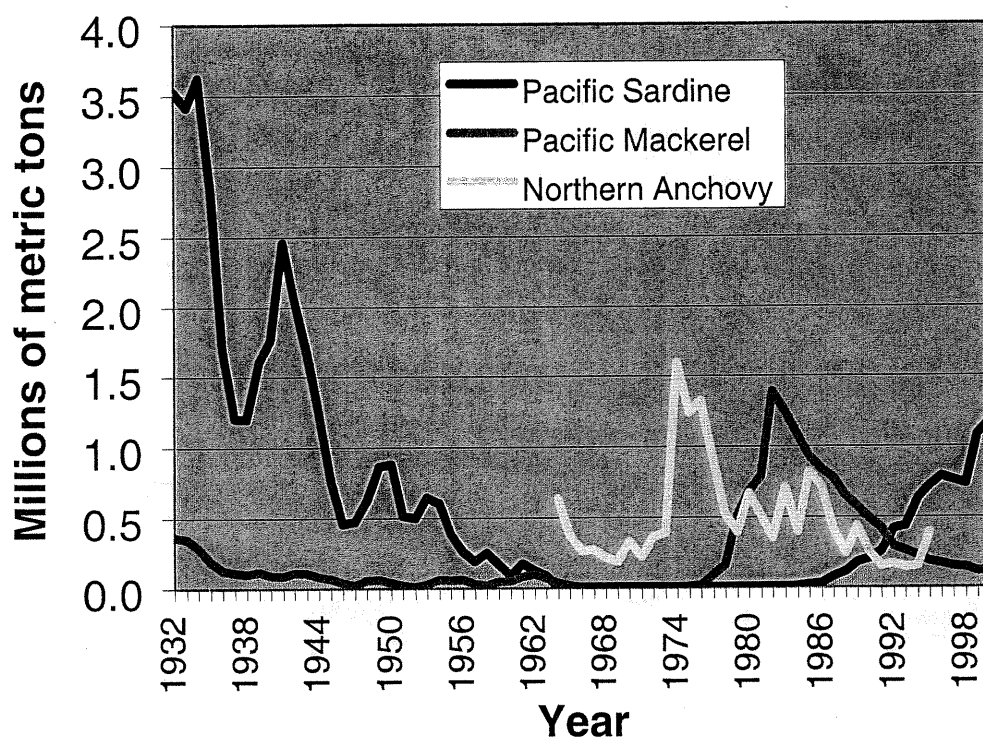
Figure 16. CPS Target Harvest Levels

Legend:
- Jack Mackerel
- Northern Anchovy
- Pacific Mackerel
- Pacific Sardine

Y-axis: Metric tons (0 to 300,000)
X-axis: Year (1932 to 1997)
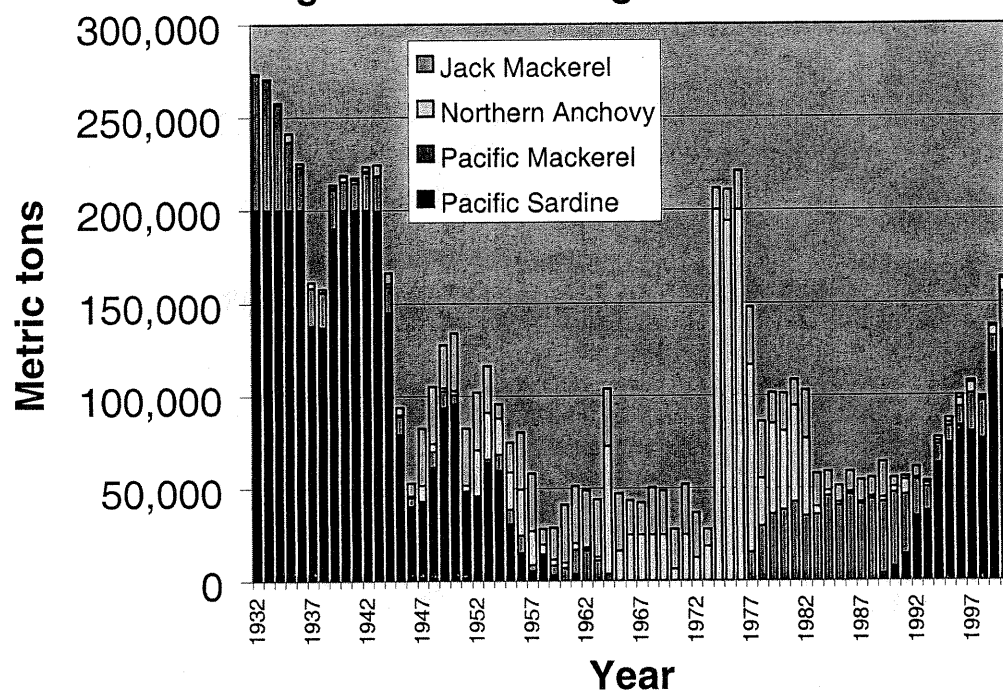
Figure 17. Data Envelopment Analysis - a piecewise linear programming procedure that optimizes on each individual observation to calculate a best-practice frontier.
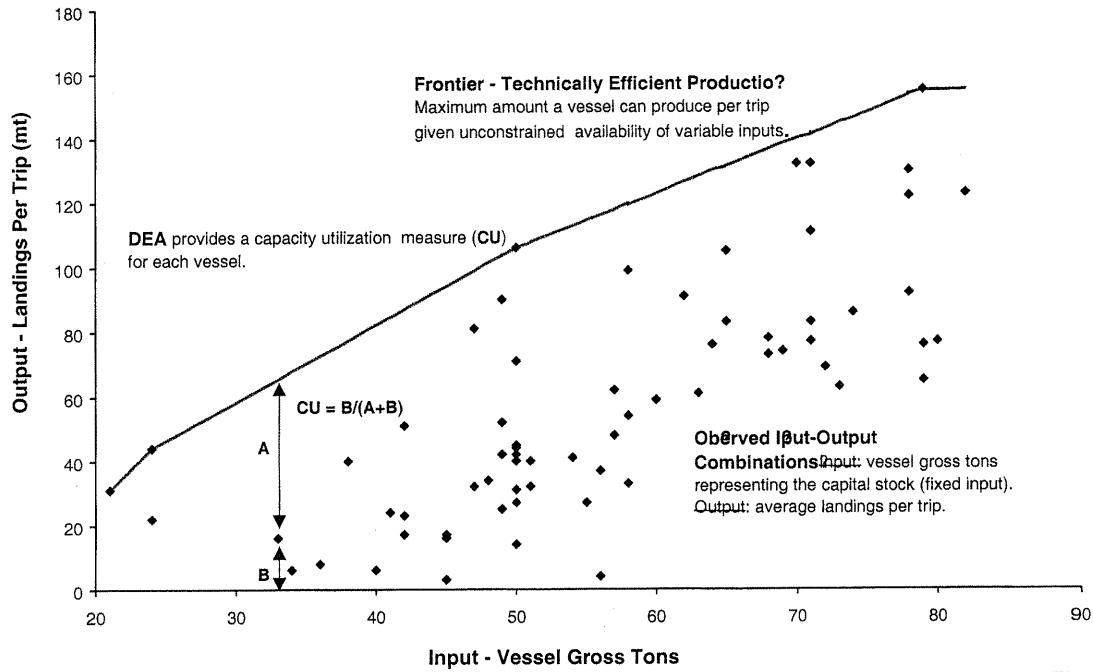
Figure 18. Estimated harvesting capacity per trip for CPS limited entry permittees
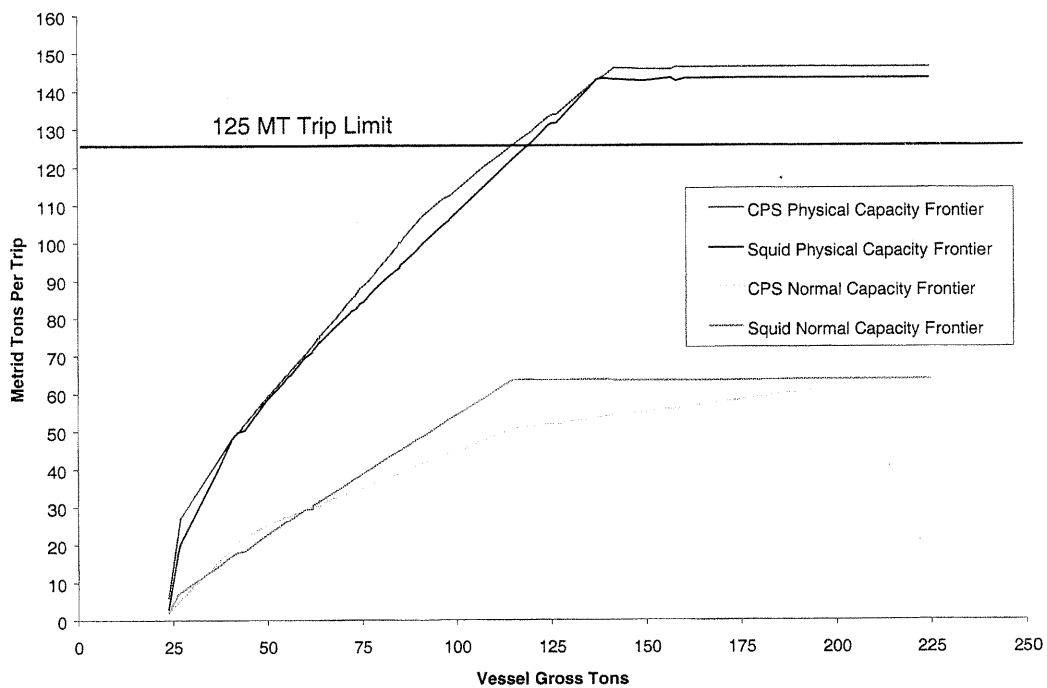
APPENDIX D: SQUID MSY ANALYSES FROM
REVIEW DRAFT AMENDMENT 9

The following analyses regarding market squid MSY have been excerpted from an early review draft of Amendment 9 (CPS FMP), presented to the PFMC as *Exhibit I.1, Attachment 1, September 2000*. These analyses were subsequently removed from the final draft of Amendment 9, and are presented here for background information. These analyses were drafted by the CPSMT prior to the squid STAR panel.

5.0 Maximum Sustainable Yield for Market Squid

5.1 Purpose and Need for Action

National Standard 1 requires that conservation and management measures prevent overfishing while achieving, on a continuing basis, the optimum yield (OY) from each fishery. OY is based on MSY, or on MSY as it may be reduced according to social, economic, or ecological factors. The most important limitation on the specifications of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing. Each FMP should include an estimate of MSY for each managed species.

At the Council's March 2000 meeting, the SSC and the CPSMT noted that setting an MSY for market squid is impractical for several reasons: (1) fishery and biological data are scarce, (2) markets tend to influence fishing effort, thus landings data are not a reliable indicator of stock abundance; and (3) the short life span of squid combined with its vulnerability to oceanographic variation limits the practicality of the sustainable yield concept. Nevertheless, recent high harvests indicate that squid can be highly productive and have precipitated action by the California Legislature to implement a research and management program for this species.

5.2 Approaches for determining an MSY Proxy

5.2.1 MSY Based on Historical Landings

Because there are not adequate data to make a mathematical MSY determination, guidance was taken from the NMFS publication: Technical Guidelines on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act (Restrepo et. al., 1998). Those guidelines propose that in data poor situations such as the California market squid fishery, a proxy may be used for MSY, and that it is reasonable to use recent average catch from a time period when there is no qualitative or quantitative evidence of declining abundance. Options for time periods warranting consideration are discussed in section 5.3.

Historic market squid landings suggest that low landing periods correspond with El Niño events when abundance and/or availability of squid to the fishery is greatly reduced. Those events are generally followed by periods of apparent increasing abundance/availability and increasing annual landings until the next El Niño. The market squid fishery is volatile and reliant on the international market and availability of squid from other squid fisheries. In the time period between the last two El Niño events (1993-94 and 1996-97) there was nearly an unlimited demand for California market squid in the Republic of China, a situation that kindled rapid development of fishing and expansion of processing for export from California. The expansion ended with the onset of the two-year 1997-99 El Niño event during which market squid abundance/availability dropped to very low levels and landings plummeted.

The first fishing season following the two-year El Niño event (1999-00), squid landings for the season were the second highest on record. Nearly all of the landings were from the southern portion of the fishery (southern California) with almost no landings to the north (Monterey area). This disparity would not have been predicted given current understanding of market squid abundance and distribution nor in temperature inclusive models, which are being considered for harvest guidelines and have been recommended by the SSC.

The ability of the California market squid fishery to support landings of 112,771 mt in 1996-97 followed by a strong El Niño and then repeat landings of the same magnitude two seasons later suggest that the stock was not being overfished and that the 113,000 mt level achieved is sustainable.

5.2.2 MSY Based on Expanding California Catch Data

Analysis of CDFG landings databases can provide general information on where squid are harvested. The

location of commercial catch is recorded by fishing block, each of which encompasses a 10 by 10 nautical mile area. During the time period 1981-1999, 262 unique blocks were recorded on landing receipts which have been submitted for the sale of California market squid. This number may be used to represent the total available or potential fishing area in the range of the California fishery for any given season. During the expansion of the fishery over this time period, the number of blocks fished has generally increased since 1981. If we assume that market squid had an equal chance of being caught in any of these potential blocks, we can expand the actual catch by the ratio of exploited to unexploited blocks and obtain the maximum catch that might have been caught in that year. Yearly maximums are averaged to obtain an MSY proxy.

Table 1.

Fishing Season (Apr-Mar)	Landings (mt)	Blocks Utilized	% Fishing Area	MSY Proxy
1980	5233	26	0.10	52730
1981	23452	52	0.20	118161
1982	11987	43	0.16	73035
1983	986	27	0.10	9570
1984	1228	33	0.13	9749
1985	13041	41	0.16	83336
1986	23226	40	0.15	152131
1987	22873	36	0.14	166466
1988	43722	31	0.12	369519
1989	29983	30	0.11	261856
1990	29458	38	0.15	203106
1991	35077	56	0.21	164110
1992	17049	45	0.17	99263
1993	49398	67	0.26	193169
1994	57689	114	0.44	132583
1995	85124	105	0.40	212404
1996	112771	105	0.40	281390
1997	9886	47	0.18	55111
1998	10639	67	0.26	41602
**1999	101700	95	0.36	280478

*   Landings (mt)/ [blocks utilized/total blocks] = MSY proxy (numbers were transferred to the table from a spreadsheet and rounded).

**   Preliminary data (likely to increase with final landings data).

5.2.3 MSY Based on Coastwide Expansion from Midwater Trawl Data

Midwater and trawl data are the only comprehensive source of coastwide information on squid distribution (See Appendix D). Using this information assumes that these surveys can provide a measure of coastwide spawning area. Length information in these databases indicates a size range of 20 to 120 millimeters, which correlates to an age distribution of a few weeks to six months. It is further assumed that there is little or no migration from spawning location to midwater trawl capture location.

MSY values calculated for the California fishery (above) could be expanded to reflect additional unfished areas based on market squid observed in trawl data for the US west coast. Using information on squid density and proportion positive in the Pacific northwest, California and Mexico (assuming all tows were equal and not accounting for year effects), the portion of squid observed in California to the coastwide total equals approximately 71 percent. Scaling the above MSY proxy values for California upward accordingly, coastwide MSY proxy values are estimated in Table 2.

Table 2.

Location	Tows	Positive Tows	Total Squid Caught	Squid per Positive Tow	Proportion Positive	Ratio	Portion in Range
Pacific Northwest	419	111	4955	44.64	0.265	11.826	0.19
California	6009	1553	270837	174.40	0.258	45.072	0.71
Mexico	1410	152	8697	57.22	0.108	6.168	0.10
Total	7838	1816	284489			63.066	

-      Squid per positive tow = total squid caught/positive tows
-      Proportion positive = positive tows/total tows
-      Ratio of total squid caught = squid per positive tow x Proportion positive

5.3 Maximum Sustainable Yield Proxy Alternatives Considered

To determine a time period during which to evaluate catch data and provide alternative MSY proxy values, several factors may be considered, based on varying interpretations of the Restrepo et al. guidelines. A 20 year time span serves to cover the entire period during which the southern California fishery was expanding, as well as several El Nino periods. A ten-year time period spans the more recent expansion period and two El Nino periods. The most recent five-year period incorporates both a strong El Nino and the two highest seasons on record, one of which directly followed an El Nino event. The 1992-1996 time period is based on the Restrepo et al. guidelines in which there was no evidence of declining abundance, assuming that abundance is reflected by catch and nothing else. In 1996, the highest seasonal catch was attained, and using the rationale that no biological information was available to indicate that there was declining abundance, this level of harvest is sustainable. In 1988, the highest California catch expansion value was attained, and likewise there was no evidence of declining abundance.

Table 3 provides a matrix of values for each of the time periods described above using the three approaches outlined in section 5.2 for determining an MSY proxy.

Table 3. MSY Proxy Alternatives

	Landings Only	CA Catch Expansion	Coastwide Expansion (CA = 71%)
1. 20-YEAR (1980-1999)	34226	147988	208434
2. 10-YEAR (1990-1999)	50879	166322	234256
3. 5-YEAR (1995-1999)	64024	174197	245348
4. 1992-1996	64406	183762	258820
5. Highest Landings (1996)	112771	281390	396324
6. Highest Catch Expansion (1988)	N/A	369519	520449

5.4 Discussion of MSY Proxy Alternatives

Although there are occasional landings of market squid in Mexico, Oregon and Washington, there is no information at this time on volume or catch location. Because landings are poorly documented, very low and sporadic, the above calculations assume that there is no utilization of these areas for fishing activity, and therefore all proxy options are based only on landings data from California.

5.4.1 Using Historic Landings

The guidelines provided in Restrepo et al. were not generated with such short-lived species in mind. Current research indicates that squid live a maximum of approximately ten months, and the average age of squid taken in the commercial fishery are just over six months of age, which makes averaging the amount harvested over any period of time potentially ineffective as a way to determine sustainable harvest levels. Additionally, as no effort data is available but there were clearly changes in effort due to expansion of the fishery and El Nino conditions, landings information alone may be less precise to calculate an MSY proxy.

5.4.2 Using Expanded California Catch Data

A criticism of this option is that using a simple sum of all the blocks where catch has been reported is not an accurate method of calculating spawning area. There are vast differences in the productivity of the 262 blocks; therefore, giving each one an equal weighting on an area basis may be erroneous. However, there is no additional biological information at this time that refutes or supports either argument. Although the northern Channel Islands are clearly the most productive areas in terms of catch, this may only be a an effect of increased effort or one driven by market conditions. For example, there are reports that abundance of squid at San Nicholas Island is often very high (from participants in squid and crab fisheries), yet reported squid catch is low. The quality of squid delivered to processors is an important issue, and fishing areas are often limited based on proximity to processing facilities. San Nicholas Island is approximately 70 miles offshore and is generally considered too far from port to catch and deliver a good quality product to the processor.

Additionally, comparison of high-density squid catch areas with high-density squid trawl areas (discounting differences between the sources of midwater and bottom trawl survey data) shows that catch may not be the

best indicator of abundance, as most of the high-density trawls occurred in the areas outside San Francisco Bay, Monterey, Cape Mendocino and southern Oregon, which are generally not the highest density areas for catch. If there were a high correlation between the catch and tow data, an MSY proxy value based on this relationship would warrant consideration.

5.4.3 Using Coastwide Expansion from Midwater Trawl Data

A criticism of this option is that the sources of survey data are different; therefore, lumping them together for treatment is erroneous. Several treatments of these data may be employed to improve the information, such as volume of water passing through the nets (not available at this time) or accounting for differences between the gear used. Seasonal and year effects were not considered in analysis of the trawl survey information, and were aggregated for the time period 1966 through 2000.

In determining a coastwide MSY, ignoring information on spawning area that is beyond the range of the fishery may be erroneous, although regional allocation issues may warrant attention if the resource moves to active management status or within state FMP's.

5.4.4 Other Alternatives Explored

The CPSMT derived catch information from CDFG block data to indicate the range of the California fishery as presented in Table 1, and calculated the portion of squid present in California waters (71%) relative to the entire Pacific coast from midwater trawl data as presented in Table 2. However, several additional methods of data treatment may be employed that could generate other alternatives to the MSY proxy value selected by the team. Following is a summary of other methods of evaluation that were considered; most of which would result in a greater range and much higher MSY proxy values.

1.   When calculating the MSY proxy value for areas within California (Table 1), comparison of catch data with tow data reveals that positive tows occurred in areas beyond those ever recording commercial catch. Consequently, it would be possible to further expand the range of squid spawning activity (and thus increase the MSY proxy values) either by expanding the sum number of blocks to a number greater than 262, or by using a measure of area other than the 10x10 nautical mile block.

2.   In looking at the midwater trawl data, both calculations of proportion positive and density were considered in determining the portion of distribution within the range of California waters. However, calculating the area of distribution (based on positive tows) would yield different results.

3.   Since the CDFG block information spans an area of 10x10 nautical miles, it is unlikely that the entire block was utilized for squid fishing activity. It is known that directed fishing activity on spawning grounds occurs generally in depths shallower than 200 feet. It could therefore be said that any positive midwater trawl tow that occurred in any depth greater than 200 feet (assuming no migration or transport between hatch location and location of capture) would represent area that is unutilized by the fishery. There is anecdotal information to indicate that spawning activity or egg deposition does occur in depths greater than 200 feet, as there are reports of squid egg cases being taken incidentally to the Dover sole, thornyhead, and other bottom trawl fisheries. Consequently, based on the distribution of positive tows, if the bottom area within the 200 foot depth contour were calculated, MSY proxy values could be scaled up to account for additional areas beyond that 200 foot-depth where positive tows occurred and the fishery does not operate. Additionally, as there are shallow areas where positive tows for squid occurred within California waters and no records of catch has ever been made there since 1981, these areas would be included with the deep water as area not utilized by fishing activity but positive for squid occurrence.

5.6 Environmental Consequences

The maximum long-term average yield of squid is likely to be of less use for managing squid than it is for other coastal pelagic species, which also respond dramatically to environmental conditions. Nevertheless, regardless of how catches are averaged, using MSY to obtain optimum yield is inadequate, as optimum harvest of an annual crop is likely to be highly variable from year to year, even when no harvesting occurs. Recent research indicates that Loligo opalescens taken in the fishery are approximately six months in age and are sexually mature and actively spawning. The maximum age of squid is approximately nine to ten months,

and they are known to die following the spawning event.

In response to market demands beginning in 1993, squid landings began an unprecedented climb. From fishing seasons 1993 through 1996, landings were 49,398 mt, 57,690 mt, 85,124 mt, and 112,771 mt respectively (Table 1). The harvest during the 1997-98 season was 9,887 mt, which would naturally raise fears that the high harvests in previous years had affected the resource. However, the harvest during the 1999-2000 fishery was 82,613 mt. There was an El Niño during 1997/98, which appears to have prevented squid from significant spawning in the area of the fishery, which has happened during all previous El Niños. If recent high harvests reflect excellent environmental conditions, then perhaps the average harvest of 23,000 mt between 1981 and 1992 reflects poor environmental conditions.

At this time, there is no way to determine how much squid should be harvested in any given year; however, squid are currently harvested only on the spawning grounds off Monterey, California, and in southern California, not on the open sea. Harvest in the remainder of the habitat has been minimal. Also, as noted above, not all areas where squid occur in the area of the fishery are exploited.

Whether large or small, any number picked that puts a limit on harvest is likely to be speculative. While it is true that a very small number will most likely prevent overfishing, it would shut down the fishery. Considering the history of landings in the fishery, this would not be justified and would not be optimal. The examination of habitat through midwater and bottom trawl data has been revealing. After looking at abundance in several different ways, there seems to be a good possibility that the resource may be capable of producing at least twice what has been recently harvested. At this time, the most that can be done for the resource to protect it while maintaining a productive fishery is to assure to the extent practicable that adequate spawning occurs. Ongoing research is likely to reveal other information that will improve on this approach, e.g., beginning the fishing season on a certain date after spawning begins or closing certain areas permanently or temporarily. One approach that might be useful would be to monitor (1) the amount of egg capsules deposited. Some kind of assessment would give managers assurance that spawning is successful, and (2) the amount of habitat exploited by the fishery. Areas where spawning occurs that are not exploited by the fishery would play the role of reserves and would provide a kind of insurance policy for protecting the resource. For the reasons stated above, the CPSMT recommends setting a proxy for MSY at 245,348 mt. This is a guide for the Council to monitor the fishery and does not preclude the Council from using information obtained from ongoing research to take action to protect the fishery as soon as it becomes available.

5.8 Proxy MSY Value and Risk of Overfishing

In addition to initial regulatory measures taken by the state of California as described above, there are additional constraints that may serve to protect squid from excessive harvest and may warrant consideration in determining an MSY proxy value.

Based on coastwide distribution and abundance of California market squid from midwater and bottom trawl surveys, the population is only utilized for commercial purposes over a fraction of its range. Over 90 percent of California landings occur in southern California, mostly in the vicinity of the Channel Islands. However, the survey data indicates squid are in greatest abundance off areas of northern California and southern Oregon, where little or no fishing activity occurs. Additionally, squid are only fished on spawning aggregations at depths traditionally shallower than 30 meters, yet mature individuals and egg cases have been collected in bottom trawls at significantly deeper depths. At this time, there is no biological or genetic information to indicate if there are geographically distinct stocks and what mixing may or may not occur over the range of the population. Within the scope of the state FMP process, area-specific MSY's could determined if warranted and additional biological information were available. Severe reductions in catch were observed during the 1983-84 and 1997-98 seasons as a result of El Nino events. If this temporary collapse in the fishery is due to a decline in stock size generated by poor environmental conditions, unavailability of the resource on the fishing grounds may offer protection against excessive harvest. Moreover, low availability of squid on the traditional fishing grounds does not precipitate fishing effort in non-traditional areas where squid may be abundant during these times.

Although little is known about vertical migration of squid and what portion of the stock may be vulnerable to fishing in shallow spawning areas at any given time, deep water areas may serve as an unexploited refuge, since the fishery operates by attracting squid with lights near the surface. Additionally, there are several known spawning areas for squid in southern California that are not utilized by the fishery due to proximity from

port, such as Cortez Banks and San Nicholas Island. As the product quality can deteriorate rapidly, offloading quickly is essential, and fuel expenses make fishing these regions cost-prohibitive if the market price is not high. Although there appears to be a substantial portion of the biomass that is unutilized for fishing activity in Baja, northern California and Oregon, the likelihood is that these areas will continue to serve as reserves, as purse-seining is not practical much of the time in those northern areas due to weather, and large-scale processing facilities are not established in these locations.

Considering the status of knowledge regarding market squid, establishing a number that purports to represent an MSY would be groundless. If the number were low, however that would be defined, an assumption might be made that the resource would be protected, but unless there were evidence that spawning was not occurring, closing the fishery based on present knowledge would also be groundless. Setting a high number, however that would be defined, may pose a greater risk of depleting the resource, but that number most likely depends on whatever environmental variables influence squid. The number itself is likely to vary widely from year to year. This FMP establishes, for want of a better term, a proxy MSY that is not regarded as a sustainable yield in any respect, but rather a benchmark to keep in mind while the fishery and the resource is observed. If the fishery expands to new areas as the benchmark is approached, that may be important information to take into account and could lead to some kind of management action. Likewise, the amount of spawning activity occurring as the benchmark is approached may also be significant information to take into account.

This FMP will not establish any number that might be regarded as a harvest limit without other protections. There are area closures, regulated and de facto, that protect certain areas from harvest. The fishery is closed two days out of every week. Market squid are widely distributed along the Pacific coast, far beyond the historical fishery. As long as the range of the fishery is confined as it has been in the past and as long as the method of harvest does not change, there is good reason to believe that the recommended approach will protect the resource.

Other Considerations

1.   Applying a definition of MSY to be 'the largest amount of catch that can be obtained on a continuing basis by applying a constant harvest rate' is ineffective for squid based on inadequate effort information. At this time, calculations of a harvest rate are not possible, although a logbook program has recently been implemented in the fishery for both light and purse seine vessels in order to attain better data for future management. Landing receipt information in CDFG databases can provide data on where, when and how much catch was taken by a particular vessel, but provides noting in terms of search time or area searched for no catch. Additionally, determining harvest rate proxies such as catch rates per boat, number of vessels participating, or number of days fished would be largely erroneous because of the impact that market conditions have upon landings information. For example, in recent years, markets have imposed trip limits on vessels, have restricted the number of vessels they will employ, and will often encourage vessels to switch target species to other coastal pelagics based on order demand. Additionally, because this fishery depends largely on the efforts of light boats, and no catch or effort information is available for these vessels, one landing made by a purse seiner could represent the efforts of zero to several light vessels on a given night. Based on these inadequacies, the CPSMT concluded that applying data-poor guidelines outlined in Restrepo, et al to use information on catch was the most appropriate method for developing proxy MSY values.

2.   Regarding the assumption that all blocks are treated equally in the expansion calculation despite the fact that landings data clearly show that densities between positive blocks vary significantly, there is not adequate information to say that squid are more or less abundant in those areas. It is assumed that catch is more abundant, although taking using this information without knowledge of effort again would be problematic. On the contrary, information from tow data sources do not show that commercial catch is strongly correlated with local abundance. Therefore, it seems more accurate to assume a constant density given these conflicting sources of information.

INFORMATION ON COASTWIDE DISTRIBUTION OF MARKET SQUID

I. Catch location information from California Fish and Game landing receipt data, 1981-1999.

Catch by Block
- 1-100 MT
- 100 - 500 MT
- 500 - 1000 MT
- 1000 - 2000 MT
- >2000 MT
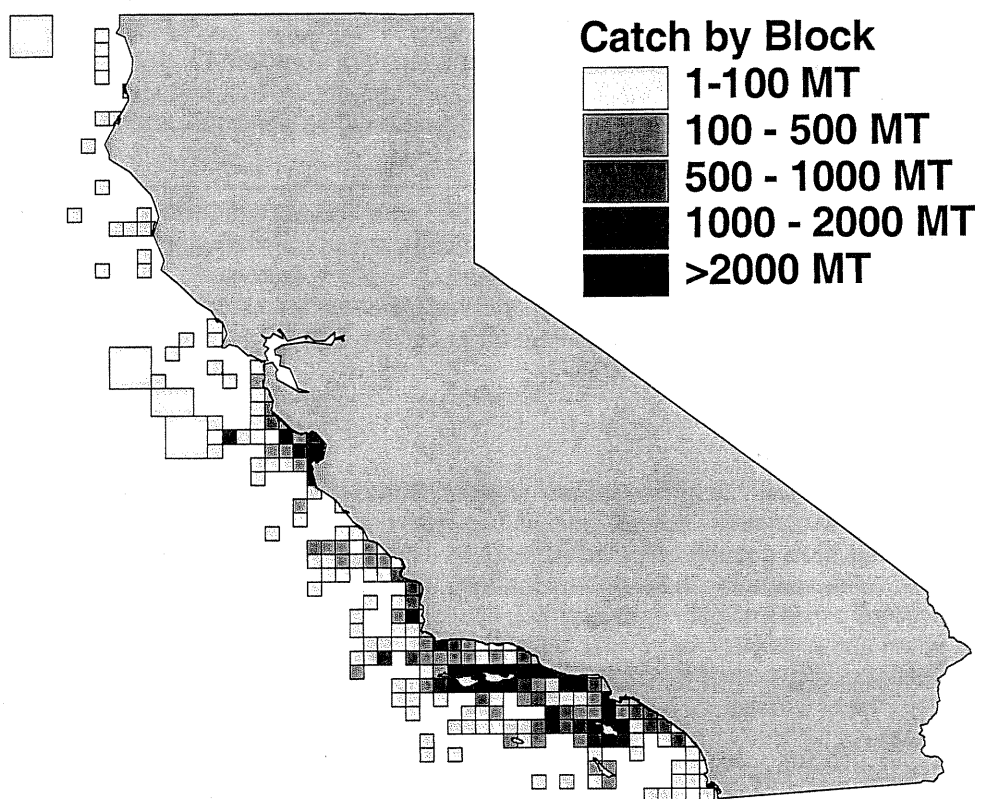
II. Midwater Trawl Information

Several sources of midwater trawl survey data yielded information on market squid taken independently of the survey's target efforts. Summary information and comparison of these surveys is provided here. Market squid was considered a significant bycatch in all surveys included.

	Tiburon Groundfish Survey	Kenny Mais Sea Survey	CDFG Sea Survey 2000	Oregon Predator Survey	Oregon Salmon Survey
Target Species	chilipepper (Sebastes goodei) and widow rockfish (S. entomelas).	Northern Anchovy	Market Squid, Sardine, mackerel, Northern Anchovy	Salmonids consumed by predators: Pacific Hake, chub mackerel jack mackerel, herring, anchovy, sardines	Salmonids tagged and released
Significant Bycatch	Market Squid	Market Squid	Market Squid	Market Squid	Market Squid
Survey Type	Midwater Trawl	Midwater Trawl	Midwater Trawl	Midwater Trawl	Midwater Trawl
Amount of Wire Out	depth dependent	depth dependent	30-35 fm	100 fm	depth dependent
Tow Depth	~5 fm or 16 fm	10-50 fm	10 fm	surface to ~10 fm	< 3.2 fm
Tow Time	15 mins.	20 mins.	20 mins.	30 mins.	30 mins.
Tow Speed	2.5 knts	2.5-3.1 knts	2.5 knts	4 knts	4 knts
Gear Type	Stauffer Modified Cobb	Mais Anchovy Trawl Net	Mais Anchovy Trawl Net	nordic 264 rope trawl	nordic 264 rope trawl
Mesh Size	Variable along net	Variable along net	Variable along net	Variable along net	Variable along net
Cod End Liner size	9 mm	12.7 mm	12.7 mm	8 mm	8 mm
Cod End mesh size	unknown	38.1 mm	38.1 mm	89 mm	89 mm
Mouth Opening Width	12 m	13.72 m	13.72 m	30 m	30 m
Mouth Opening Depth	12 m	11.58 m	11.58 m	20 m	20 m
Survey Date(s)	1986-99	tri-annually 1966-1988	Feb-00	1997-1999	1998-1999
Survey Hours	Night	Night	Night	Day & Night	Day
Area of Operation	Farallons to Monterey Bay	Central CA into Baja Mexico	Pt. Conception to Mexican boarder	Mouth of Columbia River	Mouth of Columbia River

A. Tiburon Juvenile Rockfish (Groundfish) Survey

In order to develop a recruitment index for rockfish, in 1986 the Groundfish Analysis Branch began conducting standardized annual midwater trawl surveys to provide information on the abundance and distribution patterns of young-of-the-year (YOY) pelagic juvenile rockfish off central California. Since it takes several years for rockfish to reach catchable size, sufficient data are just becoming available from fishery statistics to examine correlations between the recruitment indices and actual recruitment to the fishery. The Branch has used the indices in the past in the assessment on bocaccio (Sebastes paucispinis) and found them to be an effective source of fishery independent information on recruitment.

B. CDFG Kenny Mais Sea Survey

The survey purpose was to make acoustic and midwater trawl surveys of the Northern Anchovy, Engraulis mordax, population for estimation of biomass and age composition. Areas surveyed were northern Baja, southern California, and central California. Trawl surveys were done using a 14-meter mouth opening

midwater trawl fished at night along acoustic positive transects conducted during daylight hours. Speed of trawls was between 2.5 – 3.1 knots. This technique yielded many bycatch species that were also recorded. (Taken from: Mais, K F. 1974. Pelagic Fish Surveys in the California Current. CDFG Fish Bull. 162. 1-79).

C. CDFG Sea Survey 2000

Similar procedures were followed as above, less the acoustic surveys. Survey location was limited to the southern California bight.

D. Oregon Predator Survey

To better understand the role of large marine fishes as a potential source of mortality of juvenile salmon, this survey used a Nordic 246 rope trawl to collect fish along the surface and midwater. From April through September several species of fish and their stomach contents were collected and analyzed. The survey area was directly in front of the mouth of the Columbia River and within the river plume. This study used several different trawl nets experimentally (commercial hake trawl, rock hopper, #4 rope trawl, and Nordic 246) before selecting the Nordic net as the optimal gear type. Both the Oregon Predator Survey and the Oregon Salmon Survey differ from the other midwater surveys in the size of the area swept, as the nets used for these two surveys have a larger mouth opening (20m x 30m) than the others.

E. Oregon Salmon Survey

Similar in scope to above survey, but designed to be long term (10 years) and to also evaluate oceanographic factors such as food availability, coastal circulation regime, temperature, salinity, and smolt movement. Specific methodology and gear details are the same as the predator survey except that this survey targets salmonids rather than their predators.

III. Bottom Trawl Information

A. Groundfish Triennial Survey

The Resource Assessment and Conservation Engineering (RACE) Groundfish Assessment Program conducts and reports results of triennial surveys designed to establish time series estimates of the distribution and abundance of groundfish resources in waters off the coast of California north to the Bering Sea. Results of the surveys are used to support NMFS fishery management responsibilities for the fishery resources in the U.S. EEZ and to meet U.S. international fishery management commitments for the Convention on the Conservation and Management of Pollock in the Central Bering Sea and for transboundary management with Canada. This survey targets three depth zones, 55-183 m, 184-366 m, and 367-500 m over an area of operation from Alaska to Pt. Conception, California. The time series spans 1977-1998.

Triennial Bottom Trawl
- $ >5000 individuals
- $ 1000 - 5000 individuals
- $ 500 - 1000 individuals
- $ 100 - 500 individuals
- $ 1 - 100 individuals

Midwater Trawl Data, 1966-2000
- # >5000 individuals
- # 1000 - 5000 individuals
- # 500 - 1000 individuals
- # 100 - 500 individuals
- # 1 - 100 individuals

Catch Data
- 1-100 MT
- 100 - 500 MT
- 500 - 1000 MT
- 1000 - 2000 MT
- >2000 MT
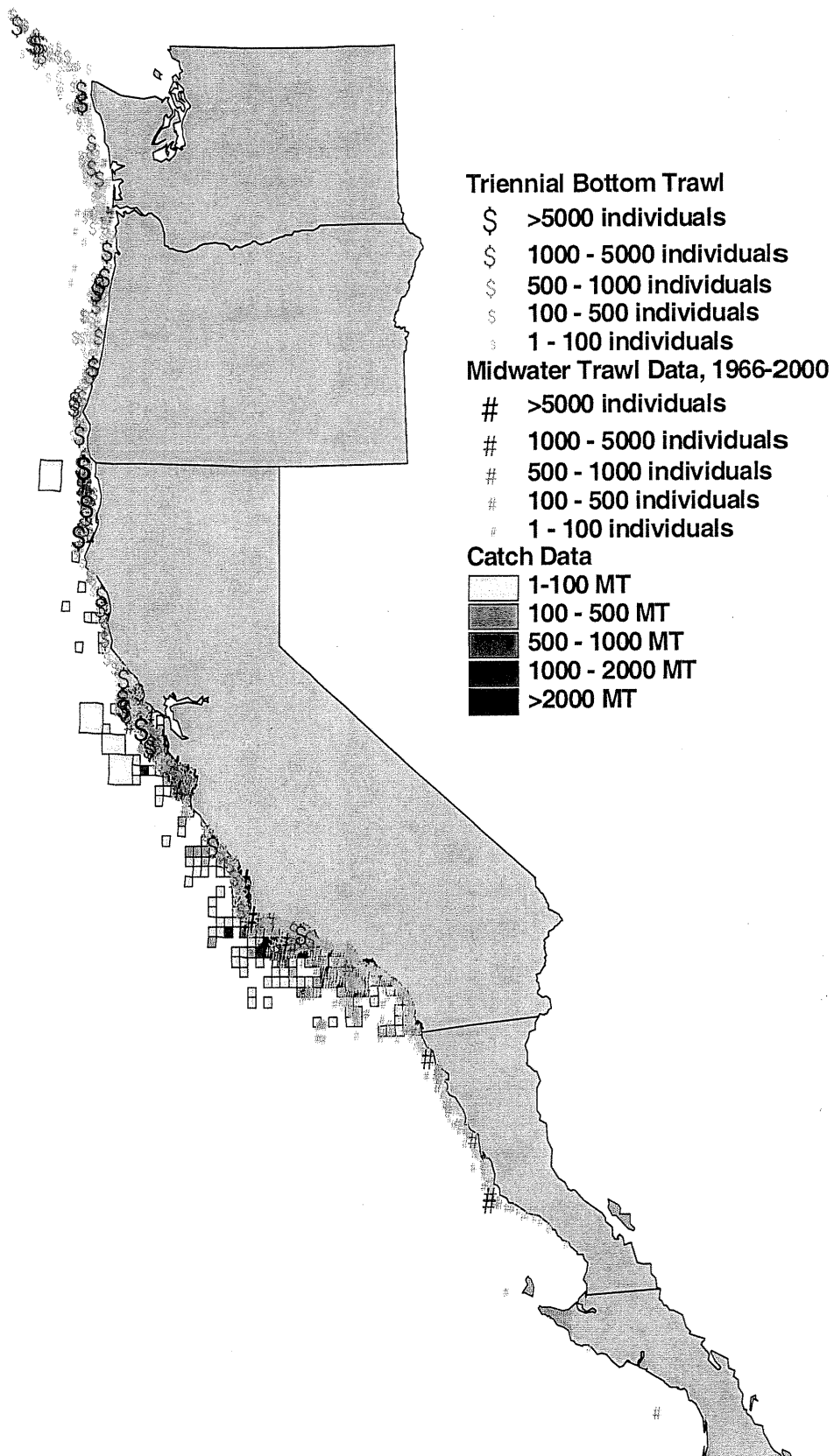
APPENDIX E: SQUID STOCK ASSESSMENT REVIEW
WORKING PAPER 9

Reproductive (egg) escapement model and management recommendations for the market squid

fishery.

(Working Paper #9, Squid Stock Assessment Review)

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Preface

This is the second draft of this document. The first draft was written as a revision of Maxwell and Crone (STAR Working Paper #8) after the squid STAR meeting in May 2001. In the first draft, two versions of an eggs per recruit model (EPR) were developed from classical spawning stock biomass per recruit theory. The text and modeling of the first draft are retained in this current draft. In the first draft, a range of values for two important parameters -- natural mortality (M) and egg laying rate (v) -- were explored because of the considerable uncertainty surrounding the estimation of both parameters. The completed first draft was reviewed by the Coastal Pelagic Species Management Team (CPSMT) in August 2001. The CPSMT made four recommendations:

1. Version 1 is currently preferable to Version 2. Version 2 incorporates more biological complexity in terms of variability in juvenile growth rates and age-at-recruitment, but the available data on these processes are too incomplete.
2. Daily natural mortality is to be set at $M = 0.15$.
3. Daily egg laying parameter is to be set at $v = 0.45$.
4. Threshold egg escapement (EE^*) is to be set at $EE^* = 0.3$.

The current draft incorporates these recommendations, and alerts the reader to them when appropriate.

Abstract

This document recommends a management strategy based on reproductive (egg) escapement for the market squid *Loligo opalescens*. A modeling approach based on this squid's life history is presented, with focus on the mortality and spawning rate of sexually mature females. Specifically, an eggs per recruit model is developed, based on spawning stock biomass per recruit theory. Model performance was measured in terms of the mean standing stock of eggs per harvested female (mean SSPF), eggs per recruit (EPR), and egg escapement (EE). The model was quite sensitive to daily natural mortality (M) and the rate of egg laying (v). Other factors, such as the maturation rate of females and gear selectivity, can profoundly affect eggs per recruit, but may go undetected in standing stock data. Fishing mortality, and associated levels of eggs per recruit and egg escapement, may be estimated from empirical data on the standing stock of eggs in harvested females, but measures of egg abundance must be developed to detect changes in egg productivity by the harvested population. Adopting the values of $M = 0.15$ and $v = 0.45$ as suggested by the Coastal Pelagic Species Management Team, egg escapement for squid in the Southern California Bight is estimated at 46% of the unfished condition. Data requirements for the application of this management strategy are discussed.

I. Recommended management strategy: reproductive (egg) escapement

This recommendation for a management strategy for the market squid is closely tied to the squid's life history. In the Southern California Bight, this squid completes its life cycle in less than one year (CDFG 2001; Butler et al., MS; Maxwell, MS). Adults can reach sexual maturity by four or five months after hatching (Maxwell, MS), and females may lay a substantial fraction of their lifetime egg output in their first night of spawning (Macewicz et al., MSa). Therefore, a primary factor that influences the abundance of squid on the spawning grounds in a particular year is the spawning success of the adults in the previous year (Beddington et al. 1990; Rosenberg et al. 1990; Pierce and Guerra 1994).

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Given these life history characteristics, this paper proposes a strategy that ensures sufficient reproductive escapement during the operation of the fishery. "Reproductive escapement" can be interpreted in at least two ways: 1) allowance of a certain quantity of spawning adults to escape harvest, or (2) allowance of a certain quantity of eggs to be laid. The former approach has been adopted for fisheries on two squid stocks off the Falkland Islands: *Loligo gahi* (Agnew et al. 1998; Hatfield and Des Clers 1998), and *Illex illecebrosus* (Rosenberg et al. 1990; Beddington et al. 1990; Basson et al. 1996). This author advocates the second approach, i.e., ensuring that a sufficient quantity of eggs is laid by each cohort affected by the fishery.

This egg escapement approach links detailed histological work on the ovaries of commercially harvested females (Macewicz et al., MSa) to an "eggs per recruit" model, which is a modification of spawning stock biomass per recruit (SSB/R; Gabriel et al. 1989) analysis in Maxwell (MS). Central to this approach is the ability to estimate the maximum lifetime reproductive output or "potential fecundity" of females captured by the commercial fleet. The model in the following section demonstrates how fishing mortality can be estimated from the eggs remaining in captured females. This estimated fishing mortality then indicates the reproductive output, in terms of eggs laid, of a population of females. To gauge the fishery's impact on the squid population, the estimated reproductive output of the harvested population is then compared to the population's output in the absence of fishing.

The proposed egg escapement strategy offers advantages for squid fishery management. First, it allows for "real-time" management of the fishery, without an unnecessarily large investment in management personnel or regulations. In the simplest scenario, in-season egg escapement for individual females may be relatively quickly estimated from the gross body measurements (described below; see also Macewicz et al., MSb). Second, this strategy clarifies the role and importance of data on age, reproductive anatomy, and fishing effort. Although such data are important to understanding the operations of any fishery, they cannot be viewed as "luxury" items for this management strategy.

The Leslie-DeLury model has been widely advocated for the management of squid fisheries, with a focus on ensuring escapement of a fraction of the spawning stock (Rosenberg et

al. 1990; Brodziak and Rosenberg 1993; Basson et al. 1996; Agnew et al. 1998). The Leslie-DeLury model allows for within-season management. An attempt to fit a Leslie-DeLury model to data for the market squid yielded equivocal results (Maxwell, MS). Reliable data on fishing effort are crucial to this particular analysis, and therefore the Leslie-DeLury model should be revisited when better effort data for the market squid fishery become available. A considerable drawback to the Leslie-DeLury model is that reliable results typically require a fairly lengthy time series of within-season population abundance (Agnew et al. 1998). Thus, estimated spawner escapement may not be calculated until late in the fishing season.

II. Model: eggs per recruit (EPR)

Rationale.

This model builds from data that can be measured for all sexually mature females taken by the fishery, such as mantle length and eggs remaining in the body at capture (i.e., eggs in the oviduct plus ovarian oocytes). Important to this model is the estimation of a female's potential fecundity from such data. "Potential fecundity" is defined as the number of oocytes in a fully mature female's ovary just before she lays her first clutch of eggs (after Macewicz et al, MSa). Female *L. opalescens* do not appear to regenerate oocytes after they have laid their first clutch of eggs (Knipe and Beeman 1978; Macewicz et al, MSa). For modeling purposes, then, a female's potential fecundity can be viewed as the maximum number of eggs that she can lay when sources of mortality are negligible.

Macewicz (MSa,b) present methods of estimating a female's potential fecundity. For simplicity, I use the equation that involves only mantle length (Equation 2 in Macewicz et al, MSa):

$$F_{p,L} = 29.8 \times L, \tag{1}$$

where $F_{p,L}$ = equals potential fecundity for a female of mantle length L (mm). More precise equations involving more parameters (e.g., ovary weight, mantle condition) appear in Macewicz et al, (MSb). The present Equation 1 is sufficient for heuristic purposes.

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Given that potential fecundity can be estimated for any measured female, each female's standing stock of eggs at capture (SS; eggs remaining in oviduct and oocytes at capture) can be expressed as a fraction of her potential fecundity. Thus,

$$\text{Fraction of potential fecundity remaining at capture} = \phi = SS / F_{p,L}. \quad (2)$$

The parameter ϕ indicates the magnitude of fishing mortality. When fishing mortality is high, newly-mature females will tend to be captured soon after they first arrive on the spawning grounds, which will result in many females with a large fraction of their potential fecundity retained in their bodies at capture. Furthermore, sustained heavy fishing mortality will capture females before they reach the end of their reproductive careers, resulting in few females with a small fraction of potential fecundity retained at capture.

It is important to note that the mean ϕ calculated for a harvested population is not a direct measure of egg escapement. At any given time during the fishing season, females that have been captured by fishermen represent a subset of an initial number of recruits. Some of these recruits may have avoided natural and fishing mortality up to that point in time. Others may have died due to natural mortality alone, and hence do not contribute to the catch. The following two versions of the egg-per-recruit model incorporate these three basic outcomes.

The first version of the model (Version 1) depicts the exponential decline of a population of harvested females as in spawning stock biomass per recruit theory (SSB/R; Gabriel et al. 1989). A fundamental assumption is that a female recruits onto the spawning grounds as soon as she is fully mature (i.e., ready to lay her first clutch of eggs). Port-sample data indicate that nearly all landed squid are sexually mature (Maxwell, MS). Furthermore, it is assumed that, once a female recruits onto the spawning grounds, she is equally vulnerable to fishing mortality for each day of the remainder of her life. In Version 1, all females mature and recruit onto the spawning grounds at the same age.

Version 1 differs from SSB/R in terms of egg output within a time step. In Gabriel et al.'s (1989) SSB/R model, all females that are alive when spawning begins are assumed to lay all of their expected egg clutch within the time step. Version 1 incorporates possible interruption of egg laying by fishing gear, as seems likely on the market squid's spawning grounds. In Version 1, two parameters describe what fraction of a female's expected egg output for a given day is laid

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before she succumbs to either fishing or natural mortality events (s_F and s_M, respectively). Version 1 yields numerically identical results to Gabriel et al.'s (1989) SSB/R model (as performed in the software FACT, National Marine Fisheries Service, Woods Hole, MA) when s_F = s_M, = 1 in Version 1 and c = d = 0 in FACT, where c and d refer to the fraction of fishing and natural mortality that occur before spawning occurs within a time step, respectively.

Version 2 follows the computations of Version 1, except that female age of maturation/recruitment is variable. Version 2 starts a population of immature females of the same age. As time advances, a small fraction of this immature "pool" matures and recruits onto the spawning grounds at the start of each day. Version 2 includes immature natural mortality and gear selectivity for immature and mature females.

Version 1: fixed age of maturity.

This model posits that a number of newly-mature females (N_0, where N_0 is arbitrarily set to 1,000 for modeling purposes) simultaneously arrive at the spawning grounds and recruit into the fishery. For simplicity, the females are of the same age and mantle length. Their actual age is not critical for this model version. Their mantle length (L) determines their potential fecundity. I set L = 129 mm based on data for females landed after the 1997-98 El Nino (i.e., landed from January 1999 through June 2000): mean ± SE mantle length = 128.6 ± 0.3 mm, n = 1,277 females. Thus, $F_{p,129}$ = 3,844 eggs.

The females all arrive at the spawning grounds at the beginning of day 0 (t = 0), and thereafter experience natural and fishing mortality (M and F, respectively). Time steps are daily, because it is possible that an individual female lays a substantial proportion of her eggs within one or two weeks, and may not live much longer than one month after maturity. Data from two cohorts of laboratory-reared market squid reveal that all egg laying by both groups occurred over a span of 50-60 days (Yang et al. 1986).

The initial number of females (N_0) declines daily by the exponential equation:

$$N_{t+1} \quad = \quad N_t \times e^{-(M+F)} , \tag{3}$$

where N_t = number of females at the beginning of day t, and t = 0, 1, ..., t_{max}. Note that t_{max} = 300 in order to encompass a broad range of M and F values. The actual persistence of the female

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population is determined by the sum M+F. The number of females caught during a given day t, C_t, equals:

$$C_t = [N_t - N_{t+1}] \times [F/(F+M)] . \qquad (4)$$

The number of females that succumb to natural mortality but are not caught in fishing gear, D_t, equals:

$$D_t = [N_t - N_{t+1}] \times [M/(F+M)] . \qquad (5)$$

Note that the number of females that survive through a given day t equals N_{t+1}, or:

$$\text{\# females that survive through day t} = N_{t+1} = N_t - C_t - D_t . \qquad (6)$$

At day 0, each female's standing stock of eggs equals her potential fecundity (i.e., $SS_0 = F_{p,129}$). Over time, the female lays these eggs. For simplicity, egg laying is depicted as a continuous exponential shedding of eggs:

$$SS_{t+1} = SS_t \times e^{-v} , \qquad (7)$$

where SS_t = standing stock of eggs at the beginning of day t, and v = egg-laying parameter. The expected number of eggs that a female will lay over the course of day t, Ω_t, equals:

$$\Omega_t = SS_t - SS_{t+1} . \qquad (8)$$

A female, however, may not lay her expected clutch for a given day, because she might die from natural or fishing mortality. The parameters s_M and s_F indicate what fraction of Ω_t that a female lays before she dies from natural or fishing mortality, respectively, during a given day. In all model runs, s_M and s_F are set to 0.5 to incorporate the interruption of egg laying. The total number of eggs laid by the female population during day t, E_t, equals:

$$E_t = \Omega_t \times [s_M D_t + s_F C_t + N_{t+1}] . \qquad (9)$$

Two management benchmarks are the mean standing stock of eggs per female in the catch (mean SSPF) and eggs per recruit (EPR). To calculate mean SSPF, the fraction of potential fecundity remaining at capture for each day, ϕ_t, is first determined:

$$\phi_t = [SS_t - s_F \Omega_t] / F_{p,129} . \qquad (10)$$

Mean SSPF is then found by:

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$$\text{mean SSPF} \quad = \quad \sum_{t=0}^{t\,\text{max}} \phi_t \times C_t \quad / \quad \sum_{t=0}^{t\,\text{max}} C_t \ . \tag{11}$$

Equation 11 is analogous to finding the mean ϕ by Equation 2 when data for standing stock of eggs are summarized as a frequency distribution. The EPR equals:

$$\text{EPR} \quad = \quad \sum_{t=0}^{t\,\text{max}} E_t \ / \ N_0 \ . \tag{12}$$

Equation 12 yields the absolute number of eggs produced per initial female recruit. For a given level of fishing mortality (F > 0), EPR can be expressed as a fraction of egg production in the absence of fishing (EPR @ F=0). This fraction is "egg escapement":

$$\text{Egg escapement} \quad = \quad \text{EE} \quad = \quad \text{EPR @ F>0} \ / \ \text{EPR @ F=0} \ . \tag{13}$$

Egg escapement is called the "escapement rate" in Macewicz et al. (in prep) and is denoted R therein.

Management decisions can be formulated by examining the responses of mean SSPF, EPR, and EE to different levels of fishing mortality. Because natural mortality (M) and the egg-laying parameter (v) are poorly known for *L. opalescens,* an initial sensitivity analysis explored a range of plausible values. High daily M values of 0.45 and 0.15 are suggested by energy expenditure during spawning (Macewicz et al, MSa), and are used in Macewicz et al. (in prep). A lower daily M was set to 0.01. This value corresponds to a lower-bound estimate of monthly M = 0.3 in Maxwell (MS), and matches monthly M $\approx$ 0.3 as estimated for other *Loligo* spp. (Brodziak 1998; Agnew et al. 1998). The daily egg-laying parameter v = 0.45 is derived by fitting the laying of 36% of a female's potential fecundity in her first clutch (Macewicz et al., in prep) to Equation 7 (i.e., $SS_1 = 0.64 = 1.0 \times e^{-0.45}$). The egg-laying period is lengthened in model runs by setting v = 0.225.

Responses of mean SSPF, EPR, and EE to increasing daily fishing mortality (F) under the six combinations of daily natural mortality (M) and egg-laying (v) values appear in Figure 1. The values of M = 0.15 and v = 0.45 recommended by the CPSMT are highlighted. When daily natural mortality (M) is high and egg laying (v) occurs relatively slowly, the females are captured with a large fraction of their potential fecundity retained (e.g., M = 0.45, v = 0.225 in Figure 1a). The standard errors associated with the mean SSPF values in Figure 1 and all other figures are

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less than 0.02, so are not presented in the interest of ease of viewing. The retention of eggs is a manifestation of females laying relatively few eggs per recruit (e.g., M = 0.45, v = 0.225 in Figure 1b). On the other hand, the females lay nearly all of their potential fecundity when daily natural mortality is low, egg laying occurs quickly, and daily fishing mortality is low (e.g., upper left portion of M = 0.01, v = 0.45 curve in Figure 1b). Eggs per recruit values are expressed as egg escapement (EE, Equation 12) in Figure 1c.

The laying of egg clutches can be depicted as a discrete process (a "step function") rather than as a continuous daily process. That is, once a female lays a clutch of eggs, her standing stock of eggs remains constant until the next clutch. This appears to reflect the biological pattern of egg laying more accurately, as indicated for *L. pealeii* in Maxwell and Hanlon (2000). From Maxwell and Hanlon (2000), it was specified in the model that egg clutches are spaced 4 days apart, and that a female partitions her potential fecundity into 6 expected clutches. Specifically, 36% of her potential fecundity is laid in the first clutch, with the remaining 64% being divided equally among the subsequent 5 clutches. This hypothesized discrete pattern of egg laying yielded results that were very similar to the cases when v = 0.225, so are not presented.

Version 2: variable age of maturity.

This version incorporates variability in the females' age of maturity and recruitment into the fishery, as well as gear selectivity. Here, the model begins with an initial number of immature females (N_0) that are all 120 days old. At the beginning of day 120, a fraction of the immature females, p_t, become mature, arrive on the spawning grounds, and are thereafter subject to fishing mortality. Once mature, a female lays eggs as in the above version of the model. In the current version, two time scales are monitored: the females' biological age (t), and the day of maturity (d) for each subset of females that matures at a given age, where d = 0 denotes the first day of maturity. So, the number of newly-mature females at the beginning of a given day t, $Nm_{0,t}$, equals:

$$Nm_{0,t} = Ni_t \times p_t , \qquad (14)$$

where Ni_t = number of immature females at the beginning of day t, and t = 120, 121, ..., 360. The parameter p_t is found by the maturation schedule in Table 1; this table is derived from Maxwell

(MS). Equation 3 becomes modified to describe the decline of this maturation "cohort":

$$Nm_{d+1,t+1} \quad = \quad Nm_{d,t} \times e^{-(Mm + PFM \times F)} , \qquad (15)$$

where $Nm_{d,t}$ = number of females of maturity day d at the beginning of day t, Mm = natural mortality for mature females, PF_M = gear selectivity for mature females, and d = 0, 1, ..., 300. The number of immature females declines by:

$$Ni_{t+1} \quad = \quad [Ni_t - Ni_t p_t] \times e^{-(Mi + PFI \times F)} , \qquad (16)$$

where Mi = natural mortality for immature females and PF_I = gear selectivity for immature females.

Similar to Equation 15, the number of females of maturity day d that are caught during a given day t, $Cm_{d,t}$, equals:

$$Cm_{d,t} \quad = \quad [Nm_{d,t} - Nm_{d+1,t+1}] \times [PF_M F / (PF_M F + Mm)] . \qquad (17)$$

The number of immature females caught during day t, Ci_t, equals:

$$Ci_t \quad = \quad [Ni_t - Ni_{t+1}] \times [PF_I F / (PF_I F + Mi)] . \qquad (18)$$

Relevant to egg production is the number of females of maturity day d that succumb to natural mortality but are not caught in fishing gear during day t. This quantity, $Dm_{d,t}$, equals:

$$Dm_{d,t} \quad = \quad [Nm_{d,t} - Nm_{d+1,t+1}] \times [Mm / (PF_M F + Mm)] . \qquad (19)$$

Potential fecundity at a female's first day of maturity (d = 0) is determined by Equation 1. For simplicity, mantle length at maturity is fixed at 129 mm for all females. Mantle length shows a slight increase with age for mature females (Figure 2); the low r^2 value, however, casts doubt on the significance of this relationship. Egg laying (i.e., the decrease in standing stock of eggs) occurs by:

$$SS_{d+1,t+1} \quad = \quad SS_{d,t} \times e^{-v} , \qquad (20)$$

and the expected number of eggs that a female of maturity day d will lay over the course of day t, $\Omega_{d,t}$, equals:

$$\Omega_{d,t} \quad = \quad SS_{d,t} - SS_{d+1,t+1} . \qquad (21)$$

The total number of eggs laid by females of maturity day d during day t, E_t, equals:

$$E_{d,t} \quad = \quad \Omega_{d,t} \times [s_M Dm_{d,t} + s_F Cm_{d,t} + Nm_{d+1,t+1}] . \qquad (22)$$

Equations for the calculation of management benchmarks follow:

$$\phi_{d,t} \quad = \quad [SS_{d,t} - s_F\Omega_{d,t}] \ / \ F_{p,129} ; \qquad (23)$$

$$\text{mean SSPF} \quad = \quad \sum_{d=0}^{300} \sum_{t=120}^{360} \phi_{d,t} \times Cm_{d,t} \quad / \quad \sum_{d=0}^{300} \sum_{t=120}^{360} Cm_{d,t} ; \quad (24)$$

$$\text{and EPR} \quad = \quad \sum_{d=0}^{300} \sum_{t=120}^{360} E_{d,t} \ / \ N_0 . \qquad (25)$$

Egg escapement (EE) is calculated as in Equation 12.

Sensitivity analyses of variable age of maturity and gear selectivity appear in Figure 3 for the preferred values M = 0.15 and v = 0.45. Daily natural mortality for immature females (Mi) is set to 0.01. Switching from Version 1 (fixed age of maturity) to variable age of maturity has no effect upon mean standing stock of eggs per female (mean SSPF; Figure 3a) or egg escapement (EE; Figure 3c). Eggs per recruit, however, noticeably decreases when age of maturity is variable (Figure 3b). Similarly, decreasing gear selectivity for matures to 0.8 and increasing selectivity for immatures to 0.2 has little to no effect upon mean SSPF (Figure 3a), but can have dramatic effects on eggs per recruit (Figure 3b). Egg escapement shows sensitivity only to increasing gear selectivity for immatures (Figure 3c).

Conclusions.

Sensitivity analyses of both model versions point to important lessons. First, management based solely on the monitoring of the standing stock of eggs for females in the catch can be misleading. The harvesting of immatures may not affect data on female egg standing stock, especially if immatures are excluded from such analyses *a priori*. Fishing mortality exerted on immatures, however, can greatly effect eggs per recruit and egg escapement.

Second, a measure of absolute egg production, such as eggs per recruit, should be considered along with the relative value of egg escapement. Hatfield and Des Clers (1998) draw attention to management based on absolute reproductive escapement as opposed to relative reproductive escapement. For example, if a management goal is to keep harvested squid populations above 0.3 egg escapement, then fishing would continue unbridled in all of the scenarios in Figure 1c. If, however, it was determined that the goal is to maintain populations

above 2,000 eggs per recruit, then several of the scenarios in Figure 1b would be affected by fishing regulations.

Measuring absolute reproductive output raises the question of the appropriate unit of "reproduction." The modeling approach in this paper has equated reproduction to the laying of fertilized eggs. But population persistence, especially for the short-lived market squid, depends upon many processes after egg deposition. Not all zygotes may hatch, due to biological factors, such as unequal oxygen availability within communal egg beds, and to fishery-related factors, such as damage or removal of eggs by gear. After hatching, density-dependent effects, such as competition and cannibalism within and between life stages, can act to loosen the relationship between hatchling number and adult number, as well as between adult number and egg number (Agnew et al. 2000).

III. Application of the egg escapement strategy

Management based on egg escapement could operate as follows. At one or more times during the squid season, landed females will be randomly sampled. Body measurements such as mantle length, mantle tissue dry weight, and weights of ovaries and oviducts will be taken from these females. Potential fecundity and the standing stock of eggs will then be estimated for each female, following analyses presented in Macewicz et al. (MSa,b). Ideally, these body measurements will provide accurate estimations of potential fecundity and standing stock. It is important, however, that detailed histology be periodically performed on a subset of females to ground-truth these parameters that are estimated from the body measurements.

With potential fecundity and standing stock estimated for each female, the mean fraction of potential fecundity remaining at capture (mean ϕ by Equation 2, or mean SSPF by Equations 11 and 24) can be calculated for the females. By way of example, Macewicz et al. (in prep) report a mean $\pm$ SE fraction of remaining potential fecundity of 0.656 ± 0.004 for harvested females sampled from the Southern California Bight (n = 1,217). Plotting this on the SSPF vs. F curve of the preferred M = 0.15 and v = 0.45 for model Version 1, this mean fraction corresponds

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to daily F = 0.74 (Figure 4a). This estimated value of daily F corresponds to EPR = 1334 and EE = 0.46 (Figure 4b). Management may stipulate that the estimated eggs per recruit (EPR) or egg escapement (EE) is to exceed a critical threshold (EE*). Applying the CPSMT's recommended threshold of EE* = 0.3, the fished population lies above this threshold (Figure 4b), so harvesting may continue at the current level of fishing mortality. If the population had fallen below the threshold, then fishing mortality might be adjusted to return to the threshold level of escapement. Tracking the change in egg escapement or eggs per recruit along the F-curve indicates the required amount of change in fishing mortality.

An important consideration is the translation of fishing mortality (F), which is a unitless parameter in the model's equations, into a "real-world" control parameter (f), such as number of fishing nights or number of boats in operation, in order to effectively manage the fishery. Suppose that the egg escapement curve in Figure 5 describes the squid population. Furthermore, suppose that the current estimate of egg escapement was 0.1, and managers wanted to raise egg escapement to 0.3. From logbook data, suppose that the level of fishing effort (f) associated with the escapement value of 0.1 was 15,509 boat-nights. Positing a relationship between F and f (i.e., F = qf, where q = catchability coefficient) converts F into boat-nights. In this case, managers would have to reduce boat-nights to 8,022 to bring egg escapement to 0.3 (Figure 5).

IV. Data requirements

The egg per recruit model approach rests on several assumptions: 1) immatures are not harvested; 2) potential fecundity and standing stock are reliably measured; 3) life history parameters, such as natural mortality and egg-laying rates, are accurately estimated, or at least vary within reasonable limits; and 4) instantaneous fishing mortality (F) translates into usable, practical units. The data described below address these assumptions, and, hence, are crucial to the successful implementation of the egg escapement strategy.

1. Composition and location of the catch. Data on the ages and maturity stages of

harvested squid are needed to continuously verify whether immature squid are being captured. Additionally, the locations of hauled squid need to be accurately recorded to detect whether new or deeper waters are being harvested. Data on harvest location are important because harvesting beyond the shallow-water spawning grounds may change the proportion of spawning females in the catch.

2. Potential fecundity and standing stock of eggs.

a. Body measurements (e.g., mantle length, mantle tissue dry mass, ovary and oviduct mass) of landed females are required to estimate potential fecundity and standing stock of eggs. Additionally, potential fecundity and standing stock should be periodically estimated by detailed histology to verify the robustness of estimation via body measurements.

b. Fine-tuning. Questions about reproductive biology raised by Macewicz et al. (MSa) remain unknown, but can potentially alter the method by which to estimate potential fecundity and standing stock.

1. Increasing the sample size of mature, pre-spawning females. Analyses in Macewicz et al. (MSa,b) involve a small subset of mature pre-spawning females. These females are crucial to the estimation of potential fecundity, and more of these are needed for histological work.

2. Ground-truthing inferred spawning history with living females. Maintaining reproductive females in captivity will indicate whether previous spawning may go undetected in histological examinations. This is crucial to the accurate estimation of standing stock of eggs. Additionally, rearing immature females will yield known mature, pre-spawning females, which will help refine the fecundity analysis (see #2.a.1, above).

3. Life history parameters. At least three of the model's parameters -- natural mortality,

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egg-laying rate, and recruitment rate into the spawning population -- have important influences on the model's results.

   a. Natural mortality. Age data will help resolve natural mortality for immatures and adults. Catch-curve analysis (Ricker 1975) is appropriate for immatures; such an analysis requires age data and a sampling program that captures large immatures. With regard to adults, individual daily movement patterns to and from the actual spawning site partly determine mortality rate, and mortality rate is reflected in the length of an individual's reproductive career. Observational work at spawning sites (e.g., visual recordings via ROV) can address daily movement patterns. Mark-and-recapture work will help address the length of reproductive careers, but marking methods may be difficult to develop for the market squid. Alternatively, the length of reproductive career could be addressed through the examination of post-ovulatory follicles, or the possible use of a bioenergetic model of egg development and deposition.

   b. Egg laying rate. This question seems best answered by observations of live animals, ideally by integrating observations in nature with work in captivity. Egg laying rates could also be estimated through a bioenergetic model with appropriate sensitivity analysis.

   c. Recruitment rate into the spawning population. A sampling program that randomly takes all ages and sizes over the course of one or more years will address the age and size distribution of sexually mature squids, and changes in the proportion of sexually mature squid over time.

   4. Reliable and accurate effort data. Squid fishermen are currently required to maintain logbooks. Effort data will enable management to respond to changes in egg escapement. Additionally, catch and effort data can be used to construct CPUE indices of population abundance for alternative modeling approaches.

   It is important to measure egg abundance at the fished spawning grounds. Lacking direct

measures of egg abundance, measures of the abundance of the spawning population are necessary. Obtaining both pieces of data will allow for the detection of density-dependence in egg production, which may occur in *Loligo gahi* (Agnew et al. 2000). Furthermore, an operational assumption of the eggs per recruit model is that the vast majority of a stock's adults spawn at sites that are targeted by the fishery. Spawning refugia probably exist for the market squid, so the spatial patterning of population abundance should be systematically measured within the squid's spawning habitat. Additionally, indices of population abundance can be used in alternative modeling approaches, such as Leslie-DeLury models, should such modeling be desired in the future. The following are various indices of egg and population abundance.

1. <u>ROV surveys of egg beds</u>. Visual recordings of egg beds *in situ* are non-intrusive, non-destructive observations of spawning habitat and egg abundance. This is an ideal, low-impact, direct method to estimate egg abundance.

2. <u>Commercial catch per unit effort</u>. When derived from the logbooks, CPUE is a potentially low-cost and fine-scale (in both space and time) indicator of population abundance. CPUE, however, is potentially confounded by market orders and/or trip limits.

3. <u>"Controlled effort" program</u>. A more rigorous use of commercial data is to design a sampling program with cooperative fishermen. Light boats would shine lights for carefully measured periods of time, and all of the squid attracted would be captured. The sampling design would involve repeated visits to fishing grounds over the course of the season. This program would provide spatially- and temporally-replicated indices of population abundance at potentially low cost.

4. <u>Trawl surveys</u>. Midwater trawl surveys could be continued to maintain continuity with earlier surveys. Net avoidance by the squid, however, may reduce these surveys' usefulness in estimating population biomass. Given that the fishery typically lands mature adults, fishery-independent trawls are probably the best method to obtain data for immatures in the ocean,

especially large immatures.

5. <u>Acoustic surveys</u>. Similar to ROV surveys, acoustic surveys are non-destructive to the squid and habitat. Acoustic surveys would require a period of ground-truthing to verify the signals of squid schools and egg beds.

6. <u>Other ancillary sources</u>. The fecal and stomach samples of "biological" samplers such as predators and scavengers provide some indication of squid abundance. This author cautions that these data should be used as complements to data obtained from randomized sampling programs.

V. Acknowledgments

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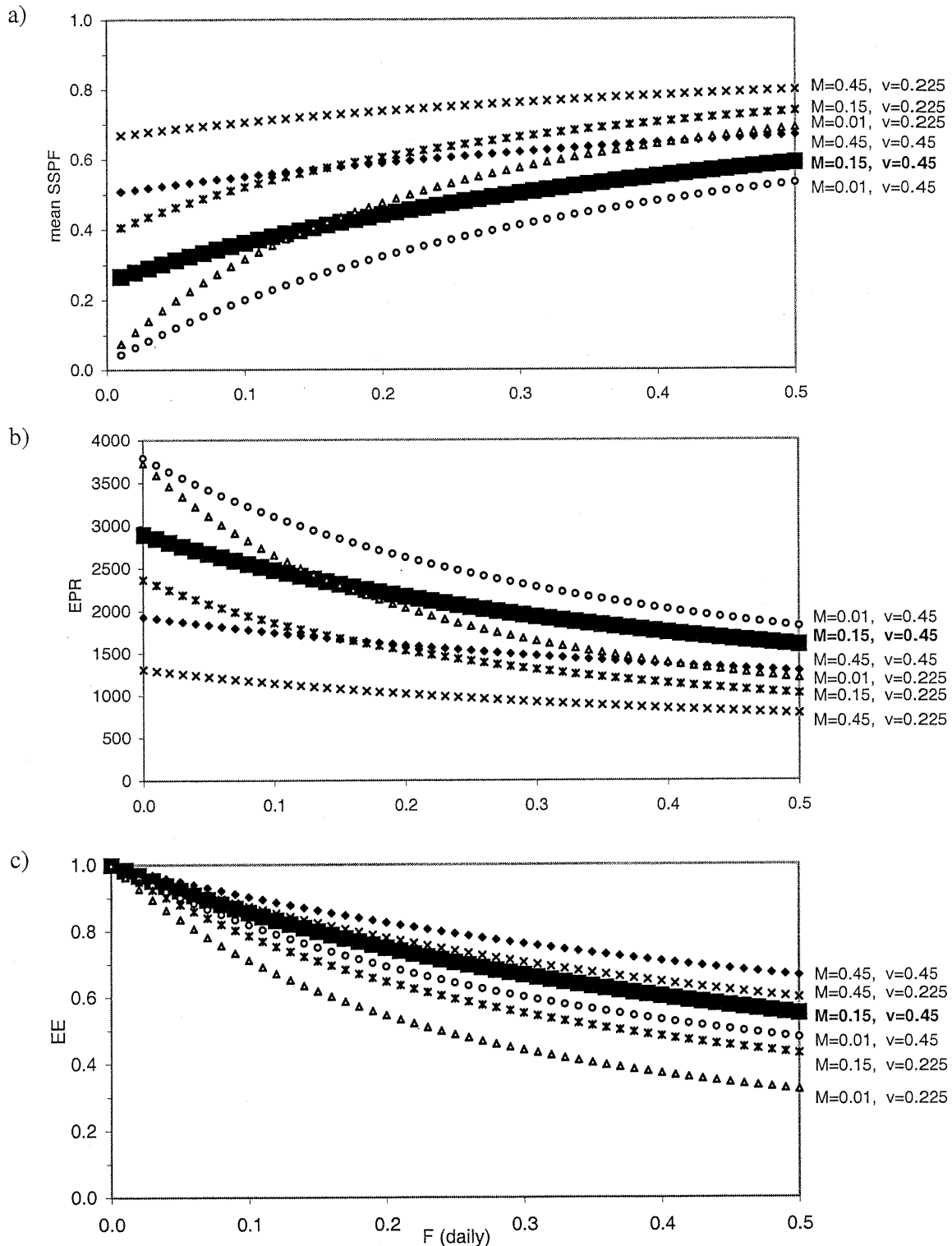
Figure 1. Management benchmarks for values of daily natural mortality (M) and egg-laying parameter (v); curve for recommended M = 0.15 and v = 0.45 is highlighted. a) Mean standing stock of eggs per female in catch (mean SSPF); b) eggs per recruit (EPR); c) egg escapement (EE).
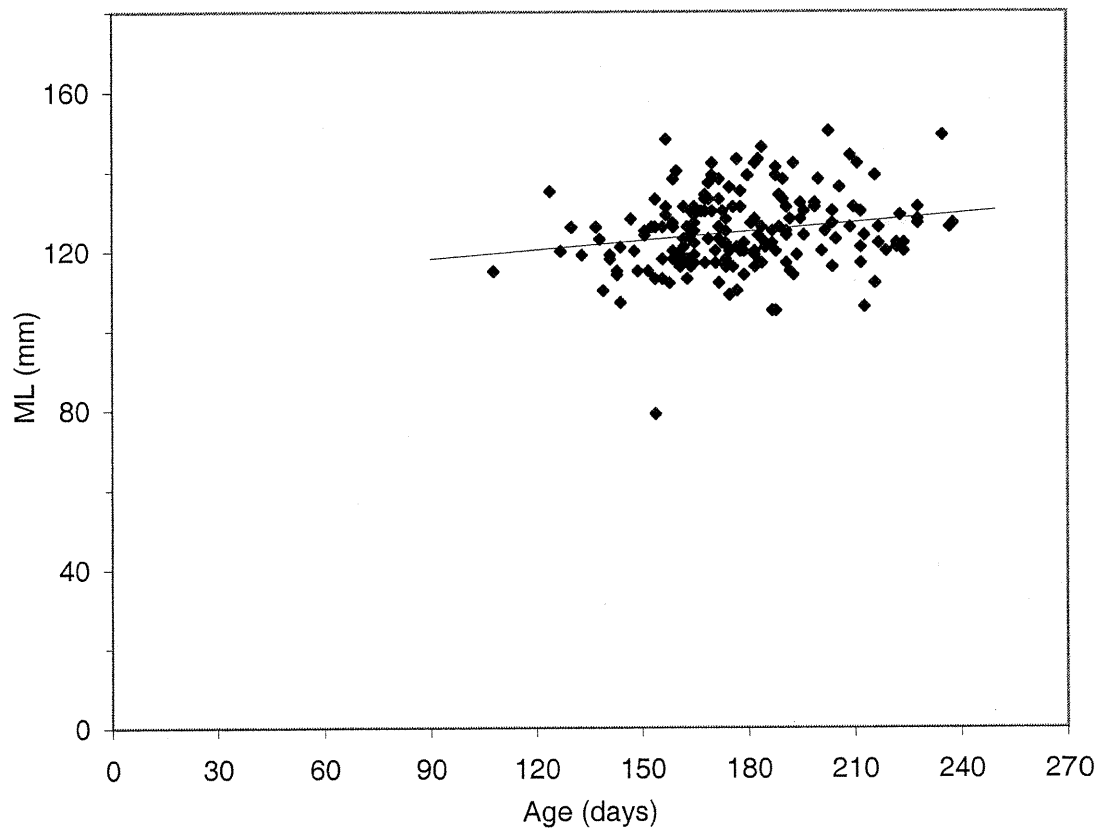
Figure 2. Mantle length (mm) vs. age (days) for mature females captured in Southern California Bight, January 1999 through June 2000. Regression line: ML = Age*0.08 + 111.30; $r^2 = 0.04$, $p < 0.05$, $n = 177$.
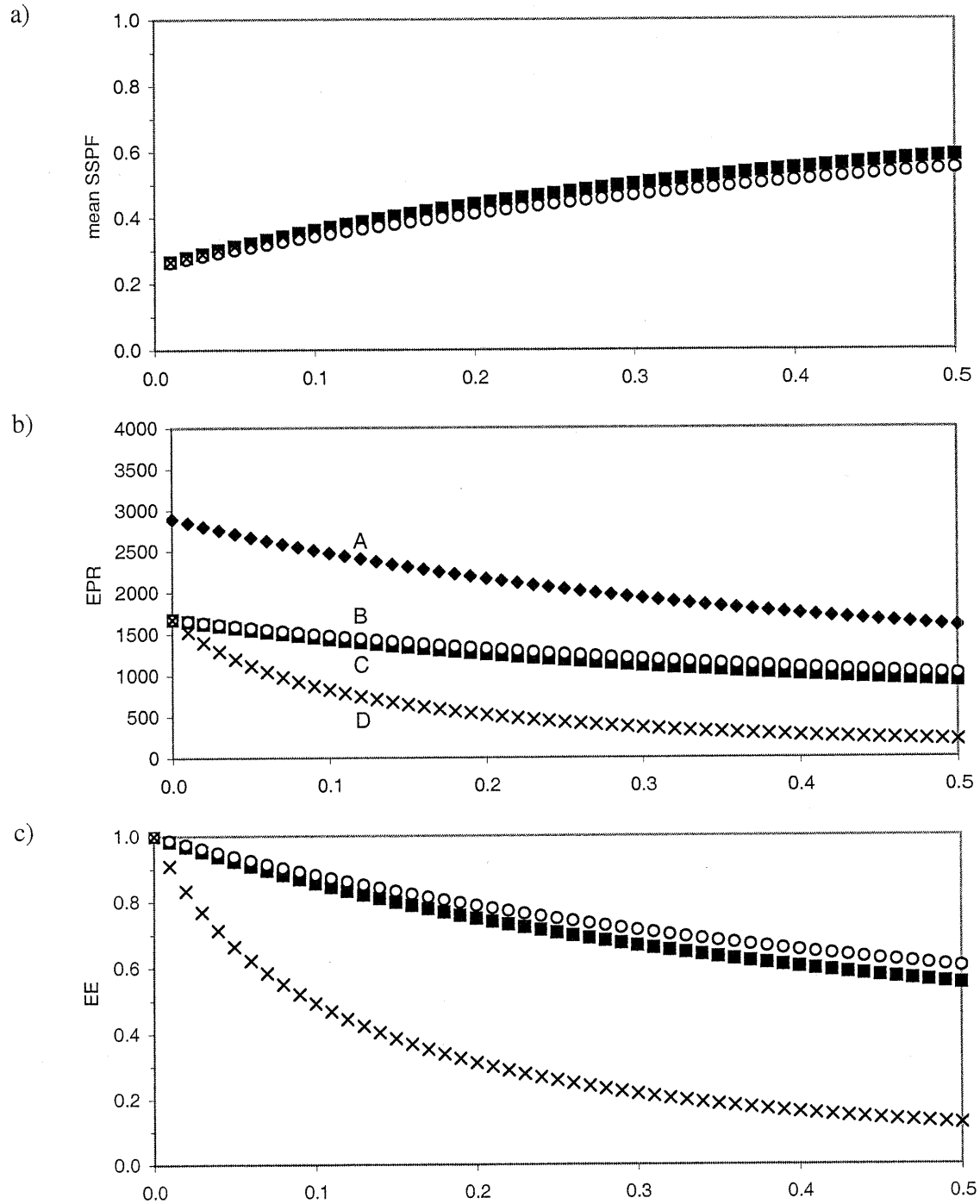
Figure 3. Effect of maturation rate and gear selectivity (PF_I and PF_M) on a) mean SSPF,
b) EPR, and c) EE for the recommended values M = 0.15 and v = 0.45. For all frames:
A (diamonds): model Version 1 (fixed age of maturity); PF_I = 0.0; PF_M = 1.0
B (squares): model Version 2 (variable age of maturity, Table 1); PF_I = 0.0; PF_M = 1.0
C (circles): model Version 2 (variable age of maturity, Table 1); PF_I = 0.0; PF_M = 0.8
D (Xs): model Version 2 (variable age of maturity, Table 1); PF_I = 0.2; PF_M = 1.0

a)

b)
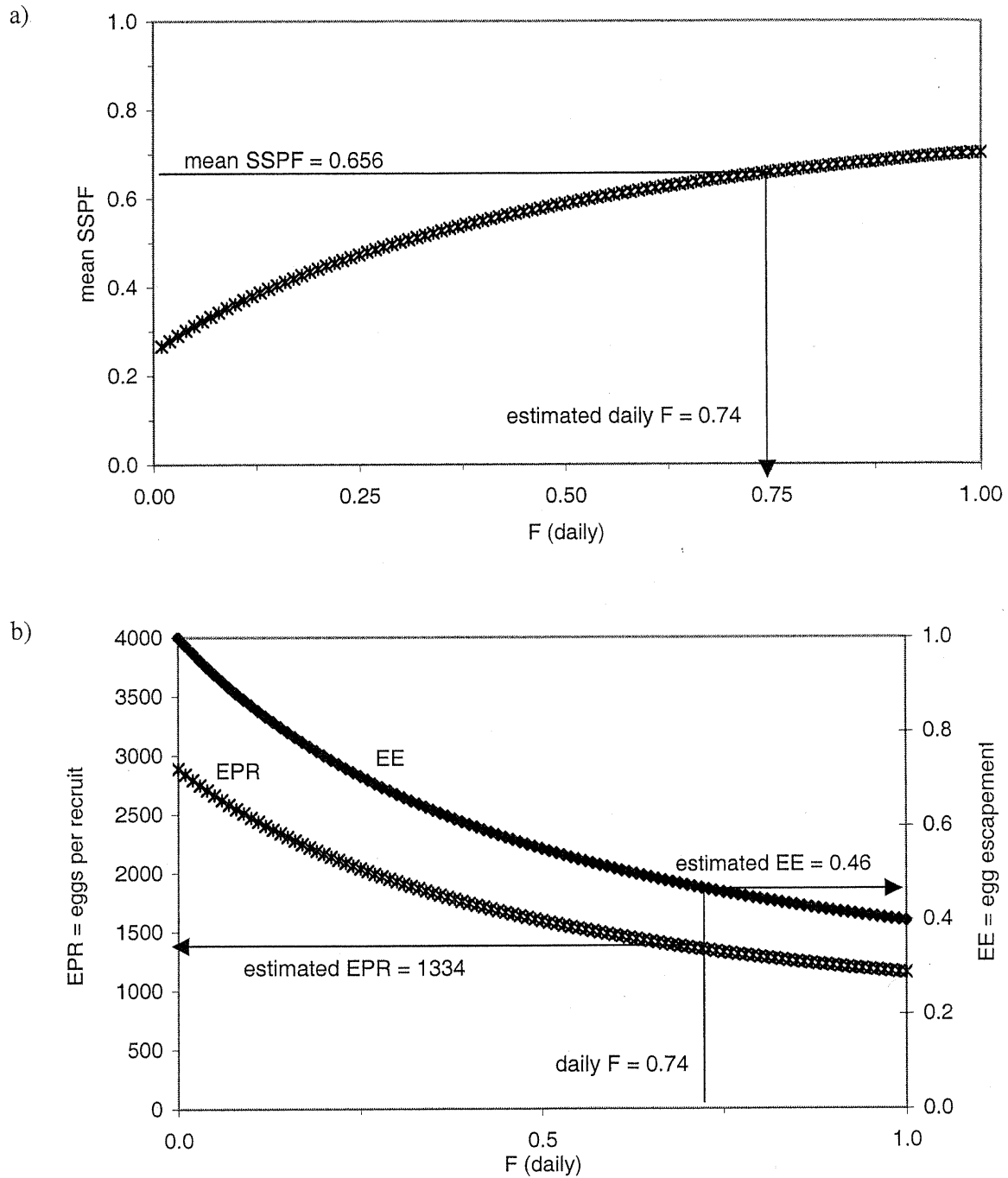
Figure 4. SSPF curve (a) and EPR and EE curves (b) for recommended values (M = 0.15 and v = 0.45) to illustrate the estimation of fishing mortality (F) and EPR and EE from empirical data for SSPF.
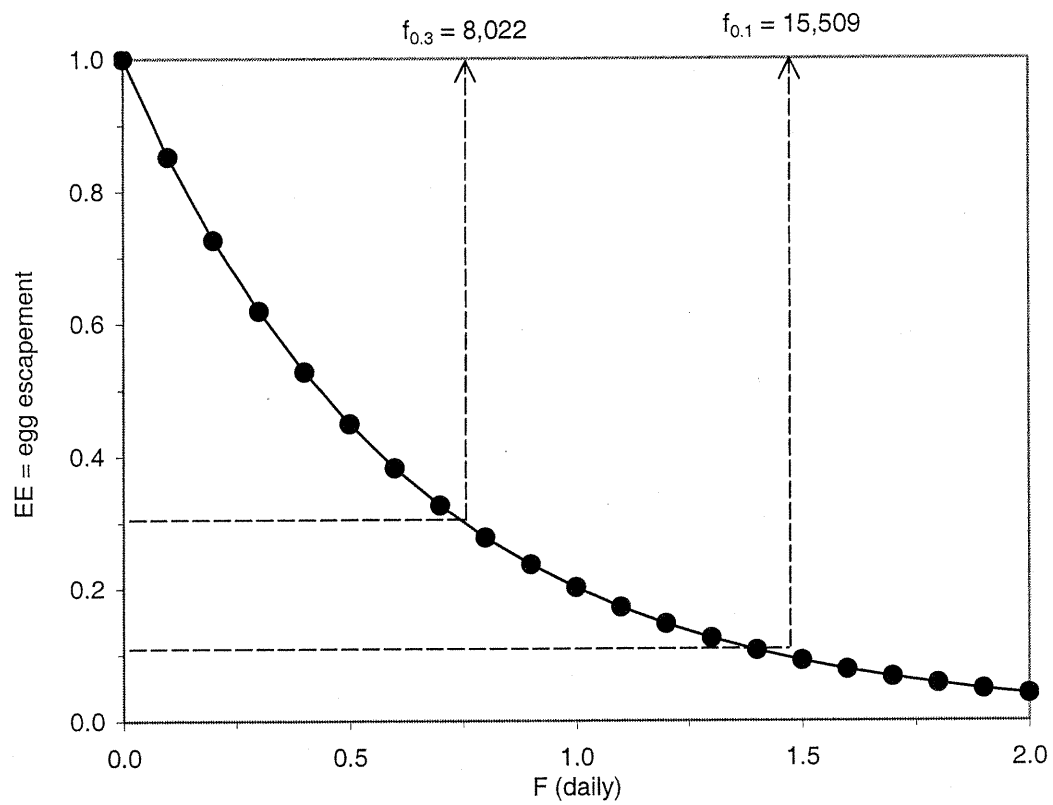
Figure 5. Hypothetical egg escapement curve and fishing mortalities associated with escapement levels of 0.1 and 0.3.

Table 1. Maturation schedule, derived from Maxwell (MS). Within each 30-day period, the daily fraction of immatures that become mature equals: $[CP(i+1) - CP(i)]^{1/30}$.

Day (i)	Cumulative proportion that are mature, CP(i)
120	0.000
150	0.375
180	0.750
210	0.813
240	0.875
270	0.938
300+	1.000

Table 2. Management benchmarks for six scenarios in Figure 1. Values M = 0.15 and v = 0.45 recommended by CPSMT boldfaced. In this table, calculations are bounded by 0.00 < daily F < 0.50.

Observed mean SSPF	M (daily)	v	Est. F (daily)	Est. EPR	Est. EE	Yield (kg) per Recruit
0.656	0.45	0.450	0.44	1334	0.69	21.8
0.656	**0.15**	**0.450**	**> 0.50**	**< 1594**	**< 0.55**	**> 34.0**
0.656	0.01	0.450	> 0.50	< 1813	< 0.48	> 43.2
0.656	0.45	0.225	< 0.01	~ 1295	~ 0.99	< 1.0
0.656	0.15	0.225	0.29	1326	0.56	29.1
0.656	0.01	0.225	0.43	1326	0.36	43.1

APPENDIX F: SQUID STAR PANEL REPORT

Report of the Stock Assessment Review (STAR) Panel for Market Squid

May 14-17, 2001

Southwest Fisheries Science Center
La Jolla, California

1. Introduction

In 1999, the Department of Commerce rejected portions of Amendment 8 to the Pacific Fishery Management Council's (Council) Coastal Pelagic Species (CPS) Fishery Management Plan (FMP) on the grounds that the amendment did not include an estimate of maximum sustainable yield (MSY) for market squid. In September 2000, the Council's Scientific and Statistical Committee (SSC) reviewed newly derived estimates of MSY for market squid. Because of the uncertainties surrounding these estimates and more generally, ongoing concern regarding the appropriateness of defining MSY for this species, the SSC did not recommend an MSY value.

Fortunately, recent research conducted on market squid life history (including growth, maturity, and fecundity) along with enhanced fishery-dependent data (port sampling and logbooks) have provided significant new information. The SSC recommended (and the Council concurred) that the SSC should work with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (CDFG) to organize a stock assessment review (STAR) panel for market squid during 2001.

The STAR Panel met May 14-17, 2001 at the NMFS Southwest Fisheries Science Center, La Jolla, CA. A principal goal of the STAR was to integrate the ongoing market squid research into the Council's CPS FMP. Terms of reference for the STAR panel addressed the MSY issue as well as control rules for practical management of the market squid fishery (Appendix A). The Panel members were:

Tom Barnes	CDFG & Council's GMT
Ray Conser (co-chair)	NMFS & Council's SSC
Larry Jacobson	NMFS - Woods Hole (outside reviewer)
Tom Jagielo (co-chair)	WDFW & Council's SSC
Heather Munro	Munro Consulting & Council's CPSAS
Paul Smith	NMFS & Council's CPSMT

An agenda and eight working papers (WP) were prepared for the STAR and distributed to Panel members and other interested parties on May 1, 2001 (Appendices B and C, respectively). The WP authors presented their work to the Panel and were available throughout the week to consult with the Panel, provide additional information and data, and to carry out additional analyses, as needed. In addition to the Panel members and WP authors, the STAR discussion and participation was open to all interested parties. In total, approximately 25 participants were involved in the process (Appendix D). Excellent facilities and support were provided by the NMFS and CDFG staff in La Jolla.

Considerable interaction occurred throughout the STAR meeting among STAR Panel members, WP authors, and other participants. In some cases, this 'give and take' resulted in alternative interpretations of data as well as modelling improvements. Additional model runs were carried out during the meeting and the results were tabled for discussion. Consequently, some important aspects of the STAR Panel consensus were based on the modelling work done during the course of the meeting. The Panel requested that WP8 be revised after the meeting to reflect and fully document the analyses carried out during the STAR Panel meeting. The analyses and results contained in WP9 reflect the STAR Panel consensus at the end of its meeting with respect to the most appropriate modelling and management control rules.

2. Biology and Life History Findings

The STAR panel considered new results about the biology of the market squid. Together these findings are crucial for beginning the consideration of rational management techniques for controlling the future direction of the fishery from the standpoint of sustainable yield over time. There are also elements in the biology and life history which represent exotic departures from the usual fishery management principles and approaches and these deserve special attention. Thus it is the task of this report to consider the wide range of biology and life history results, and focus on those which provide the most information for management and supply questions which must eventually be considered. The headings under which these will be considered are age and growth, temperature controlled development rates, genetics, fecundity, and some behavioral aspects of the El Niño phenomenon.

The fundamental distinction in the squid fishery, versus fisheries on long-lived multiple spawning fishes, is that little or no fishing precedes spawning and consequently, substantial population spawning has occurred before any adults are caught. Thus, the management approach can be based directly on the status of spawning from the appearance of past spawning in the squid catch. It is common to both of the squid fisheries in California (Monterey and Southern California) that there are substantial periods in the year in which spawning most likely has occurred for which there is no fishery. Similarly, the height of the fishery within each year is restricted to a few months. If the life cycle is materially less than one year, there will be interspersed reproductive episodes with only natural mortality occurring.

Lastly, the catch records for both Monterey and Southern California show cataclysmic decline of landings during El Niño Southern Oscillation (ENSO) events. Since the fishery is on adults, some degree of reproductive success has already occurred. Subsequent fishing seasons will reflect either deficiencies in reproductive success or changes in the availability of squid. If the subsequent season is low in catch, also, one would tend to think of depletion of that cohort of spawners; if the subsequent season is high in catch, one would have to infer reproductive recovery to that extent or introduction of squids which have not been affected adversely by ENSO.

2.1 Age and Growth
Growth of squid paralarvae is slow. Juvenile growth accelerates as the animal approaches maturity as described with a power function:

$$DML = a\,T^{\,b}$$

Where DML is dorsal mantle length and T is age in days. In a single cohort, the reported 'a' was 0.001342 and the exponent 'b' was 2.132. The average age of females sampled in the fishery was 186 days following hatching and feeding. The male average age was essentially the same at 190 days. It is not known whether age rings in the statolith continue after maturation or if continuing rings are visible.

If one assumes that daily rings continue to be formed and can be counted, a display at monthly interval in the 1998-99 fishery shows that squid age composition in the catch ranges from 5 to 9 months with a mode which is at either six or seven months. (WP3, Figure 2). Since statolith rings form in the week between hatching and disappearance of yolk, about 2 months can be added to the period between generations, 8-9 months. The seasonality of catches in both habitats may not reflect the progression of cohorts from short seasons in an annual cycle but may merely reflect the economic factors or availability of shallow spawning aggregations. Cohort formation, if any, may be smeared with temperature, by the depth distribution of hatching, and subsequent variations of rates of growth to maturity.

The key uncertainties with respect to market squid age and growth are:
[i]   variations of growth rate following maturity;
[ii]   interannual and intra-cohort variations in juvenile growth rate;
[iii]   interannual and intra-cohort variations in maturation by age;
[iv]   a more complex growth model may be needed to adequately represent growth throughout the full life

history, especially for mature animals; and
[v]   accuracy of daily statolith ring counts after the onset of maturity.

2.2   Temperature Dependent Incubation
Temperature controlled incubation time at 7 degrees C exceeded 90 days; at about 12.5 C, squid eggs hatched in 50 days; and at 20 C hatching time was as fast as 24 days. The 25 C temperature was lethal and hatching at 6 C temperature was not lethal but did not complete development. Since all ages are from hatching without knowing the temperature at incubation, the incubation period appears to range from 1 to 3 months with a mean approaching 2 months. The yolk-sac may persist a week. The key uncertainties are: [i] temperature distribution at spawning; [ii} possible change in depth during ENSO; and [iii] possible transport or migration of adjacent stocks after ENSO.

2.3   Genetic Separation of Stocks
The degree of genetic mixing of squid between the Monterey and the Southern California Bight fisheries is not well established but there may be short-term isolation sometimes referred to as 'viscous' dispersal. Coast wide genetic studies are now being conducted to which the local studies reported so far from Monterey and Southern California Bight may be referred. Uncertainties are [i] the local depletion and resupply rates and [ii] the scale and degree of genetic mixing

2.4   Dynamic Fecundity
Potential fecundity may be obtained from oocytes as the gonadal tissue is formed. Maturation begins with the investment of a mode of oocytes with yolk. Ovulation onset is detected by empty follicles in the ovary and the presence of eggs in the oviducts. There appear to be more than one batch of eggs spawned by most females. By far the majority of females sampled in the commercial catch have some evidence of spawning. The dynamics of fecundity are controlled by temperature, size of female, and age of female. Only small numbers of females so far sampled have greater than 3 post-ovulatory follicular stages. Signs of multiple spawning waves in the ovary are accompanied by changes in mantle condition. There are also signs of wide area synchrony in modes of mantle condition which may be more useful in determining actual age than statolith rings after maturity. Uncertainties are: [i] the relationship between potential and residual fecundity at the population scale; [ii] the persistence of detectable post-ovulatory follicles; and [iii] the relationship between mantle condition and environment.

2.5   Aspects of El Niño
Within most decades of fishery management, we can expect one or two ENSO events. Based on previous ENSO's in the modern market squid fishery, we can expect, at least, wide disruption in the availability of squid on the spawning grounds, and perhaps increases in natural mortality as well. To date, the recovery of the fishery following ENSO's has been remarkably fast. The key El Niño issues with respect to squid management are:
[i]   Does ENSO change the risk of overfishing?
[ii]   Should the first year after recovery from ENSO be managed differently?
[iii]   Do management models require additional parameters to account for the environmental effects?
[iv]   Are there other organisms in the ecosystem approach which need to be considered in this light?

3. Fishery and Fishery-Independent Data

The STAR panel discussed a number of fishery and fishery independent data sources with potential for use in the assessment of market squid (Table 1). The data sources in the present assessment (WP7, WP8, and WP9) came primarily from fishery and survey information sampled in the S. California Bight. The additional data sources listed in Table 1 were discussed by STAR panel members as potential sources of information for future assessments.

Catch data, summarized by blocks from which the squid were taken, were obtained from CDFG landing receipt information. Samples from CDFG 1998-2000 port sampling were used to characterize mantle length, body mass, and sexual maturity of the landed catch. Age composition of the catch was derived from a sub-sample of 908 port sampled squid. Biological samples from a CDFG midwater trawl cruise in 2000 were used to supplement the port sample data. Presently, port sampling data are also used to estimate the bycatch of immature squid in the fishery; the assumption is that few discards are made at sea because squid are pumped directly from the seine net to the vessel hold without at-sea sorting.

WP7 presented three indices of squid abundance: 1) a CPUE index of abundance, 2) a midwater trawl survey index of abundance, and 3) a sea lion scat index. The CPUE index of abundance utilized catch per block information from fish landing receipts, and a time series of fishing effort which was obtained from analyzing satellite images of the S. California Bight (1992-2000). Light pixels on the satellite images were quantified and used as an index of fishing effort; a positive relationship was apparent when light pixels for each night were compared with catch landed the following morning. A project to ground truth the light pixel – fishing effort relationship with night time flyovers of the S. California Bight (1999-2000) is underway. Because light shields are now required on light boats, satellite data may not be useful for future effort estimation. In the future, it may be possible to use information from fishery logbooks to establish a new index of fishing effort. The midwater trawl survey index of abundance was derived from the Mais surveys (1966-1988). Tows were filtered by depth, duration, and location criteria, and an index for the S. California Bight was prepared. Squid abundance in each survey was described in terms of the proportion of tows that caught one or more squid of mantle length 80 mm or longer (proportion positive). The sea lion scat index was derived from scat samples taken from San Nicolas and San Clemente Islands. The trend in squid abundance was quantified as the proportion of scat samples that contained squid beaks per calendar quarter for each island (proportion positive).

The STAR panel noted that non-linear relationships can exist between stock abundance and both types of indices used for market squid, i.e. catch rate indices and proportion positive indices. Non-linear relationships in catch rates can result from saturation for schooling species, and proportion positive indices may be nonlinear because they are bound between zero and one (see Section 5.2, below). The STAR panel also pointed out that using CPUE as an index of abundance is problematic for a schooling animal such as squid. In the squid fishery, light boats locate spawning aggregations and attract squid to the surface for subsequent capture by the round haul fishing vessels, and unqualified CPUE is not likely to be directly proportional to abundance. A mandatory fishery logbook program was instituted in 2000, and logbook data are now available for both the light boat and fishing boat components of the fishery. Logbook data, if properly standardized, hold potential as a tool to estimate effective fishing effort. It will be important to take into account factors such as search time, changes in catchability, and market factors which could bias the results.

The SSB/R fecundity escapement management, as described in WP1, WP2, WP8, and WP9, approach would require reliable estimates of 1) age composition of the landed catch, 2) egg escapement from harvested and unharvested components of the population, 3) growth and maturation rates, 4) adult vulnerability to the fishery, and 5) fishery effort data. Biological data will be required from both survey and fishery samples to characterize mantle length, mantle condition factor, fecundity, and proportion mature by age. Reliable estimates of total catch and effort will be required to estimate egg take by the fishery.

Finally, the SSB/R approach as described in WP8 and WP9 assumes that the great majority of the stock's adults spawn at sites that are targeted by the fishery. There is a need to quantify the full extent of the squid spawning distribution, to evaluate the escapement of squid eggs from the unfished components of the

population. Midwater trawl surveys, ROV surveys, and paralarvae surveys are tools which could potentially be used to characterize the full distribution of the squid resource.

4. Stock Assessment-Related Models and MSY Estimation

4.1 Maximum Sustainable Yield
Working papers with results from several different approaches to estimating MSY were made available to the Panel (WP7 and WP8). Assessment authors presented the data, methods, and results for one of the approaches. Group discussion focused on the technical strengths and weaknesses of their work, and whether the basic MSY concept was appropriate to a species that is very short lived and exhibits wide year-to-year fluctuations in availability and/or abundance.

Results from a surplus production model were presented, using the ASPIC software where the stock was not assumed to be in equilibrium. Input data were catch for the southern California Bight, effort on the primary fishing grounds, and three auxiliary tuning indices. The auxiliary indices were proportion positive for squid in a midwater trawl survey, and proportion positive for squid beaks in California sea lion scats at two separate locations. Assessment authors explained that the auxiliary data were included despite a caveat that the data were suspect and might introduce bias. The CPUE and effort data met a primary assumption for surplus production because CPUE decreased with increasing effort. Also, use of satellite images of lightboats (number of pixels) suggests a good approximation to lightboat effort.

The MSY range for the Southern California Bight was 30,000-60,000 mt. Considerable discussion was given to whether surplus production results from a time series that included obvious habitat response (i.e. El Niño years) was appropriate for estimating MSY. There was a consensus that resulting MSY estimate represented an intermediate or average value across a range of environmental conditions. Such an average MSY estimate would not represent stock conditions in most individual years, and would be impractical for use in year-to-year fisheries management. In response to that concern, the assessment authors informed the Panel that an attempt had been made to estimate MSY with no El Niño years in the data, but the range of results was so wide that they were not useful. There was general agreement that the use of auxiliary indices in the model had the potential benefits, but squid were not rare in some of the auxiliary data and therefore it appeared that the indices might be saturated.

The Panel recommended that the surplus production model be further explored when substantial new data such as a logbook time series become available, with particular attention to: 1) accounting for environmental effects; and 2) transformation of the auxiliary index data. However, the Panel did not request additional surplus production model work by the assessment authors during the meeting because it was thought that their efforts could be better spent investigating more promising harvest control rules in the limited time available.

Some additional approaches to MSY proxies were available from an Environmental Assessment to Amendment 9 of the CPS-FMP (WP5). The data and methods were presented to the Panel with the caveat that these approaches had already been reviewed by the Council's SSC and were not found to provide useable estimates of MSY for market squid. The Panel briefly discussed some of the alternatives in WP5, but did not think that they warranted further investigation at this time. A major concern was that although the approaches were straightforward and easy to understand, they require several tenuous assumptions and do not utilize much of the recently available data on biology, life history, and reproduction.

4.2 Estimation of Mortality Coefficients (Z)
During the Panel meeting, a catch curve was constructed from southern California catch and age data during December 1998 through June 1999. Daily age data were pooled to estimate catch composition by age in months. Log transformed catch at age estimates suggested that full recruitment occurred at age 6 months, and data from age 6-10 months were used to estimate Z. Two approaches for estimating Z resulted in a range of $Z = 0.3-0.6$ per month. The assessment authors suggested that monthly M is therefore less than 0.6. Considering the atypical life history of market squid, it is unclear if catch curve assumptions about constant

recruitment were violated. Further, and perhaps more importantly, market squid ageing via daily ring counts appears to be problematic after the onset of maturity.

4.3   Leslie-DeLury (Modified Depletion) Model
A Leslie-DeLury depletion model was explored by in WP7, but the results were equivocal. The Panel thought that the approach was not appropriate for market squid at this time, in part because of uncertainty surrounding recruitment. In particular, there do not appear to be any viable recruitment indices currently available. The model would also benefit greatly from improved effort data such as a mandatory logbook time series. The Panel suggested that the model be further explored when such data become available.

4.4   Panel Recommendations on MSY for Market Squid
The Panel concluded that current attempts to estimate MSY were not defendable as a basis for managing the fishery, and there was doubt that technical refinements to this approach would change the determination. Major conceptual problems inherent in applying this approach to market squid remain to be addressed, such as: a life span of less than one year duration; strong environmental effects on availability and/or abundance; potentially biased or saturated auxiliary indices of abundance; harvest centered on terminal spawning grounds; and high variability in recruitment. Although correcting problems in the surplus production approach may be worth pursuing, the Panel believes that a more robust and promising prospect for harvest control rules lies in further investigation and development of spawning escapement targets with respect to SSB/R, along the lines of the data and analyses that were presented as an alternative to MSY (see Section 5, below).

5.   Control Rules and Other Management Measures

As discussed in Section 4,above, the concept of MSY as a constant level of catch is problematic for most species, including market squid. The potential policy importance of MSY in management of market squid is heightened because stock assessment models, data and biological reference points to guide management actions under the MSFCMA are lacking. If suitable biological reference points and models were available, they could be used qualitatively (e.g. in making decisions about "active" vs. "monitored only" management) or quantitatively as management targets and management thresholds in overfishing definitions, harvest control rules, calculation of ABC or short-term management of fishing effort.

Approaches based on biological reference points are more effective in terms of maintaining high catches and conservation than trying to manage a fishery towards a static MSY catch level. The panel therefore concentrated on developing approaches for calculating biological reference points, evaluating the probability of overfishing in the current fishery for market squid, developing approaches to collecting data from the fishery for comparison to biological reference points, and in developing conceptual approaches to harvest control rules that might be applicable to market squid.

5.1   Biology and Fishery Considerations
The following are key points (not prioritized) concerning the biology and fishery for market squid are important in considering technical and policy aspects of biological reference points and harvest control rules.

a.   In the current fishery, market squid are caught almost entirely while aggregated on spawning grounds. This fact has several important implications:
   i.   Landings are almost entirely composed of sexually mature market squid.
   ii.   There is little or no fishing mortality on immature individuals.
   iii.   Maturity and recruitment to the fishery occur at the same time for market squid living in an area where fishing occurs.

b.   Market squid appear to live 6-12 months under natural conditions. Thus, natural mortality rates for market squid are uncertain, but the average lifetime natural mortality rate is much higher than for most finfish. These characteristics have several important implications:
   i.   Recruitment and future catches in each year or generation depend on successful and

adequate spawning in each preceding year or generation.

ii. The persistence of the fishery depends entirely on new recruits to the spawning population. The catch is composed entirely of new recruits to the spawning population.

iii. The fishery and stock are potentially sensitive to environmental factors or fishing that might reduce spawner abundance or survival of eggs over short periods of time. However, sensitivity to these factors has not been clearly demonstrated.

c. Market squid are determinate spawners whose potential lifetime fecundity appears to be fixed at maturity. This means that individual market squid would not replace oocytes and eggs after they are spawned.

d. According to the best available information and opinion of experts at the STAR Panel meeting, individual market squid probably die shortly after their potential fecundity is exhausted and spawning is completed. The duration of spawning, number of spawning bouts and time to death for individual spawning market squid are uncertain and possibly variable. Duration of spawning and time to death are believed to be on the order of days to weeks. Longer spawning periods seem less likely but cannot be ruled out completely. Thus, market squid appear to be functionally semelparous with natural mortality rates that are high on average (to account for the short life span). Moreover, natural mortality rates may increase substantially when market squid become sexually mature and recruit to the fishery.

e. Relatively high fishing mortality rates are probably necessary to catch market squid in terminal spawning ground fisheries before they die of natural causes. This characteristic is due to high natural mortality rates in general, and is likely reinforced by increases in natural mortality rate around the time of spawning.

f. There are spawning grounds where no fishing currently occurs. The size of these areas is unknown but may be significant.

g. Discard appears to minor for market squid.

h. Fishing activities are currently prohibited on weekends (29% of the fishing season).

i. Market squid are a valuable fishery.

j. Landings data suggest that availability of market squid to California fisheries is affected strongly during El Niño periods. This may be due to reductions in abundance, to displacement of the stock away from the fishery, or both factors. Presently, data are not available to prove or disprove either hypothesis.

k. With the exception of El Niño periods, market squid have consistently supported high levels of catch over the last twenty years while markets were favorable. Thus, the current level of average catch appears sustainable under current environmental conditions with no El Niño.

l. Availability and markets have changed over time making long-term trends in landing data difficult to understand.

m. Relatively smooth short-term, inter-annual trends in landings data suggests that catch in the market squid fishery tends to be relatively consistent from year to year, with the exception of El Niño periods. The relationship between abundance and catch is uncertain, however, and short-term abundance may be more variable than catch.

n. Recent increases in landings correspond to a period of warm water conditions in the California Current and strong markets. Hypotheses about the climate-induced trends in abundance are difficult to evaluate based on landings data due to changes in markets.

o. The market squid fishery is currently regulated by license moratorium. A limited entry system is under

consideration. These measures may reduce the probability of dramatic increases in fishing effort over the short term.

p.   Market squid paralarvae can be taken in plankton nets throughout the year indicating that spawning occurs throughout the year. Birth dates of recruits to the fishery spanned a range of at least eight months during one season of sampling (1998-1999).

5.2 Approaches to Developing Biological Reference Points

Preliminary attempts to estimate biological reference points (MSY, F_{MSY}, and B_{MSY}) from surplus production models were not fruitful (WP7; Section 4, above). In reviewing modeling efforts, the STAR panel noted that stock assessment models should use all available information to the extent possible and that nonlinear relationships between abundance and indices expressed as commercial catch rates or proportions (e.g. proportion mid-water tows positive for market squid) should be considered.

a.   Catch rates are often nonlinear for schooling species due to "saturation". The relationship between abundance and catch rates for schooling species is often, for example, expressed as a nonlinear power function $cpue=qB^x$, where cpue is the catch rate, B is market squid biomass, and q and x are parameters. Values of the exponent parameter around x=0.5 are common for pelagic fish.

b.   Proportions are nonlinear because they are confined to the range between zero and one. Depending on the frequency of a positive sample, the number of samples and other factors, indices based on proportion positive data (e.g. proportion tows positive for market squid) are often best modeled based on likelihood calculations for binomial or Poisson variables.

In view of difficulties with surplus production models for market squid, and because new information on reproductive biology was available (WP1), the STAR panel focused attention on reference points based on egg escapement, and related concepts. Egg escapement, for example, is the number (or proportion) of a female squid's potential lifetime fecundity that she is able to spawn, on average, before being taken in the fishery.

At least two traditional escapement approaches are potentially useful for squid. The first is based on depletion models and real-time management. This approach has been used in the Falkland Islands for *Illex argentinus* with some success. It attempts to manage a fishery so that some fraction of abundance or spawning biomass (a proxy for egg production) escapes the fishery. Fishing effort, season length and other management measures are established prior to the fishing season, based on data from the previous years and any additional information that might be available (e.g. results from a preseason trawl survey). Once the fishery is opened, catch rates and other data are monitored closely. The fishery is closed if escapement is likely to fall below the management target. Preliminary attempts to fit depletion models to market squid data were not fruitful (WP7; Section 4, above). The market squid fishery is a terminal spawning ground fishery with high natural mortality rates and continuous recruitment of newly matured individuals so that trends in catch rates would be difficult to evaluate. Real time management is data and analysis intensive, and likely not applicable to the market squid fishery at this time because data and modeling resources are limited. For these reasons, the STAR panel does not consider depletion model approaches to be potentially useful for market squid at this time.

The second traditional reference point approach for egg escapement is based on conventional yield- and spawning biomass "per recruit" models used in many other fisheries. The second approach, or variants described below, is more useful for market squid. The idea was proposed in WP8 where preliminary model runs were carried out. Refinements and extensions are in WP9.

The most typical approach is to use a spawning biomass per recruit model to calculate the lifetime spawning biomass expected from an average female recruit to the fishery, at various levels of fishing mortality. Biological reference points based on fishing mortality rates and expected spawning biomass per recruit from model results are chosen by policy makers. A common biological reference point in squid fisheries is F40%, the fishing mortality rate that reduces a females expected lifetime spawning biomass to 40% of the expected value if no

fishing were to occur.

Using new biological information presented for the first time at the STAR Panel meeting, conventional spawning biomass per recruit models for market squid can be parameterized to calculate egg production (egg escapement) over the life of an average female, rather than spawning biomass. Egg production is a better measure of reproductive output than spawning biomass for market squid and most other species.

Information required to fit per recruit models was available from working papers, participants at the STAR panel meeting and published sources. The required information includes estimates of growth (size at age, WP3), natural mortality (WP 3 and 7), maturity and fecundity at age (WP1), and fishery selectivity. The available information was reliable enough for "ballpark" calculations at the STAR Panel meeting. This modelling is documented in WP9.

Market squid biology and the market squid fishery are unique and it was important to configure per recruit models in appropriate ways:

a.   Recruitment to the spawning stock (maturity at age) and recruitment to the fishery (fishery selectivity at age) were assumed the same because the fishery operates on spawning aggregations.

b.   Mortality rates are extremely high, particularly for spawners, so short time steps (i.e. one day) were used in calculations.

c.   Mature individuals (spawners recruited to the fishery) may have a higher natural mortality rate than immature individuals. Therefore, models incorporating potential changes in natural mortality with spawning are required.

d.   Average lifetime egg production must be less than the average standing stock of oocytes in newly mature virgin females (WP1).

Two models for calculation of egg escapement per recruit and yield per recruit were used at the STAR panel meeting (see WP9). The models were both based on traditional Thompson and Bell (1934) per recruit calculations. Both per recruit models were run with a range of parameter values to accommodate uncertainty in key parameters. Similar results were obtained using both approaches.

Model 2 had the potential advantage of being more biologically realistic, but the potential disadvantage of greater complexity and the greater cost of requiring estimates for more biological and fishery parameters. Model 1 may be more appropriate given uncertainty about biological and fishery parameters in squid and consequently, this model will be relied upon more heavily in the discussion that follows, However, use of two models allowed the STAR panel to verify calculations and the robustness of conclusions to different model structure.

Based on discussions at the STAR panel meeting, new biological information about fecundity and the possibility of measuring fecundity in port samples, per-recruit models for market squid were modified to calculate standing stock of eggs per female in the catch (SSPF) as a function of fishing mortality (see equations in WP9 and Figure 4 in WP9 for illustration of the concept). There are two novel aspects to this approach: 1) use of fecundity in each age group rather than egg production, and 2) calculations per surviving spawning female rather than per female recruit. In the context of SSPF, "daily fecundity" means the standing stock of eggs and oocytes in the ovary and oviduct at time of capture of spawning female market squid. It is important to distinguish between daily fecundity in the context of SSPF (a measure of the standing stock of eggs and oocytes in female market squid), and daily reproductive output or egg production (a measure of eggs spawned per day) in the context of traditional egg per recruit analysis. SSPF may be more useful than daily egg production for market squid because fecundity can be measured in field samples directly or indirectly using proxies such as mantle condition (WP1).

SSPF is a new concept developed at the STAR meeting, but the idea is analogous to using average size of fish in the catch or population as a measure of fishing mortality (Ricker 1975). For comparison, egg production per recruit was calculated as well. SSPF can be calculated with a few simple modifications to the traditional Thompson and Bell (1934) per-recruit model (WP9 Fig 4). The STAR panel recommends that this approach be explored as the basis of control rules for market squid management.

<u>Status of the Stock Relative to Commonly-Used Reference Points (such as F40%)</u>
F40% has not been established as either a management target or threshold for the market squid fishery. However, it is used as a biological reference point in other fisheries for short-lived squid species and maybe an adequate proxy reference point for a future threshold overfishing definition or management target.

The conclusion, based on sensitivity analysis and other considerations, that current F in the market squid fishery is likely less than F40% (see WP9) is due primarily to high natural mortality rates for spawners and determinate fecundity. Basically, the preliminary sensitivity analysis suggests that natural mortality occurs so quickly that it is difficult for a fishery on the spawning grounds to "keep up" and remove spawners before a substantial fraction of their eggs are spawned. Rapid spawning of a substantial fraction of potential egg production is due, in part, to determinant fecundity in female market squid (eggs are not replaced after spawning). This result is a preliminary and qualitative one, but likely robust given the life history of market squid, current fishing practices, and the results of sensitivity analyses. However, more extensive sensitivity analysis, particularly involving assumptions about daily fecundity, spawning duration and natural mortality rates of mature individuals should be carried out.

It is important to remember that conclusions about the probability that F exceeds F40% in the market squid fishery depend on current fishing practices and, in particular, on the assumptions that almost all fishing occurs on terminal spawning aggregations and that squid are short lived with determinate fecundity. The resilience of the fishery may change significantly if a substantial fishery develops for immature squid.

Finally it should be noted that F40% was used in sensitivity analysis for demonstration purposes only, and is not proposed by the STAR panel as a policy for market squid. The STAR panel did not evaluate the potential suitability of F40%.

6. Conclusions and Recommendations

The analyses carried out during the STAR panel and described more fully in WP9 indicate that average fecundity of market squid from port samples could be compared to reference points from per recruit analysis cast in units of fecundity per spawner (SSPF), if assumptions about determinate spawning are valid, if fecundity in fishery samples can be practically measured, and if the fishery continues to operate on terminal spawning aggregations. There appears to be a direct correspondence between equilibrium fecundity per spawner, equilibrium fishing mortality, and equilibrium egg escapement calculated using per recruit models. The utility of equilibrium reference points seems as valid for market squid as for finfish, where they are commonly used, although this is a topic for future research given the unusual life history of squid. Thus, in principle, it should be possible to find a fecundity based reference point that corresponds to a fishing mortality rate goal or egg escapement goal, and that can be compared to data from samples of catch in the market squid fishery.

The practical problems that still need to be answered include: 1) refinement of biological parameters for per recruit modeling; 2) development of port sampling protocols for measurement of fecundity on a routine basis (e.g. mantle condition samples requiring laboratory analysis will likely be required); 3) evaluation of the precision of reference points and fecundity estimates; and 4) recommendation of options for management target and thresholds in the market squid fishery. Additional consideration and review of the concept of using fecundity samples in stock status determinations for market squid is required because the approach is new and untried. For example, the fecundity-based approach may not provide adequate sensitivity to reliably detect significant changes in stock status in a timely enough manner to implement an appropriate management response. Empirical validation of the performance of this method through several El Niño cycles will be

necessary to document the viability and responsiveness of this new management approach for market squid.

Once biological reference points for management targets and thresholds are specified, conventional control rule approaches for actively managed fisheries could be readily employed. It should be possible to use threshold reference points in defining overfishing for market squid and defining overfished stock conditions. It may be possible to achieve target egg escapement levels by regulating the number of days fished, even in the hypothetical circumstance of very high fishing mortality rates on all spawning grounds. This approach or one based on seasonal closure could, theoretically, make more complex harvest control approach unnecessary. However, socio-economic factors would have to be considered as well. For example, the simple weekend closure presently in place has the advantage of allowing for escapement throughout the fishing season, regardless of year to year variations in spawning timing, and in theory could afford unimpeded escapement of approximately 28% of the full spawning potential annually. As a topic of future research, it is important to determine if control rules for market squid should be adjusted to allow more or less harvest in the face of unusual environmental events (e.g. El Niño), ecosystem factors (predator requirements), unusual stock conditions (e.g. evidence or recruitment failure), or changes in the operation of the current fishery (e.g. fishing on immature market squid). As described above, the most important potential change would be the development of substantial fishing pressure on immature squid.

Operationally, there are a number of approaches to changing fishing mortality in the context of achieving management targets in routine management of an actively managed stock with a control rule (e.g. see WP9, Figure 5). The STAR panel cannot recommend specific measures to increase or decrease fishing mortality. However, the list of candidate measures includes changes to trip limits, changes to the number of boats fishing, changes to the days per week when fishing occurs, changes in the fishing season, or changes in areas where fishing occurs, etc. Many of these examples appear practical and likely to be effective.

In principle, fecundity estimates from port samples might be used to indirectly determine the status of the market squid fishery with respect to F-based biological reference points used as management targets and thresholds in the market squid fishery. However, it would be more desirable to use a modern stock assessment model that incorporated all available data (including catch, fecundity, abundance index trends, etc.) to calculate fishing mortality rates directly for comparison to F-based biological reference points. This will become increasingly important as additional data sources (e.g. logbooks) and new research surveys come online. This type of modelling could also be instrumental in assessing the overall performance of the fecundity-based per recruit management approach, discussed above.

7. Research and Data Needs

A number of questions were raised at the STAR panel meeting as to data requirements for management of the market squid fishery and, in particular, if it is necessary to continue collecting age samples and other data from port samples and logbooks. These important practical questions are closely related to choice of reference points and control rules. However, given uncertainties about the nature of the eventual management approach and likely rapid development of new modeling approaches, it was impossible to provide definite advice. The STAR panel therefore recommends that current fishery data collection procedures be maintained in the near term as appropriate, until management approaches and data requirements become more clearly established or until data needs can be prioritized. Issues related to fishery sampling should be discussed with the full range of stakeholders.

As described above, there are a number of biological parameters with imprecise and uncertain estimates. Many of these parameter estimates are important and could be improved with additional fishery independent surveys, enhanced sampling, and analyses. The most important areas requiring additional work include questions about reproductive biology (a key area of uncertainty) that include potential fecundity of newly mature virgin females, duration of spawning, egg output per spawning bout, temporal pattern of spawning bouts, growth of relatively large immature squid, and growth of mature market squid. Important questions about growth might be addressed through SEM studies of statoliths.

The potential use of target egg escapement levels is partly predicated on the assumption that the spawning which takes place prior to capture is not affected by the fishery and contributes to future recruitment. However, since the fishery takes place directly over shallow spawning beds, it is possible that incubating eggs are disturbed by the fishing gear, resulting in unaccounted egg mortality. It is also possible that the process of capturing ripe squid by purse seine might induce eggs to be aborted, which could also affect escapement assumptions. A comparatively small-scale program to obtain at-sea observations could provide information on the degree to which these concerns are a factor in the fishery.

The CalCOFI ichthyoplankton collections contain approximately 20 years of unsorted market squid specimens that span at least two major El Niños. This untapped resource might be useful in addressing questions about population response to El Niño conditions.

Table 1. Fishery independent and fishery dependent data sources for market squid stock assessment and management.

Fishery Independent Data

Data Type	Data Source	Coverage	Notes
Midwater trawl survey	Kenny Mais CDFG	Central CA - S. Baja up to 8 times annually 1966-1988	In 2000, CDFG conducted a survey with similar methods. Examined by Maxwell (Doc#7) as auxilliary index of abundance for surplus production modeling. Summarized by population positive tows
Midwater trawl survey	NMFS-Tiburon	Farralons to Monterey Bay 1987 - present	
Midwater trawl survey	Oregon predator and Salmonid survey	Mouth of Columbia River 1997-1999 to present?	
Midwater trawl survey	NMFS-AFSC Whiting survey		
Sea lion scat data	Lowry and Carretta 1999	San Clemente and San Nicholas Islands 1981 - present	Proportion of scat samples containing squid beaks per calander quarter. Examined by Maxwell (Doc# 7) as auxilliary index of abundance for surplus production modellin
ROV transects	CDFG	Fishing grounds in S. CA and Monterey Bay 1999 - present	Sampled known spawning grounds to observe egg case attachment and distribution.
ROV transects	NMFS-SWFSC	Fishing grounds in S. CA, 2000?	Sampled at depths beyond fishing grounds
Paralarval survey	CalCOFI Bill Hamner, UCLA	S. California Bight 1999 - present	Bongo net tows
Bottom Trawl survey	NMFS-AFSC Triennial shelf survey	BC, WA, OR, CA to Point Conception 1977 - present	
Bottom Trawl survey	CDFG Halibut survey		
Power plant impingement			Samples from power plant water intakes
Sanitary district otter trawls			Samples from areas around sewer outfalls
Areal spotter survey	CDFG	Fishing grounds in S. CA	

Fishery Dependent Data

Data Type	Data Source	Coverage	Notes
Commercial fishery port samples	CDFG	Fishing grounds in CA November 1998 - present	Sexual maturity, age-at-length, species composition, observed bycatch, landings, fecundity
Fishery logbook	CDFG, CA commercial fishery	Fishing grounds in CA November 1998 - present	Effort data, fishing location, bycatch information
Fishery landing receipts	CDFG, CA commercial fishery	Fishing grounds in CA 1929-1980 by port; 1981-present by block	tonnage, price, location, and gear type (1981-present); tonnage by port only (1929-1980)
Satellite imagery	NOAA, CDFG	Fishing grounds in S. CA	Effort data (1992-2000); problematic going forward due to light boat shielding requirements. Used in surplus production and Leslie-DeLury modelling.

Appendix A. Terms of Reference

The following terms of reference for the Market Squid STAR Panel were approved by the Pacific Fisheries Management Council at its April 2001 meeting:

[1]   Review recent findings on the biology and life history of market squid, including the assessment-related aspects of age and growth, maturity, fecundity, spawning behavior, longevity, habitat, and environment.

[2]   Review newly developed fisheries-related data, including catch history, effort data, and port sampling protocols as they relate to estimation of key biological, population parameters.

[3]   Review all aspects of MSY estimation, as required by the Magnuson-Stevens Fishery Conservation and Management Act for all FMPs, and address the concept of MSY as it relates to a species that is short-lived and whose abundance/availability is largely environmentally determined.

[4]   Consider management measures for market squid, including operationally-practical control rules, long-term monitoring programs, and in-season adjustment mechanisms.

[5]   Prepare a report for the SSC detailing the findings of the review, practical management recommendations, and the key research & data needs.

Appendix B. Agenda for the Market Squid Stock Assessment Review (STAR)

Southwest Fisheries Science Center
8604 La Jolla Shores Drive
La Jolla, CA   92038
May 14-17, 2001

Monday, May 14th
08:00	Welcome, introductions, and logistics
08:15	Review terms of reference and agenda. Assignment of rapporteurs.
08:30	Presentation of working papers
12:00	Lunch
13:00	Presentation of working papers -- continued
14:30	Discussion of recent biological findings as they relate to stock assessment & management (Section 2 of the STAR Panel Report). Requests for additional information and/or data from working paper authors (as necessary).

Tuesday, May 15th
08:00	Discussion of newly developed fisheries-related data as they relate to stock assessment & management (Section 3 of the STAR Panel Report). Requests for additional information and/or data from working paper authors (as necessary).
10:00	Discussion of MSY estimation for squid and the SFA requirements (Section 4). Requests for additional analysis and/or data from authors (as necessary).
12:00	Lunch
13:00	Discussion of management measures including operationally-practical control rules, long-term monitoring programs, and in-season adjustment mechanisms (Section 5). Requests for additional analysis and/or data from authors (as necessary).
15:00	Review additional data and analyses, as requested from working paper authors.

Wednesday, May 16th
08:00	Review additional data and analyses, as requested from working paper authors.
10:00	Review draft rapporteur's report on biology and life history findings (Section 2).
11:00	Review draft rapporteur's report on fisheries-related data (Section 3).
13:00	Continue review of additional data and analyses, as requested from working paper authors, as necessary.
14:00	Review draft rapporteur's report on MSY estimation (Section 4).
15:00	Review draft of rapporteur's report on control rules & other management measures (Section 5).
16:00	Drafting session for full STAR Panel draft report.

Thursday, May 17th
08:00	Drafting session for full STAR Panel draft report -- continued
10:00	Discussion of research and data needs (Section 6 of the STAR Panel Report).
10:30	Review full STAR Panel draft report.
12:30	Discuss procedures for completion of the final STAR Panel report.
13:00	Adjournment

Appendix C. Working Papers Presented to the Market Squid STAR Panel

WP1   Macewicz, B. J., J. R. Hunter, N. C. H. Lo, and E. L. LaCasella. 2001. Lifetime fecundity of the market squid, *Loligo opalescens*. *Working Paper 1.*

WP2   Macewicz, B. J., J. R. Hunter, and N. C. H. Lo. 2001. Validation and monitoring of the escapement fecundity of market squid. *Working Paper 2.*

WP3   Butler, J., J. Wagner, and A. Henry. 2001. Age and growth of *Loligo opalescens*. *Working Paper 3.*

WP4   California Department of Fish and Game (CDFG). 2001. Status of the market squid fishery with recommendations for a conservation and management plan. M. Yaremko (editor). *Working Paper 4.*

WP5   Coastal Pelagic Species Management Team (CPSMT). 2001. Coastal pelagic species fishery management team working review: market squid optimum yield and maximum sustainable yield working plan. *Working Paper 5.*

WP6   Isaac, G., N. Neumeister, and W. F. Gilly. 2001. The effects of temperature on early life stages of the California squid (*Loligo opalescens*). *Working Paper 6.*

WP7   Maxwell, M. R. 2001. Stock assessment models for the market squid, *Loligo opalescens*. *Working Paper 7.*

WP8   Maxwell, M. R., and P. R. Crone. 2001. Management recommendations for the market squid fishery. *Working Paper 8.*

WP9[*]   Maxwell, M. R. 2001. Reproductive (egg) escapement model and management recommendations for the market squid fishery. *Review Summary Paper.*

[*] WP9 is a revision of WP8 requested by the STAR Panel to document the analyses carried out during the STAR Panel meeting. The analyses and results contained therein reflect the STAR Panel consensus at the end of its meeting with respect to the most appropriate modelling and management control rules

Appendix D. Participants

Last Name	First Name	Affiliation	
Amoroso	Orlando	San Pedro Purse Seine Vessel Owners	May 17 only
Barnes	Tom	CDFG, La Jolla	
Butler	John	SWFSC, NMFS	
Conser	Ray	SWFSC, NMFS	
Crone	Paul	SWFSC, NMFS	
Garrison	Karen	NRDC, San Francisco	May 15 only
Henry	Annette	CDFG, La Jolla	
Herrick	Sam	SWFSC, NMFS	
Hill	Kevin	CDFG, La Jolla	
Hunter	John	SWFSC, NMFS	
Jacobson	Larry	NEFSC, NMFS – Woods Hole, MA	
Jagielo	Tom	WDFW, Olympia, WA	
Klingbeil	Rick	CDFG, Los Alamitos	May 15 & 17
Lo	Nancy	SWFSC, NMFS	
Lutz	Steven	USC	
Maxwell	Mike	UCSD, Scripps Institution of Oceanography	
Munro	Heather	Munro Consulting	
Oliver	Chuck	SWFSC, NMFS	May 14-15
Smith	Paul	SWFSC, NMFS	
Vetter	Russ	SWFSC, NMFS	May 14 only
Wagner	John	UCSD, Scripps Institution of Oceanography	May 14 only
Wertz	Steve	CDFG, Los Alamitos	May 14 only
Yaremko	Marci	CDFG, La Jolla	

APPENDIX G: CPSMT REPORT - RECOMMENDATIONS FOR MARKET SQUID MANAGEMENT AND RESEARCH

Recommendations for Market Squid Management and Research

Coastal Pelagic Species Management Team

Preface

The Coastal Pelagic Species Management Team (CPSMT) convened from August 14-15, 2001 to address management and research issues associated with the market squid (*Loligo opalescens*) resource off the California coast. The overall goal of this CPSMT meeting was to review information generated from the recently conducted Stock Assessment Review (STAR) session for squid held in May 2001. Specifically, the CPSMT focused on the following objectives during the two-day meeting: (1) develop consensus regarding important points concluded in the STAR Panel's Report; (2) determine if the suite of model configurations based on the *Egg Escapement* (EE) method could be further reduced into a tractable subset (Maxwell 2001); (3) further evaluate important parameters of the EE approach (e.g., population 'threshold' levels) in efforts to establish maximum sustainable yield (MSY)-based management schemes; and (4) develop sampling, laboratory, and analysis schedules that support the EE approach in particular, and also discuss the merits of gathering auxiliary data that would improve understanding of squid population dynamics. The following synopsis presents the CPSMT's recommendations.

Summary

First and foremost, the CPSMT generally supports the findings of the STAR Panel and in particular, its conclusion that the EE method can provide an effective framework for monitoring/managing the squid population in the future (see objective (1) in Preface). That is, the current port sampling program implemented by the California Department of Fish and Game (CDFG), along with newly developed laboratory and analysis procedures conducted by the National Marine Fisheries Service (Southwest Fisheries Science Center, SWFSC), will provide an objective method for establishing Maximum Sustainable Yield (MSY)-based management goals for the squid resource, e.g., for developing biological reference points. In practical terms, the EE approach can be used to evaluate the effects of fishing mortality (F) on the spawning potential of the stock and in particular, to examine the relation between the stock's reproductive output and candidate proxies for the fishing mortality that results in MSY (F_{MSY}). However, it is important to note that this approach does not provide estimates of historical or current total biomass and thus, a definitive yield (i.e., quota or Acceptable Biological Catch) cannot be determined at this time. Ultimately, the EE approach can be used to assess whether the fleet is fishing above or below an a priori-determined sustainable level of exploitation and in this context, can be used as an effective management tool. Reasons for adopting the EE method for monitoring/managing the squid population, rather than other analytical approaches (e.g., surplus production and depletion models), are presented in STAR (2001).

A critical underpinning of this recommendation is that the fishery continues to concentrate strictly on squid spawning grounds–the fishing fleet attracts mature squid using lights deployed during the evening hours. This *spawning-grounds* squid fishery appears to have the following characteristics: (1) historically, harvests have consisted almost entirely of mature animals that had had an opportunity to spawn, i.e., lay some or all of their eggs before capture; (2) recruitment and future catches in each fishing season largely depend on successful and adequate spawning in the preceding season; (3) the squid are determinate spawners, with potential lifetime fecundity fixed at maturity; (4) the squid die soon after laying their full complement of eggs, i.e., semelparous reproduction; and (5) interpretable, anatomical evidence of spawning must be able to be estimated from commercial harvest data, which can be routinely collected through an ongoing port sampling program. The fact that evidence of spawning can be derived from commercially landed specimens offers a unique opportunity to implement an EE method for fishery monitoring/management. Ultimately, estimates of past spawning, coupled with per-recruit analysis theory, can provide the necessary statistics for determining the relationships between important equilibrium-based fishery descriptors, e.g., for determining how fishing mortality (F) influences residual eggs at time of capture, eggs per recruit, and EE.

Although the CPSMT is supportive of such an approach for this fishery and recommends beginning efforts for its implementation, there still exist areas of uncertainty that would greatly benefit from further evaluation. In this regard, the following areas of squid biology are only generally understood at this time and thus, were treated through 'sensitivity' analysis at the modeling stage: (1) maturation rate; (2) duration of spawning; (3) egg-laying rate; and (4) natural mortality rate.

The CPSMT recommends that the squid resource be formally reviewed again in 2004. Thus, a research/management sequence should be started for completion by early 2004. Important areas of work include: (1) rigorous monitoring of the landed catch for the occurrence of immature squid; (2) collection of fishermen logbook data that will allow changes in fishing techniques and success to be accurately measured;

and (3) initiating studies that shed light on areas of squid biology still unresolved (see above). An extensive research/management list is presented in Maxwell (2001) and summarized in STAR (2001).

Finally, the following discussion (see Additional Notes) addresses pertinent decisions made by the CPSMT to develop a workable monitoring/management plan for the squid fishery based on the EE method, i.e., the STAR Panel (STAR 2001) provided general recommendations regarding analytical methods and left determination of specific model configurations and other management-related parameters to the CPSMT.

Additional Notes

The following discussion briefly describes technical decisions made by the CPSMT regarding the squid stock assessment conducted in 2001 in general and the EE method in particular (see Maxwell 2001). The discussion is partitioned into four general areas: (1) selection of a 'preferred' model scenario; (2) selection of a 'threshold' level of egg escapement (EE value) that can be considered a warning flag when tracking the status of the population; (3) fishery operations in (and after) El Niño/Southern Oscillation (ENSO) events; and finally, (4) necessary management-related constraints.

Preferred Model Scenario

The CPSMT largely relied on researchers familiar with squid biology to identify a 'preferred' (most plausible) model scenario from the suite proposed in the overall analysis. First, given that *model version 1* was the more general of the two proposed versions and adequately captured what is known (at this time) regarding the maturation schedule of this species, the CPSMT recommended that this version be focused on when deriving final estimates. Further, two important areas of squid biology that were treated in sensitivity analysis during modeling exercises included hypothesized rates of natural mortality (M) and egg laying (v). The CPSMT recommended that the preferred model scenario be based on $M = 0.15$ and $v = 0.45$ (both are daily rates), given: (1) data on the energetics of egg production and longevity of sexually mature adults indicate higher values of M are more likely than lower values; and (2) anatomical examinations of reproductive organs of young spawning females support egg-laying rates that are roughly equivalent to $v = 0.45$. It is important to note that rates of natural mortality (M), as well as fishing mortality (F), are generally believed to be much higher for this marine animal than that estimated for species of fish; however, mortality associated with squid should be interpreted in the context of this species' life history strategy, namely, it's relatively short life span and associated high productivity.

Threshold Level of Egg Escapement

A 'threshold' level of egg escapement can be practically interpreted as a level of 'reproductive' (egg) escapement (EE) that is believed to be at or near a minimum level that is considered necessary to allow the population to maintain it's level of abundance into the future (i.e., allow for 'sustainable' reproduction year after year). It is important to note that a threshold level of egg escapement applicable to this species is not known in strict terms at this time (and likely not a fixed value on an annual basis), but rather, determined from evaluating general patterns of harvest observed in the squid fishery off California, as well as examining similar reference points relied upon in other squid fisheries as approximate guidelines. The CPSMT recommended that a threshold value of 0.3 (30%) be used initially, given: (1) a reproductive escapement threshold of roughly 0.4 (40%) has been used effectively in other squid fisheries (e.g., Falkland Islands fishery)–keeping in mind that the Falkland Island fishery harvests primarily juveniles; (2) not all of the squid spawning grounds off the California coast are subject to fishing pressure; (3) an existing weekend closure allows two days per week for spawning in the absence of fishing; and (4) the daily mortality of females during spawning is likely quite high.

Given the reasons above, it is certainly possible that a more appropriate threshold level is even lower than 0.3; however, the CPSMT does not recommend a lower level of egg escapement, given: (1) this is a new approach that should be monitored for some time before adopting a lower threshold; (2) there are some uncertainties about the retention of eggs in the females after capture; (3) there may be unevaluated fishery-dependent sources of mortality after spawning, such as fishing gear destruction of egg beds; (4) squid are members of a lower animal trophic level of the marine ecosystem and thus, play an important role as a forage species utilized by animals at higher trophic levels; and (5) sample data indicate that it is not likely that the recommended threshold will hamper the operations of the fishery as observed since the mid 1990s.

ENSO Events

The CPSMT deferred consideration of the effects of ENSO conditions on the squid population and ultimately, the fishery itself, until studies that focus on the influence of such oceanographic phenomena on squid abundance and distribution generate useful management advice. A consistent observation during such events is a temporary cessation of availability to the fishery. Although researchers generally believe this 'disappearance' is due to both reduced reproduction by the population and movement out of the established spawning grounds and into favorable habitat, the extent and magnitude of each response are not clearly defined at this time. Most importantly, there is no indication from the post-ENSO landings of long-term detrimental damage to the population's ability to sustain itself, i.e., the population has recovered relatively quickly following El Niño events. Although catches by the fleet dramatically decline during such periods and in effect, 'self-regulate' the fishery, the CPSMT cautioned that further restrictions on catch may be warranted in the future, given the broad impact that these oceanographic conditions have on many marine animal populations distributed along the U.S. Pacific coast.

Monitoring and Management Issues

Most importantly, the CPSMT concurred with the STAR Panel that the current squid fishery should remain under the immediate jurisdiction of the state of California (i.e., CDFG)–keeping in mind the federal-based policies inherently in place for all U.S.-based fisheries. The newly adopted EE method should be considered a joint effort between the CDFG and NMFS (see Summary above). Additionally, sample data (e.g., catch-related statistics) are currently being collected by the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW), with the possibility that in the future, ODFW and WDFW, along with CDFG, may assist in collection of information directly related to the EE method.

The CPSMT recognized that the management measures already in place by the CDFG for the squid fishery are effective tools for controlling the amount of fishing pressure exerted on the population, e.g., weekend closures and protected (no fishing) areas along the coast. In this regard, the CPSMT recommended that management-related exercises that may be needed in the future (via the EE method, e.g., falling below a threshold of 0.3) be implemented by the CDFG using similar, but somewhat more rigorous, regulations as those in place currently. Finally, the CPSMT strongly recommended that the recent CDFG-proposed annual landings cap on the total harvest of squid be supported. This management measure should not be considered a trivial constraint, given many of the conclusions drawn from the overall squid assessment were based on past fishing practices of the fleet and the dynamics of the population may indeed change if subjected to uncharacteristically high catches (also, see *spawning grounds* squid fishery in Summary above for related point).

References

Maxwell, M. R. 2001. Reproductive (egg) escapement model and management recommendations for the market squid fishery. Summary Paper from *Stock Assessment Review (STAR)* Meeting, NOAA/NMFS/SWFSC, May 14-17, 2001. 27 p.

Stock Assessment Review (STAR) Panel. 2001. Report of the Stock Assessment Review (STAR) panel for market squid. Panel Report from *Stock Assessment Review (STAR)* Meeting, NOAA/NMFS/SWFSC, May 14-17, 2001. 18 p.

APPENDIX H: FMP AMENDATORY LANGUAGE

To be Completed

AMENDMENT 10 TO THE COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

Situation: The Council will consider adopting a public review draft of Amendment 10 to the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP).   Amendment 10 addresses two separate CPS-related issues: (1) capacity goal and permit transferability in the limited entry fishery and (2) determination of a maximum sustainable yield (MSY) proxy for market squid.   In compliance with the National Environmental Policy Act (NEPA), Amendment 10 is written in the form of a combined Environmental Assessment/Regulatory Impact Review (EA/RIR).

Capacity Goal and Permit Transferability – The purpose for establishing a capacity goal is to ensure fishing capacity is in balance with resource availability.   In April 2001, the Council adopted preferred alternatives for a capacity goal and provisions for limited entry permit transferability.   The Council also asked for alternatives to maintain the capacity goal and provide for issuance of new permits if fleet capacity fell below the capacity goal.   These subissues were reviewed by the Council in November 2001.

The proposed action (or preferred alternative) is a combination of management options.   This action is presented and analyzed relative to no action (or *status quo)*.   Other capacity-related alternatives that were considered are also presented.   The proposed action represents the combined preferred alternatives adopted by the Council and CPS Management Team recommended alternatives for capacity-related sub-issues (i.e., mechanisms for maintaining fleet capacity and issuing new permits).

Market Squid MSY – The purpose for establishing a MSY proxy for market squid is to bring the FMP into compliance with Magnuson-Stevens Fishery Conservation and Management Act requirements.   In November 2001, the Council reviewed results from a stock assessment review (STAR) of recent squid life history research.   The Council endorsed the MSY proxy approach recommended by the CPS Management Team, CPS Advisory Subpanel, and Scientific and Statistical Committee (SSC).

The proposed action is analyzed in comparison to the suite of other alternatives developed by the CPS Management Team (including no action) for determining a MSY proxy.

The CPS Management Team will provide a review of the alternatives and analysis of proposed actions. The SSC and CPS Advisory Subpanel will report on their review of Amendment 10.

After hearing the advice of the Council's advisory bodies and the public, the Council will consider whether to adopt Amendment 10 as a public review draft.   The Council should review the proposed actions and ensure they embody the Council's preferred alternatives.   If alternatives other than the proposed actions are preferred or if new alternatives are to be considered, the Council should provide guidance to the CPS Management Team.   Modifying the proposed actions and/or adding new alternatives will likely require additional analyses.

If the Council adopts Amendment 10 for public review the document will be finalized (based on Council guidance) and made available to the interested public and National Marine Fisheries Service for review and comment.   It is anticipated that Amendment 10 would come before the Council for final action at the June 2002 Council meeting.

Council Action:

1.   Adopt Amendment 10 for public review.

Reference Materials:

1.   Exhibit H.2, Attachment 1 – Amendment 10.
2.   Exhibit H.2.b, Supplemental CPSMT Report.
3.   Exhibit H.2.c, Supplemental SSC Report.

4. Exhibit H.2.c, Supplemental CPSAS Report

Agenda Order:

a. Agendum Overview   Dan Waldeck
b. Coastal Pelagic Species Management Team Report   Kevin Hill
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action**:   Adopt Amendment 10 for Public Review

PFMC
02/26/02