LIMITED ENTRY FISHERY – CAPACITY GOAL AND OTHER ISSUES

Situation: After December 31, 2000, limited entry permits in the coastal pelagic species (CPS) fishery may not be transferred to a different owner, a permit owner may transfer the permit to another vessel only if the permit's original vessel is totally lost and the replacement vessel is of equal or less tonnage. The Coastal Pelagic Species Advisory Subpanel (CPSAS) and the public have expressed concern about these 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 in the limited entry fishery 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. Establish a procedure (with criteria) for issuing new permits after the goal is attained and if the fishery becomes under-utilized.

3. Evaluate the pros and cons of extending the current permit transfer window to allow consideration of the non-transferability of California's market squid permits; under two scenarios, (1) basic extension of the transferability deadline, or (2) extension of transferability contingent on holding a California market squid permit.

4. Develop mechanisms for achieving the goal.

5. Transferability of permits after the goal is achieved; under two scenarios – on achieving goal, (1) all permits (including new permits) are freely transferable, or (2) new permits (i.e., those issued after goal is achieved) would have restricted transferability.

The CPSMT discussed these issues at their October 17-18, 2000 meeting; the CPSMT also discussed their findings with the CPSAS on October 18, 2000. The CPSMT and CPSAS will provide reports to the Council addressing the five issues outlined above.

Council Action: Discussion on Capacity Goals and Other Issues.

Reference Materials:

1. Exhibit E.1.a, Supplemental CPSMT Report.
2. Exhibit E.1.b, Supplemental CPSAS Report.

PFMC
10/16/00

WEST COAST SEAFOOD PROCESSORS ASSOCIATION

West Coast Seafood Processors Association
P.O. Box 1477, Portland, OR 97207
503-227-5076 / 503-227-0237 (fax)

Serving the shore based seafood processing industry in California, Oregon and Washington

E.1

November 2nd, 2000

Coastal Pelagic Species
Limited Entry Fishery - Capacity Goals and Other Issues

Heather Munro, Deputy Director

The West Coast Seafood Processors Association represents those seafood packers who process the majority of coastal pelagic species landed on the west coast.

January 1st, 2001 marks the one-year anniversary of the implementation of the limited entry program for coastal pelagic species finfish south of 39° N latitude (Pt Arena). In March of 2000 the Council directed the CPS Management Team to analyze several aspects of the limited entry fishery. In June, the Council reiterated those instructions asking the CPS Team to provide recommendations to:

1. Establish a goal for the CPS finfish fishery (i.e. number of vessels and amount of capacity)
2. Establish a procedure for issuing new permits after the goal is attained (if the fishery becomes underutilized)
3. Evaluate the pros and cons of extending the current permit transfer window
4. Develop mechanisms for achieving the goal
5. Address transferability of permits after the goal is achieved

Now it is November of 2000. Frankly, I am thoroughly disheartened by the actions of this Council. Now, almost a year after a limited entry program was implemented, the Council is trying to figure out what the goal *should be?* I believe this was something the Council should have considered prior to instituting a plan that has significantly altered the existing fishery.

While this Council waits for the hard-working CPS Management Team to answer questions that I believe the Council should have already considered when initially implementing a limited entry scheme, an extension of the permit transferability window should have been exercised. The Council had the opportunity to begin this two-meeting process in September, but for reasons that I do not believe are reasonably justified, you did not.

When Amendment 8 was being drafted, and subsequently through the review and comment periods, the CPS Plan Development Team, the CPS Advisory Subpanel, and many stakeholders in the fishery continuously recommended to the Council that limited entry permits be fully transferable. Transferable permits were a critical element in making this plan a success. Without this particular component, members of the CPS panel and other stakeholders active in the industry would never have supported limited entry in the first place. The Council, acting on the recommendation of the state of California's designee, chose to ignore these recommendations from both the industry panel and the scientific team that they themselves had appointed.

We are all aware that the State of California believes the CPS finfish fleet should be smaller then its current configuration. California Department of Fish and Game has gone on the record stating their support for a fleet of 41 boats. Furthermore, Dr. Sam Herrick's recently completed capacity study indicates that the seventy boats that were *expected to qualify* under limited entry criteria adopted by the Council are capable of harvesting 268,000 metric tons of coastal pelagic finfish species annually. Dr. Herrick's study does not evaluate the fishery that is currently in place as a result of the implemented limited entry program. For instance, although 70 boats were expected to qualify, only 64 permits were actually issued. I do not disagree with Dr. Herrick's findings, in fact, I applaud his efforts at attempting to determine an estimation of capacity that is unarguably a difficult concept to quantify. I do, however, disagree with the application of these findings, if this Council and the state of California continues to believe that the CPS finfish fishery operates in a vacuum. It does not and it will not.

The state will tell you, and has told me personally that they were doing the industry a favor by making an attempt at a compromise. They would allow the upper range of boats into the fishery (70 as opposed to 41), and make the permits transferable for one year. Their expectation was that after the year 2000, through attrition, the fleet size would begin to shrink to a significantly smaller number. Forty percent smaller.

And so, when the issue of transferability was brought in front of this Council once again in September, the Council chose once again to do nothing, even though the deadline for transferring permits was fast approaching. I use the term Council loosely here, because for all intensive purposes, even though CPS are a federally managed fishery, the state of California decides how, when, and what will be done with this fishery. In this case, the Council through the state of California has chosen once again to ignore what the majority of stakeholders in the fishery have been saying, that is: that CPS limited entry permits should be freely transferable.

It was anticipated that 70 limited entry permits would be issued as a result of the limited entry scheme adopted by the Council. It turns out that only 64 permits were issued. I was interested in finding out how many of the 64 permits issued had actually made landings and in what quantities. When I went looking for that information it was not readily available. I finally received the details after prompting PacFIN staff to begin tracking the statistics. On October 4th, Will Daspit reported the following information from the PacFIN database (included on Attachment 1). Of the 64 permits issued, 56 had made at least one landing. Two permits show only one landing each. Thirteen boats have made between 2 and 25 trips. Forty one boats have been relatively active and have made between 26 and 79 deliveries in 2000. A number of boats who have received permits have been identified as strictly bait boats, this may explain why some of the 64 permits do not have associated landings - a permit is not necessary to fish for bait. Total landings for the 56 boats are 60,346 metric-tons of CPS finfish. This is less than 30% of the available harvest of Pacific sardine alone.

The most active boat in the limited entry program has only fished for CPS finfish 28% of the available fishing days in 2000. In fact, only twelve boats have made between 60 and 79 trips, that equates to fishing between 21-28% of the days available through September of this year. These types of statistics support my earlier statement that the CPS finfish fishery does not operate in a vacuum.

The available data indicate that there are, in fact, far less than 41 boats actively prosecuting the CPS finfish fishery.

While the Council continues to explore what the goal of the fishery should be, we strongly urge you to consider the available data. Continue to debate and decide what the optimum fleet size for the finfish fishery should be. But in the meantime, do not continue to punish current participants and those who want to participate in the fishery. We are strongly recommending that the Council implement an emergency regulation that would allow for the extension of the transfer of limited entry permits past the deadline of December 31st, 2000. There is no justifiable reason that the permits should be non-transferable. The fishery is obviously underutilized. More than 10% of the permits issued have never been employed. There are fishermen with the existing ability to participate successfully in the fishery. There are processors in need of more available boats to deliver finfish. I am not suggesting issuing additional permits at this time- but at least make the permits that have been issued transferable and available for use.

While I recognize that the Council is under considerable pressure at this time in regards to groundfish. I would like to take this opportunity to remind the Council that there is an entire sector of the industry that relies on the CPS finfish fishery in conjunction with the squid fishery for their livelihoods. They are depending on this Council to evaluate the available data and take their concerns into consideration when crafting regulations. In this case it only makes sense to allow the issued permits to be transferred after December 31st.

Number of trips per permitted vessel through September 2000

Number of Trips	% of days fished (out of 274 days)	Number of Vessels
1-25	.3 - 9%	15 (2 vessels that show only one trip)
26-43	9 - 16%	15
46-58	17 - 21%	14
60-79	22 - 29%	12

Catch in Metric Tons through September 2000

Catch in Metric Tons	% of total landings all CPS finfish (60,346 mts)	Number of Vessels
8 - 239	.01 - .4%	15
254-976	0.4% - 2%	15
1,089 - 1,921	2 - 3%	14
1,952 - 3,349	3 - 6%	12

Source: Will Daspit, PacFIN database

Testimony of Rob Zuanich
Purse Seine Vessel Owners Association
CPS Management, Item E (1) --Limited Entry

REQUEST: ***Adopt an emergency regulation to***

(1) Extend the December 31, 2000 deadline for transferring a CPS limited entry permits to those persons holding a California market squid permit, and

(2) Provide after December 31, 2000 that the CPS permit can only be transferred to a vessel of comparable capacity. This requirement would be consistent with current California law that prohibits the issuing of a squid permit to a vessel of greater (not comparable) capacity.

In 1998 we strongly opposed this Council's adoption of a limited entry scheme under the CPS Fishery Management Plan. We did so for two reasons:

1. There was no showing that the CPS fishing fleet was overcapitalized and the sardine resource was then, and still remains, underutilized.

2. The CPS plan failed to consider the development of parallel-licensing scheme for squid--yet there was no dispute that squid and sardines were part of an economic package or unit for the fishing fleet. Both fisheries involve the same type of fishing vessel and number of crew, and utilize the same type of fishing gear. Squid was then and still remains the leading commercial fish species in California. The need or appropriateness of a CPS limited entry plan should have been reconciled in concert with squid. By not doing so, we now have a patchwork licensing scheme that disadvantages a majority of California fishermen and discourages new investment in the fisheries.

Earlier this year asked that this Council extend the permit transfer deadline. To date, the only response is that the question should wait for the establishment of a goal for the CPS fishery. This is nothing more than intellectual virtuosity. Can anyone articulate for me what major goals were not addressed in the current CPS plan? By allowing this very limited extension on transferability we accomplish the following:

1. Provide current CPS permit holders, who no longer wish to participate in the CPS fishing, an ongoing opportunity to sell the permit.

2. Remove this unnecessary barrier to allow for an orderly transition in the CPS and squid fisheries. Otherwise, we ignore the reality that participation in multiple fisheries is crucial to preserve a healthy and independent small boat fishing.

Exhibit E.1.a
Supplemental CPSMT Report
November 2000

COASTAL PELAGIC SPECIES MANAGEMENT TEAM STATEMENT ON LIMITED ENTRY FISHERY ISSUES: CAPACITY GOAL AND PERMIT TRANSFERABILITY

The Coastal Pelagic Species Management Team (CPSMT) addressed concerns expressed by the Council on a target fleet for the CPS finfish fishery in terms of number of vessels and corresponding harvesting capacity. The CPSMT reviewed a technological-economic, data envelopment analysis (DEA) of fleet harvesting capacity in the Pacific coast coastal pelagic species finfish fishery (Appendix to CPSMT Report), which was undertaken in conjunction with the National Marine Fisheries Service's evaluation of harvesting capacity in fisheries under national Fishery Management Plans. The technological-economic DEA highlighted the dynamic nature of annual harvesting capacity in the CPS finfish fishery, primarily due to the inherent variability in CPS resource abundance, heterogeneous vessels, alternative fishing opportunities and instability in CPS markets. DEA was also used to approximate an engineering (physical) measure of finfish harvesting capacity which suggested that the current fleet of 64 vessels has sufficient physical capacity to take the maximum expected CPS finfish harvest guideline in any given year.

Based on the findings from the DEA, and the difficulties of predicting finfish maximum sustainable yields and future market conditions, the CPSMT was unable to come up with a specific recommendation for what the CPS finfish fishery should "look like" in terms of an optimal number of vessels with a harvesting capacity that represents a realistically sustainable maximum level of output. Nonetheless, the Team did agree to a range of options that could serve as Council or Industry goals for the fishery:

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

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");

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 Team recognized that achievement of an optimal CPS fleet is contingent on harmonizing the CPS finfish limited entry program with California's pending market squid limited entry program. The CPSMT proposed several options to alleviate this conflict at the Council's June, 2000 meeting (Supplemental CPSMT Report F.5., June 2000). The Team's preferred option then, and now, would extend the current permit transfer window two years from the current closing date, December 31, 2000. Loosening finfish and squid permit transferability constraints would allow an optimal CPS fleet to evolve based on Industry's expectations of future conditions in the fishery.

The CPSMT has no recommendations at this time pertaining to procedures for issuing new finfish permits, and transferability of permits after the finfish capacity "goal" is attained.

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Appendix to CPSMT Report – Exhibit E.1.a.

Assessing Fleet Harvesting Capacity in the Pacific Coast Coastal Pelagics Species Finfish Fishery

Samuel F. Herrick, Jr.
National Marine Fisheries Service
Southwest Fisheries Science Center
P.O. Box 271
8604 La Jolla Shores Drive
La Jolla, CA 92038
Voice (858)546-7111
FAX (858)546-7003
Email Sam.Herrick@noaa.gov

Dale Squires
Southwest Fisheries Science Center

James E. Kirkley
Virginia Institute of Marine Science

Donna Dealy
Southwest Fisheries Science Center

Marci Yaremko
California Department of Fish and Game

August, 2000

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1. Introduction

The Pacific Fishery Management Council's (Council) fishery management plan (FMP) for Pacific coast coastal pelagic species (CPS), which includes Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), Pacific (chub) mackerel (*Scomber japonicus*), northern anchovy *(Engraulis mordax*), and market squid (*Loligo opalescens*) was implemented on December 15, 1999. The CPS plan was developed to provide comprehensive management of CPS primarily in response to a resurgence of Pacific sardine along the Pacific coast and an increase in the demand for market squid.

The CPS FMP includes a limited entry program for coastal pelagic finfish species (P. mackerel, Pacific sardine, jack mackerel, and northern anchovy) south of 39° N latitude. An important advantage in implementing the CPS FMP with limited entry, is that future increases in capacity of the CPS finfish fishery could be managed before problems arise. It was deemed likely that the CPS fishery would become overcapitalized faster than management authorities could react if sardine, or other CPS, increased in abundance or markets expanded.

The Council considered several CPS finfish limited entry fleet size options based on a proportion of total CPS finfish landings south of 39° N latitude during a 1993-97 window period (Pacific Fishery Management Council 1999). The preferred option was for a limited entry fleet consisting of the 70 vessels that accounted for 99% of total CPS finfish landings during the window period.[1] While the Council recognized the optimal fleet size was likely smaller, the 70 vessel fleet was considered less disruptive in terms of displacing vessels from the fishery and to reduce impacts on existing fishing patterns and, therefore, on fishing communities.[2]

This paper addresses the measurement of harvesting capacity and capacity utilization (CU) for the 70 vessels expected to initially constitute the CPS limited entry finfish fleet. Capacity and capacity utilization estimates for these vessels will provide the Council with useful information regarding a target fleet size and configuration given expectations concerning rates of fleet attrition, future resource abundance and market demand.

The definition and measurement of harvesting capacity used in this paper draws heavily on recent work by Kirkley and Squires (1998, 1999), discussions from the Breakout Group on defining and measuring fishing capacity in the FAO Technical Working Group (TWG) on the Management of Fishing Capacity, La Jolla, USA, 15-18 April 1998 (FAO 1998a), the U.S. NMFS National Capacity Management Team meeting, La Jolla, 25-26 January 1999, the U.S. NMFS workshop on Assessing Efficiency and Capacity in Fisheries, Silver Spring, 29 September - 1 October 1999, and the FAO Technical Consultation on Measuring Fishing Capacity in Mexico City, November 29 - December 3, 1999 (FAO 2000). Accordingly, capacity is a short-run concept, where firms face short-run constraints, the stock of capital or other fixed inputs,[3] existing regulations, the state of technology, and other technological constraints. Given these constraints and the peculiarities of commercial fisheries, fish harvesting capacity represents the maximal or expected harvest that variable inputs are capable of producing given the observed capital stock, other vessel characteristics, the state of technology, and the resource stock (Kirkley and Squires 1999).

In fisheries, we actually consider the maximum potential nominal catch or maximal level of landings. Rarely is it possible to know what is actually caught and discarded at sea. The definition adopted by the TWG Break-Out Group is (FAO 1998) is, "Fishing capacity is the maximum amount of fish over a period of time (year, season) that can be produced by a fishing fleet if fully-utilized, given the biomass and age structure of the fish stock and the present state of the technology. Fishing capacity is the ability of a vessel or fleet of vessels to catch fish." This definition was adopted by the U.S. National Marine Fisheries Service Capacity Management Team and a very closely related one was adopted by the U.S. Congressional Task Force on Subsidies and Investment in Fisheries, and the FAO Technical Consultation on Measuring Fishing Capacity.

Capacity can be measured following either a technological-economic approach or explicitly predicated on economic optimization from microeconomic theory (Morrison 1985, 1993, Nelson 1989). This paper adopts the former because a lack of cost data for the CPS finfish fishery precludes estimation of cost or profit functions used to derive economic measures of capacity and capacity utilization. Johansen (Färe *et al.* 1989, 1994) defined capacity for the technological-economic approach as, "...the maximum amount that can be produced per unit of time with existing plant and equipment, provided the availability of variable factors of production is not restricted." Capacity output thus represents the maximum level of production the fixed inputs are capable of supporting. This concept of capacity represents a realistically sustainable maximum level of output rather than some higher unsustainable short-term maximum (Klein and Long 1973).

The technological-economic approach gives an endogenous output and incorporates the firm's *ex ante* short-run optimization behavior for the existing production technology (given full utilization of the variable inputs). Thus it indirectly captures the influences of changes in economic variables but is not explicitly based on economic optimization.

The balance of the paper is organized as follows. The next section discusses measurement of harvesting capacity in fisheries. Section 3 specifies the empirical model and discusses the data. Section 4 discusses the empirical results and policy implications, and section 5 provides concluding remarks.

2. Measuring Harvesting Capacity in Fisheries

The most promising, tractable means of measuring fishing capacity corresponding to the technological-economic definition of capacity are the "peak-to-peak" method of Klein (1960), and the data envelopment analysis (DEA) approach developed by Färe *et al.* (1989, 1994) and proposed for fisheries by Kirkley and Squires (1998). Both approaches are nonparametric. The strictly economic approach is well developed in Morrison (1985, 1993), Nelson (1989), Segerson and Squires (1990, 1995), Squires (1987), and Kim (in press), and hence is not further discussed here.

The peak-to-peak approach is best suited when data are especially parsimonious, such as when the data are limited to catch and numbers of vessels.[4] The approach permits determining the capacity output and potential level of capital to reduce in decommissioning schemes, although it does not indicate the actual operating units to be decommissioned (Kirkley and Squires 1999). Ballard and Roberts (1977) and Garcia and Newton (1997) are the key fisheries applications.

2.1 Data Envelopment Analysis

DEA is a nonparametric or mathematical programming technique to determine optimal solutions given a set of constraints. DEA can be used to calculate capacity and CU using the approach of Färe *et al.* (1989, 1994). The DEA approach determines the maximal or capacity output given that the variable factors are unbounded or unrestrained and only the fixed factors and state of technology constrain output. The maximum possible output or capacity corresponds to the output which could be produced given full and efficient utilization of variable inputs, but constrained by the fixed factors, the state of technology, and when included, the resource stock(s).

DEA has several unique advantages (Kirkley and Squires 1998, 1999). DEA can estimate capacity under constraints including TACs, bycatch (incidental catch of species other than those intended), regional and/or size distributions of vessels, restrictions on fishing time, and socio-economic concerns such as minimum employment levels. DEA readily accommodates multiple outputs and multiple inputs. DEA effectively converts joint outputs (multispecies harvesting) into a single composite output and multiple fixed factors (heterogeneous capital stock) into a single composite fixed factor (Segerson and Squires 1990). DEA can also determine the maximum potential level of effort or variable inputs in general and their optimal utilization rate, corresponding to full capacity output. The analysis accepts virtually all data possibilities, ranging from the most parsimonious (catch levels, number of trips, and vessel numbers) to the most complete (a full suite of cost data). With cost data, DEA can be used to estimate the least-cost (cost minimizing) number of vessels and fleet configuration. DEA allows either an input-oriented (inputs are allowed to change while output is held constant) or an output-oriented (output is allowed to change while inputs are held constant) approach.

Other issues which could be considered within the DEA framework include calculation of capacity output under various bycatch mitigation or habitat restoration policies. Adding bycatch simply requires reformulating the problem such that bycatch is treated as an undesirable joint output -- a "bad". Vessel decommissioning in capacity reduction programs can be directly addressed using the DEA approach (Kirkley and Squires 1998, 1999). Because DEA can be either output-oriented or input-oriented, different aspects of vessel decommissioning can be addressed. The input-based measure considers how inputs may be reduced relative to a desired output level, such as a TAC. Hence, it would allow determining the optimal vessel or fleet configuration and actual vessels which should be decommissioned in a fishery corresponding to a TAC.

The output-oriented DEA measure allows fishery managers to identify the level of capacity output for the fishery, and the vessels which would maximize output subject to full utilization of variable inputs and fixed factors and (optionally) resource constraints. Hence, it can be used to identify operating units (individual vessels or vessel size classes) which can be decommissioned. By rearranging observations in terms of some criterion, such as capacity by region and vessel size class, the number of operating units can be determined by adding the capacity of each operating unit until the total reaches the target.

2.2 The DEA Framework

Following Färe *et al.* (1989), let there be $j = 1,\ldots,J$ observations or firms in an industry producing a scalar output $\mu^j \in R_+$ by using a vector of inputs $x^j \in R^N_+$. We also assume that for each

$n,\quad \sum_{j=1}^{J} x_n^j \rangle 0,\quad$ and for each $j,\ \sum_{n=1}^{N} x_n^j \rangle 0).$

The first assumption states that each input n is used by some firm j. The second assumption indicates that each firm uses some input. A remaining assumption is that each firm produces some output, $u^j > 0$ for all j.

The following output-oriented DEA problem calculates Johansen's notion of capacity (Färe *et al.* 1989, 1994):

$$\max_{\theta\lambda z} \theta$$

$$\text{s.t. } \theta\, u_1 \le \sum_{j=1}^{J} z_j u_j\,,\ \sum_{j=1}^{J} z_j x_{jn} \le x_{jn}\,, n \in \alpha \qquad [1]$$

$$\sum_{j=l}^{J} z_j x_{jn} = \lambda_{jn} x_{jn}\,, n \in \alpha^{\wedge}$$

and $z_j \ge 0$, $j = 1,2,\ldots, J$ *and* $\lambda_{jn} \ge 0,\ n \in \alpha^{\wedge}$. The variable factors are denoted by $\alpha^{\wedge}$, the fixed factors are denoted by α, and the z_j define the reference technology. Problem (1) enables full utilization of the variable inputs and constrains output with the fixed factors. Moreover, the vector λ is a measure of the ratio of the optimal use of the variable inputs (Färe *et al.* 1989, 1994). λ gives the capacity utilization rate of the n^{th} variable input for the j^{th} firm for $x_{jn} > 0$, $n \in \alpha^{\wedge}$. Problem (1) imposes constant returns to scale, but it is a simple matter to impose variable returns to scale (i.e., variable returns to scale requires the convexity constraint $\sum_{j=1}^{J} z_j = 1$.

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Problem (1) provides a measure of technical efficiency (TE), θ_1, which corresponds to full capacity production. The parameter θ is an output-oriented measure of technical efficiency[5] relative to capacity production, $\theta \geq 1.0$. It provides a measure of the possible (radial) increase in output if firms operate efficiently given the fixed factors, and their production is not limited by the availability of the variable factors of production (e.g., a θ value of 1.50 indicates that the capacity output equals 1.5 times the current observed output). If * denotes an optimum, then $\theta^*_j\,\mu^j$ equals the maximum amount of μ^j that can be produced given observed levels of fixed factors α and full utilization of variable inputs $\alpha^\wedge$ – capacity output for output μ^j.

3. Empirical Application: The Pacific Coast Coastal Pelagics Species Finfish Fishery

The Pacific coast fishery for CPS finfish occur mainly off California. However, with the resurgence of Pacific sardine, fishing has increased in Oregon and Washington. Vessels using round haul gear (purse seines, drum seines, lampara nets, and dip nets.) are responsible for 99% of CPS total landings and revenues in any given year. Sardine, P. mackerel and anchovy are typically targeted and harvested separately, and all three species can be harvested on the same trip. Occasionally mixed schools are encountered. Squid is an important source of income for many round haul vessels that also target CPS finfish.

Sardines are showing signs of recovery after the fishery's collapse in the 1940s, with an apparent population increase of 30% to 40% per year over the past decade. Market squid landings have increased substantially over the same period, while market and biological conditions are contributing to declining landings of anchovy and P. mackerel. Jack mackerel, less preferred than P. mackerel, are difficult to take in purse seines and are distributed offshore and north of traditional fishing grounds. In addition to fishing for CPS, many of these vessels also target Pacific bonito, bluefin tuna, and Pacific herring.

3.1 Conditions and Assumptions

The technological-economic approach, as applied to our assessment of fleet harvesting capacity in the Pacific coast CPS finfish fishery, implicitly incorporates each vessel's *ex ante* short-run optimization behavior for the existing production technology (given full utilization of the variable inputs). Thus our estimates of harvesting capacity are tempered by each vessel's short-run operational strategies with regard to changes in resource stocks, markets and the regulatory environment.

We note that DEA only considers radial expansions of outputs. CPS vessels harvest a number of different species, where the choice of output to a great extent is dictated by relative economic conditions. For example, changes in the exvessel price or quantity harvested of P. mackerel likely affects the quantity harvested of sardine. When there are economic interactions among the outputs (i.e. joint production) capacity and CU should not be calculated separately for each species, but jointly. In this case, a radial measure of output does not generally exist. To overcome this DEA effectively converts the multiple products into a single composite output by imposing fixed proportions production on outputs.

We treated the stocks of anchovy, P. mackerel and sardine as natural capital stocks (i.e.

as fixed inputs). This is consistent with the notion that capacity and CU are short-run measures. Each species output flows from a corresponding resource stock. The estimates of capacity and CU can be made conditional upon the existing (or target) resource stocks, given a single stock of man-made capital. The resource stocks can alternatively be conceived as technological constraints, like the state of technology, and capacity and CU measured conditional upon their levels. Either conceptualization of the resource stocks gives equivalent empirical results.

3.2 Data and Input Specifications

The panel data set for the vessels expected to qualify [6] for finfish limited entry permits under the FMP criteria contains trip-level observations on output and measures for vessel fixed factors for the 1993-97 period. Landings data for sardine, P. mackerel and anchovy were obtained from the PacFIN Management Database which are compiled from Washington, Oregon and California landings receipts. Output is measured in terms of metric tons of sardine, P. mackerel and anchovy landed per trip over the 1993-97 period, the landings qualifying limited entry window period.

Data on fixed factors are available from Coast Guard Documentation files and State Vessel Registration files. Vessel length in feet, gross registered tonnage (GRT) and engine horsepower were fixed factors considered in the analysis. However, because of discrepancies in measures of vessel GRT between Coast Guard Documentation and State Vessel Registration files and missing observations for engine horsepower, and because there were consistent measures of vessel length between the two files for the 69 expected qualifying vessels, vessel length was the fixed factor used in the analysis. Vessel level variable input data - - labor hours, fuel consumption, expendable gear, etc. - - were not available for the analysis.

The 69 vessels expected to qualify for finfish limited entry permits ranged in length from 21 to 82 feet, with 50 feet as the mode of the vessel length distribution (Figure 1). For purposes of confidentiality of analytical results, vessels were categorized by length. Less than 100 percent of the expected qualifiers had CPS finfish landings in any year of the period (Table 1). Based on the number of trips per vessel for the 1993-97 period, expected qualifiers averaged 32 trips per year, with vessels in the 20-34 foot length category averaging a low of 15 trips per year and vessels in the 65-69 foot length category averaging a high of 57 trips per year (Table 2). Vessels 60 feet or greater in length had the highest landings of sardine and P. mackerel per trip during the period, while vessels less than 60 feet in length had the highest landings of anchovy per trip over the period (Table 3).

3.3 Full Variable Input Utilization

Full variable input utilization (Problem 1) harvesting capacity was calculated for expected finfish qualifiers based on their annual anchovy, P. mackerel and sardine landings per trip over the 1993-97 period. Problem 1 was solved for the active vessels in each year using one fixed input, vessel length, and three outputs, average landings of anchovy, P. mackerel and sardine per trip for each year of the period. Each annual DEA solution determined which of the active vessels, in terms of vessel length, comprise the best-practice frontier and also provided an output oriented measure of technical efficiency relative to capacity output for each vessel. Multiplying each vessel's average output per trip of each species by its output oriented TE measure gives its corresponding capacity output per species per trip.

To expand the per trip measures of vessel capacity to an annual measure, we multiplied each vessel's estimated capacity output per species per trip by its number of trips annually. Annual fleet capacity for each species is then the sum of the individual vessel capacities. Capacity utilization was calculated as the ratio of actual output to full variable input utilization harvesting capacity.[7]

4. Annual Capacity and Capacity Utilization in the CPS Finfish Fishery

4.1 Active Capacity

Solutions to the DEA problem indicate a high degree of variability in technical efficiency within and between length categories for active vessels over the 1993-97 period (Figure 2, Table 4). Within each length category, there was considerable variability in landings per trip among vessels each year (Table 3), which gives rise to extremes in TE measures within each category year-to-year (Figure 2). Moreover, there appeared to be a greater propensity for this variability within the length categories, less than 60 feet, where the range of vessel lengths within length categories tends to be greater (Figure 1), and the number of vessels that are active on an annual basis is more variable (Table 1).

This pattern of variability carried over to estimates of vessel trip capacity for each species, observed average output per trip, per vessel multiplied by its measure of TE given full variable input utilization (Table 5). In terms of total capacity output per trip over the period, no vessel came close to meeting the 125 mt CPS finfish trip limit established in the FMP.

Annual capacity estimates for each species were generally increasing over the period (Table 6). This had a lot to do with an increase in the number of active vessels (Table 1) over the period, an increase in the number of trips for most vessels (Table 2), and an increase in sardine abundance. In all years, annual anchovy, P. mackerel and sardine capacity for active vessels exceeded their actual landings, and in most years capacity exceeded the annual quota for each species, indicating excess capacity, although the exception was anchovy (Table 6). Vessels operating at full capacity could have increased their total production 21 percent in 1993, 50 percent in 1994, 36 percent in 1995, 40 percent in 1996 and 40 percent in 1997.

4.2 Latent Capacity

The definition and measurement of capacity and capacity utilization depend on the universe of potentially active participants, i.e. which vessels to include in the industry. The great mobility of vessels -- the capital stock -- complicates defining the participating vessels. Most fishing industries have a core of active participants, some more active than others. However, there are often potential participants that fish elsewhere or on other species that are currently inactive, or active only at low levels of variable input utilization, but which could suddenly actively participate if resource stock, market conditions, or regulations change. The number of potential participants and the duration and intensity of operations of potential and existing participants lead to the issue of "latent capacity". Latent capacity could be estimated attributing the full variable input utilization rates of active participants to the currently partially or fully inactive participants and using their capital stock information. In our analysis, this task was made somewhat easier because the universe of potentially active participants consisted of only those vessels expected to qualify for a limited entry finfish permit.

To estimate the potential capacity of inactive expected qualifiers (vessels without landings) in each year of the 1993-97 period we first assigned each inactive vessel in each year to its appropriate length category (Table 1). We then found its corresponding average capacity output per trip for each species (Table 5) and average trips per year (Table 3). Each inactive vessel's potential capacity over the period was the product of average capacity output per trip, and average trips per year for the corresponding length category. Annual latent capacity for each species was the sum of potential annual capacity output for all inactive vessels (Table 6). Annual potential capacity was the sum of active capacity estimates and latent capacity estimates (Table 6). In all years, estimates of total potential anchovy, P. mackerel and sardine capacity exceeded actual landings and, except for anchovy in 1996 and 1997, exceeded the annual quota for each species (Table 6).

4.3 Capacity Utilization

Annual CU was calculated as actual landings divided by capacity landings for active vessels over the 1993-97 period (Table 7). Overall, we find that average CU, when based on observed output and resource constraints, is quite high, .67 for the period. Larger vessels, 60 feet and longer, tend to operate at higher levels of capacity utilization. Based on total production for the period, CU averaged over .75 for vessels 60 feet and greater and .59 for vessels less than 60 feet in length. Capacity utilization was highest for sardine harvesting, averaging .62 over the period, versus .32 and .50 for anchovy and P. mackerel respectively. For vessels 60 feet and greater, CU was generally increasing over the period.

5. Capacity Output Based on Maximum Observed Finfish Landings Per Trip

We also estimated fleet harvesting based on each expected finfish limited entry qualifier's maximum landings per trip of all finfish species, across all of its trips for the 1993-97 period. Per trip landings of sardine, mackerel and anchovy were aggregated into a single output, finfish. Essentially we impose nonjoint harvesting - - there are no technical or economic interactions among outputs - - which allows us to estimate capacity separately for each species, or for all species combined.

The largest finfish landing of each vessel for the 1993-97 period was specified as the output and the vessel's length was specified as the fixed factor in a data envelopment analysis to evaluate harvest capacity under extreme operating conditions. This case approximates a engineering-technological approach towards deriving a static measure of physical harvesting capacity, where harvesting capacity is the maximum possible output per unit time given the design limitations of the vessel. To the extent that the maximum observed output for at least some vessels corresponds to their maximum possible output, the DEA generates the most widely accepted measure of maximum possible catch, fleet hold capacity. The best practice frontier generated by the DEA simply equates to a technological-physically based measure of the maximum possible catch that could be obtained given full and efficient utilization of all fixed and variable factors and the resource stock does not constrain production.

The DEA provided output oriented TE measures that indicate how much each vessel's finfish output needed to expand to reach the frontier (Table 8). Multiplying each vessel's observed maximum finfish output per trip by its TE measure yields the capacity output per trip that would place it on the best practice frontier (Figure 4). The product of finfish capacity output per trip and number of finfish trips taken by each vessel during the year provides a measure of annual finfish capacity output per vessel, where number of trips was an annual average based on each vessel's participation over the 1993-97 period. The maximum possible harvest by expected finfish qualifiers, based on their maximum observed finfish landing per trip during the 1993-97 period, was 267,584 mt. This amount represents the maximum possible annual harvest of sardine, mackerel or anchovy, or any combination thereof by the 69 vessels expected to qualify for a CPS finfish limited entry permit. This amount is more than twice the largest aggregate annual finfish quota for the period, 125,276 mt in 1997 (Table 6).

6. Concluding Remarks

The DEA approach was used to calculate annual harvesting capacity in the CPS finfish fishery for those vessels expected to qualify for a finfish limited entry permit. DEA provides a technological-economic measure of capacity corresponding to the output which could be produced given full and efficient utilization of variable inputs, but constrained by the fixed factors, the state of technology, and the resource stock(s), and implicitly accounting for economic conditions affecting a vessel's operations. In this sense, CPS finfish harvesting capacity represents that level of landings produced in accordance with achieving some underlying behavioral objective (e.g. profit or revenue maximization) and operating under "normal operating conditions". These technological-economic measures of capacity differed from our approximation of a static, purely technological or physical measure of capacity based on "extreme operating conditions".

Annual estimates of CPS finfish capacity and CU, for vessels expected to qualify for a limited entry permit in the Pacific coast CPS finfish fishery, exhibited substantial variability over the 1993-97 measurement period. CU measures were consistently less than one indicating that vessels have the potential for greater production without having to incur major expenditures for new capital and equipment. The static, extreme measure of fleet physical harvesting capacity obviously revealed a greater difference between actual and potential aggregate output for the existing capital and equipment.

Substantial variability in annual harvest capacity of sardine, mackerel and anchovy should not be unexpected for several reasons. First, there is a high degree of natural variability in the stock sizes of CPS finfish species (e.g., annual P. mackerel quotas based on biomass estimates range from 7,615 mt to 18,307 mt over the period). The CPS fleet is able to adapt to changes in available harvest and abundance by targeting alternate CPS and non-CPS species which contributes to variability in landings and harvesting capacity across species and across vessels from year to year. When stocks are not evenly distributed over time and place, harvests on occasion, can be large but infrequent. Under these conditions vessels may be designed with extra harvesting capacity, i.e. above that corresponding to normal operating conditions, to accommodate peak period harvests.

This is analogous to the peak load problem encountered by utilities, where power plants have built in excess capacity to satisfy energy requirements during times of extreme demand. Estimates of harvesting capacity based on each vessel's maximum observed aggregate output per trip indicates the fleets maximum physical production capability which may be utilized in times of extreme resource availability.

Second, there are not always ready markets for all the CPS finfish that may be available for harvest. Most CPS finfish species harvested off the Pacific coast are destined for foreign markets, and thus compete with a number of international sources of supply. Therefore harvests of Pacific coast CPS finfish are subject to conditions in the international CPS markets, as well as vagaries in global resource stocks and the harvesting capacity of foreign fleets. This uncertainty gives rise to different purchasing arrangements between individual vessels and domestic buyers of CPS finfish, which contributes to the variability in capacity and CU within the CPS fleet.

Third, based on the vessel attributes that were considered when determining which fixed inputs to use in the analysis, there appears to be a high degree of vessel heterogeneity within the fleet of expected qualifiers. This means inherent differences in harvesting capacity among vessels comprising the fleet. Another factor which could strongly influence a vessel's technical efficiency is the managerial skills of the operator "skipper skill". Information on skipper skill (e.g. years of experience) was not available for the analysis.

The natural variability in small pelagics stock abundance and limited finfish markets point to the difficulty in trying to estimate harvesting capacity under "normal operating conditions". Normal operating conditions take into account short-run, natural fluctuations in the size of the CPS finfish resource stocks and inconsistency in the markets for CPS finfish, and indicate the necessity of a high degree of flexibility in individual vessel operations. Because of this flexibility annual harvesting capacity for any one species could be increased by redirecting effort (number of trips) from one species to another. For example, the 2000 sardine quota is 186,791 mt, far in excess of the highest total potential annual sardine capacity estimated for the period, 68,299 mt in 1997. However, if all of the effort in 1997 were directed towards sardine, potential sardine capacity would approach 106,000 mt. On the other hand, if the expected limited entry fleet were to harvest at its maximum possible level, 267,584 mt per year, there would be ample physical capacity to utilize the entire 1997 sardine quota. Nevertheless, the instability in resource availability and exvessel markets make the notion of some level of sustainable capacity under normal operating conditions, i.e. an "optimum" fleet size, largely untenable for the Pacific coast CPS finfish fishery.

The third factor is somewhat mitigating with respect to the first two, in that a more sustainable CPS finfish harvesting capacity might be achieved by reconfiguring the fleet towards fewer, larger vessels. Indeed, this may be occurring in the first year (2000) of the finfish limited entry program during which there is unconstrained transferability of permits. To date several permits have been transferred to bigger, newer vessels with advanced refrigeration systems. Industry contends that an upgraded fleet capable of consistently providing a high quality product in reliable quantities would greatly enhance efforts to establish a permanent presence in the global market for CPS finfish. Based on normal operating conditions in 1997, a fleet of 58 vessels in the 75-85 foot range would be capable of harvesting the sardine quota for 2000. In 1997 there were only eight such vessels among those expected to qualify for a CPS finfish limited entry permit.

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Based on capacity estimates reflecting extreme operating conditions over the 1993-97 period, the number of vessels in the 75-85 foot range required to take the 2000 sardine quota would be 23.

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Table 1. Number of vessels expected to qualify for finfish limited entry permits by length category, 1993-97.

	Length Category (ft)									
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85	Total
					Vessels with landings (Active)					
1993	2	3	4	8	6	3	4	8	5	43
1994	2	4	3	7	5	3	4	6	5	39
1995	1	5	5	11	7	4	5	6	5	49
1996	2	5	5	11	7	4	4	6	6	50
1997	2	5	8	12	7	4	4	7	8	57
					Vessels Without Landings (Inactive)					
1993	3	4	6	6	2	1	1	0	3	26
1994	3	3	7	7	3	1	1	2	3	30
1995	4	2	5	3	1	0	0	2	3	20
1996	3	2	5	3	1	0	1	2	2	19
1997	3	2	2	2	1	0	1	1	0	12
					Total Vessels					
1993-97	5	7	10	14	8	4	5	8	8	69

Table 2. Average and maximum number of annual finfish trips by vessels expected to qualify for finfish limited entry permit across length categories, 1993-97.

	Length Category (ft)								
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
1993	26	30	9	19	38	16	44	41	46
1994	40	39	19	9	47	33	49	22	44
1995	13	29	19	14	52	28	65	58	67
1996	4	41	40	15	47	42	56	39	56
1997	8	52	24	21	37	55	74	41	67

Table 3. Average landings (mt) per trip by vessels expected to qualify for finfish limited entry permit across length categories, 1993-97.

	Length Category (ft)								
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
					Anchovy				
1993	1.91	1.91	0.55	3.16	2.33	3.60	0.38	0.00	2.72
1994	1.06	0.62	1.17	3.06	9.18	1.74	0.02	0.00	2.27
1995	0.00	0.73	1.13	0.53	1.89	1.28	1.30	0.28	1.49
1996	8.75	2.39	1.61	1.16	1.56	4.31	1.81	0.37	2.75
1997	4.29	0.49	1.31	0.81	1.81	1.40	1.00	0.30	3.64
					Pacific Mackerel				
1993	0.18	0.67	1.52	1.70	5.48	0.81	10.19	12.30	12.86
1994	0.25	0.88	2.96	3.57	5.47	6.55	12.59	10.99	10.52
1995	0.23	0.31	0.73	1.39	1.35	4.13	7.45	8.58	5.06
1996	0.25	0.44	1.06	1.94	3.98	3.25	6.76	5.53	7.04
1997	0.00	1.18	4.20	5.75	4.53	4.83	11.76	12.39	10.22
					Sardine				
1993	0.12	4.81	6.95	7.17	4.46	13.95	11.42	16.79	18.11
1994	0.11	5.35	2.47	7.56	4.87	14.14	10.35	14.41	14.17
1995	0.15	10.34	8.32	11.12	12.79	19.84	18.73	29.18	30.39
1996	8.17	3.78	11.55	17.49	11.19	22.18	18.86	23.11	27.99
1997	16.31	8.71	12.99	10.23	14.34	21.05	21.80	19.03	26.72
					Total				
1993	2.21	7.39	9.02	12.04	12.28	18.36	21.99	29.09	33.69
1994	1.42	6.85	6.60	14.19	19.52	22.42	22.97	25.40	26.96
1995	0.38	11.39	10.18	13.03	16.03	25.25	27.48	38.04	36.94
1996	17.17	6.62	14.22	20.58	16.73	29.74	27.43	29.01	37.78
1997	20.60	10.38	18.50	16.79	20.67	27.28	34.57	31.72	40.58

Table 4. Average measures of output oriented technical efficiency per trip for vessels expected to qualify for finfish limited entry permits by length category, 1993-97.

	Length Category (ft)								
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
1993	1.29	2.13	2.61	7.41	2.64	1.29	1.75	1.20	1.04
1994	1.35	2.91	7.63	21.90	6.40	1.40	1.42	1.34	1.35
1995	1.00	1.36	2.22	20.62	2.36	2.10	1.38	1.24	1.29
1996	4.13	4.47	4.30	5.64	10.45	1.36	1.52	1.86	1.14
1997	1.00	4.17	5.58	4.59	2.81	1.73	1.41	1.82	1.23

[1]This is an output-oriented measure of technical efficiency, where full TE equals one. The further from one,
the less technically efficient a vessel is.

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Table 5. Average capacity landings (mt) per trip by vessels expected to qualify for finfish limited entry permits by length category, 1993-97.

	Length Category (ft)								
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
Anchovy									
1993	1.91	4.09	2.34	4.71	4.00	4.70	1.30	0.00	2.72
1994	1.06	3.57	8.11	5.49	17.32	2.58	0.03	0.00	2.79
1995	0.00	0.78	2.08	0.61	3.21	1.60	1.59	0.33	1.50
1996	8.75	8.12	8.11	1.29	6.69	4.46	3.40	0.79	2.79
1997	4.29	2.50	4.18	2.09	5.17	1.83	1.45	0.59	3.74
Pacific Mackerel									
1993	0.28	0.67	2.55	3.03	7.40	1.15	11.89	13.78	13.51
1994	0.43	1.60	3.99	4.30	6.95	8.13	15.55	14.55	13.87
1995	0.23	0.42	1.74	3.56	1.94	5.39	9.18	10.30	6.28
1996	1.81	2.20	1.72	3.63	6.05	4.34	9.62	7.11	7.83
1997	0.00	3.96	5.26	10.36	6.52	7.80	16.13	16.80	12.47
Sardine									
1993	0.19	5.95	9.93	9.99	6.65	17.80	16.78	20.32	18.79
1994	0.19	6.34	8.66	17.51	8.99	20.50	15.03	17.00	18.10
1995	0.15	12.65	13.66	21.94	22.42	31.07	27.17	35.16	39.26
1996	8.17	11.85	18.02	30.06	16.21	29.95	27.74	34.28	31.72
1997	16.31	19.10	20.58	21.33	21.65	33.84	30.13	28.82	31.63
Total									
1993	2.38	10.71	14.81	17.73	18.05	23.65	29.96	34.10	35.02
1994	1.68	11.51	20.76	27.31	33.26	31.21	30.60	31.54	34.76
1995	0.38	13.85	17.48	26.11	27.58	38.06	37.94	45.79	47.04
1996	18.73	22.17	27.84	34.98	28.95	38.76	40.76	42.18	42.35
1997	20.60	25.55	30.02	33.78	33.35	43.47	47.71	46.21	47.83

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Table 6. Annual capacity estimates and actual landings for fleet of vessels expected to qualify for finfish limited entry permits, 1993-97.

Year	Anchovy	P. Mackerel	Sardine	Total
		Vessels with Landings (Active)[1]		
1993	3,379	13,143	18,570	35,092
1994	6,486	12,110	15,838	34,435
1995	2,851	11,151	54,463	68,465
1996	8,651	12,248	43,375	64,274
1997	8,079	25,223	59,881	93,183
		Vessels without Landings (Inactive)[2]		
1993	2,117	3,566	6,537	12,220
1994	4,913	5,523	8,865	19,301
1995	771	2,898	16,044	19,713
1996	3,312	2,953	14,489	20,754
1997	961	3,216	8,418	12,594
		Total Potential Capacity[3]		
1993	5,496	16,709	25,107	47,312
1994	11,399	17,633	24,703	53,735
1995	3,622	14,049	70,506	88,177
1996	11,963	15,202	57,864	85,029
1997	9,040	28,439	68,299	105,777
		Actual Landings		
1993	1,882	11,705	15,304	28,892
1994	1,671	9,821	11,506	22,998
1995	1,864	8,438	40,079	50,380
1996	4,363	9,353	32,224	45,939
1997	5,619	18,128	42,728	66,475
		Annual Quota		
1993	4,900	18,307	18,144	41,351
1994	4,900	10,793	9,072	24,765
1995	4,900	9,372	47,305	61,577
1996	66,500	7,615	34,791	108,906
1997	66,500	9,788	48,988	125,276

[1]Based on number of vessels with landings, estimated capacity per trip, number of trips annually.

[2]Based on number of vessels in each length category without landings, and estimates of average capacity per trip in each length category and average number of trips in each length category for active vessels.

[3]Total potential capacity is the sum of capacity estimates for active vessels and capacity estimates for inactive vessels.

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Table 7. Average capacity utilization[1] for vessels expected to qualify for limited entry finfish permits by length category,1993-97.

	Length Category (ft)								
Year	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
Anchovy									
1993	0.50	0.31	0.19	0.42	0.36	0.49	0.07	0.00	0.20
1994	0.50	0.04	0.27	0.37	0.21	0.73	0.20	0.00	0.16
1995	0.00	0.38	0.33	0.19	0.33	0.43	0.43	0.56	0.34
1996	0.50	0.18	0.26	0.08	0.23	0.44	0.32	0.43	0.57
1997	0.50	0.04	0.36	0.16	0.30	0.39	0.56	0.26	0.79
Pacific Mackerel									
1993	0.32	0.33	0.30	0.33	0.61	0.23	0.64	0.85	0.76
1994	0.29	0.28	0.25	0.36	0.40	0.51	0.76	0.79	0.77
1995	1.00	0.32	0.16	0.33	0.27	0.68	0.59	0.83	0.80
1996	0.07	0.17	0.38	0.37	0.48	0.78	0.67	0.64	0.89
1997	0.00	0.30	0.38	0.47	0.29	0.62	0.72	0.69	0.86
Sardine									
1993	0.32	0.64	0.51	0.53	0.39	0.78	0.71	0.85	0.96
1994	0.29	0.54	0.33	0.40	0.40	0.73	0.76	0.70	0.77
1995	1.00	0.68	0.44	0.45	0.58	0.68	0.76	0.83	0.80
1996	0.50	0.22	0.38	0.58	0.49	0.78	0.67	0.68	0.89
1997	1.00	0.34	0.54	0.47	0.48	0.62	0.72	0.69	0.86
Total									
1993	0.82	0.64	0.55	0.63	0.63	0.78	0.71	0.85	0.96
1994	0.79	0.54	0.33	0.54	0.61	0.73	0.76	0.79	0.77
1995	1.00	0.80	0.53	0.45	0.58	0.68	0.76	0.83	0.80
1996	0.57	0.26	0.43	0.58	0.50	0.78	0.67	0.68	0.89
1997	1.00	0.34	0.56	0.47	0.57	0.62	0.72	0.69	0.86

[1]Capacity utilization calculated as the ratio of observed output to the full variable input utilization measure of capacity output.

Table 8. Summary statistics by length category for the DEA analysis of trip capacity for expected finfish qualifiers based on their maximum observed finfish landing over the entire 1993-97 period.

	Length Category (ft)								
Summary Statistic	20-34	35-44	45-49	50-54	55-59	60-64	65-69	70-74	75-85
Average Number of Trips Annually	14	30	24	15	38	37	55	38	53
Average Maximum Landings Per Trip (mt)	24	24	39	43	46	72	83	94	105
Average TE[1]	3.88	5.54	5.98	3.07	5.98	1.82	1.66	1.63	1.60
Average Trip Capacity (mt)	50	82	100	107	118	127	135	142	154
Average Annual Capacity (mt)	845	2,489	2,374	1,606	4,442	4,654	7,407	5,335	8,230

[1]This is an output-oriented measure of technical efficiency, where full TE equals one. The further from one, the less technically efficient a vessel is.

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Figure 1. Distribution of expected finfish Limited Entry Qualifying Vessels by vessel length.

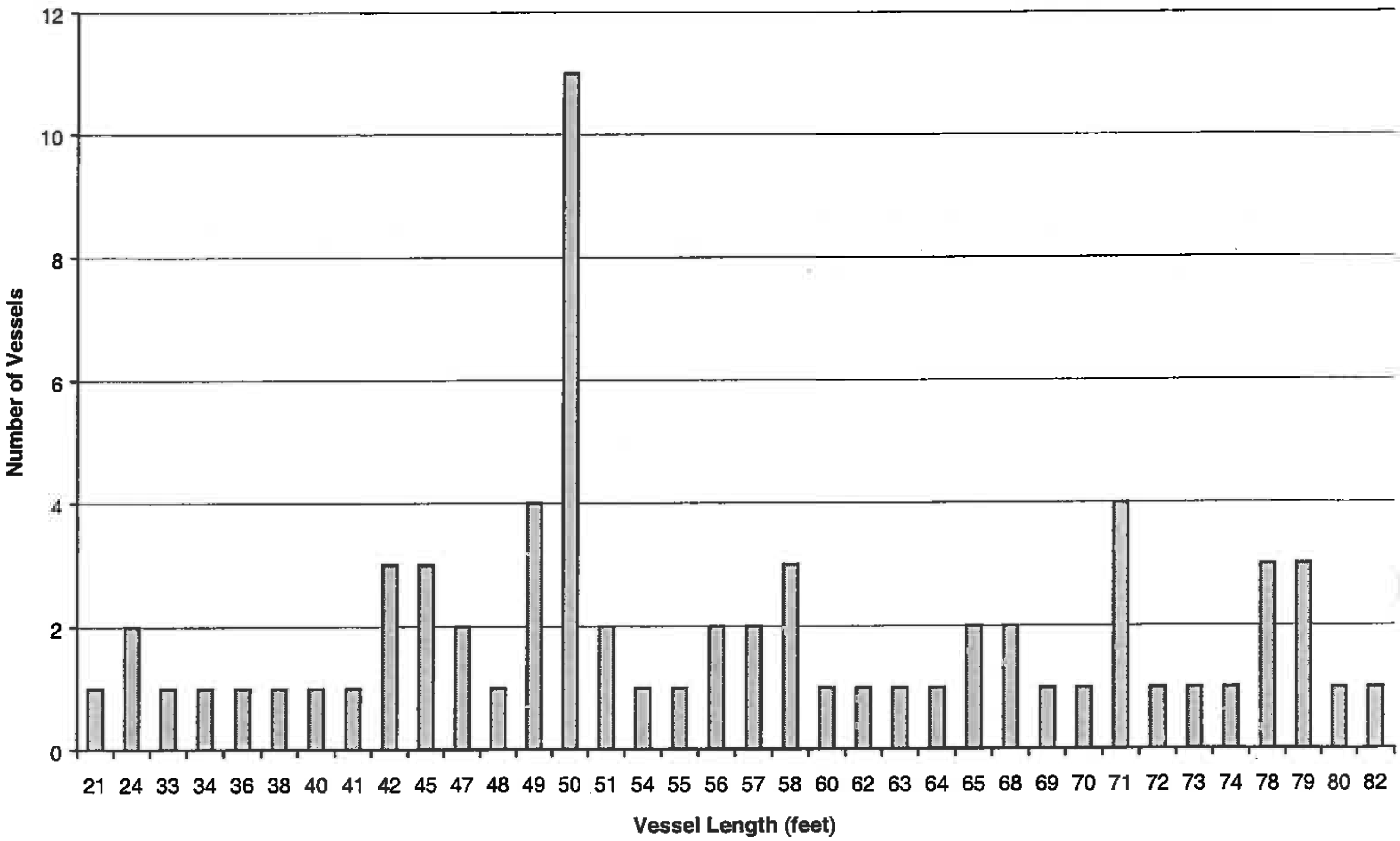

Figure 2. Distribution of vessels expected to qualify for a finfish limited entry permit by technical efficiency and length, 1993-97.

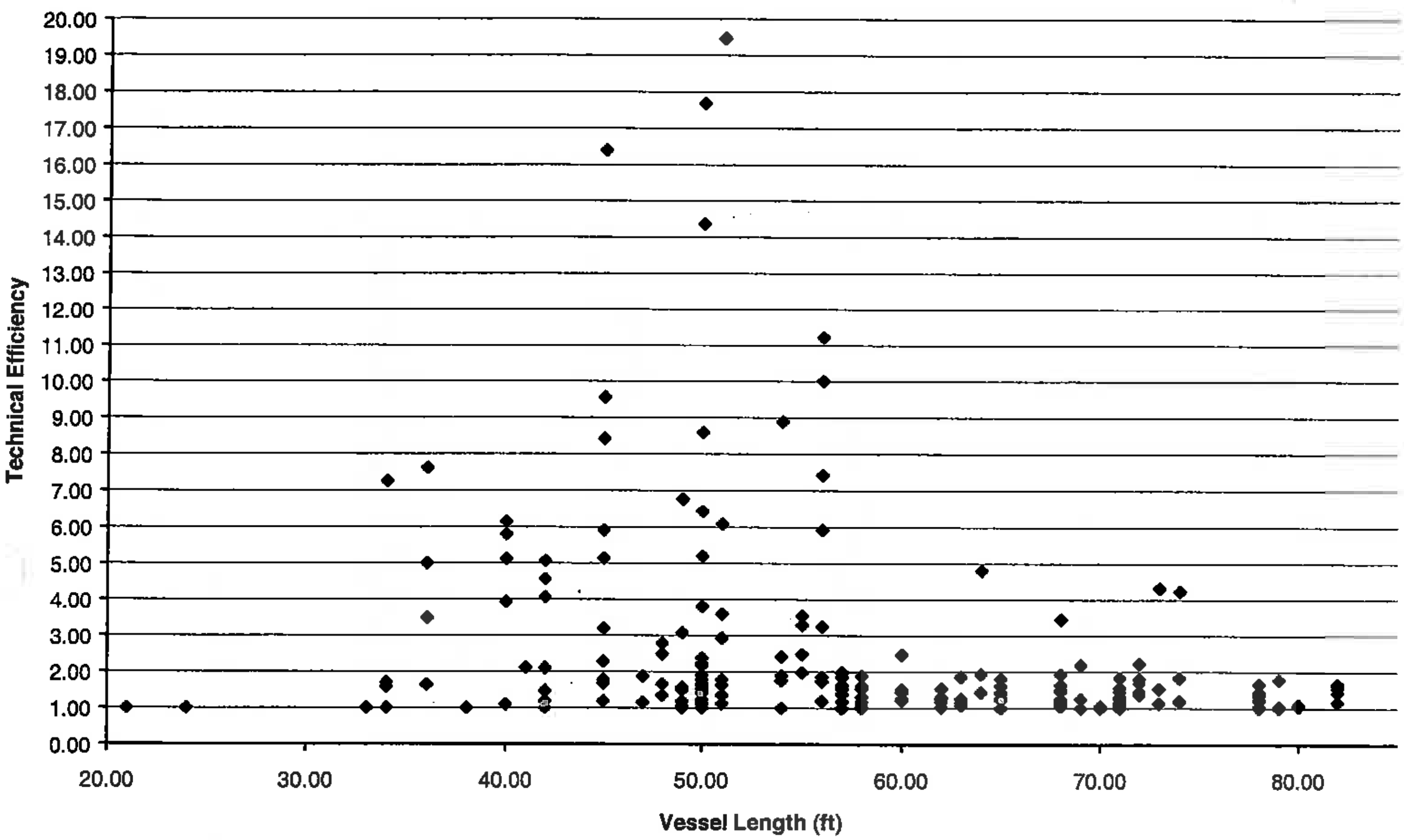

Figure 3. Annual capacity output for expected finfish limited entry qualifiers, 1993-97.

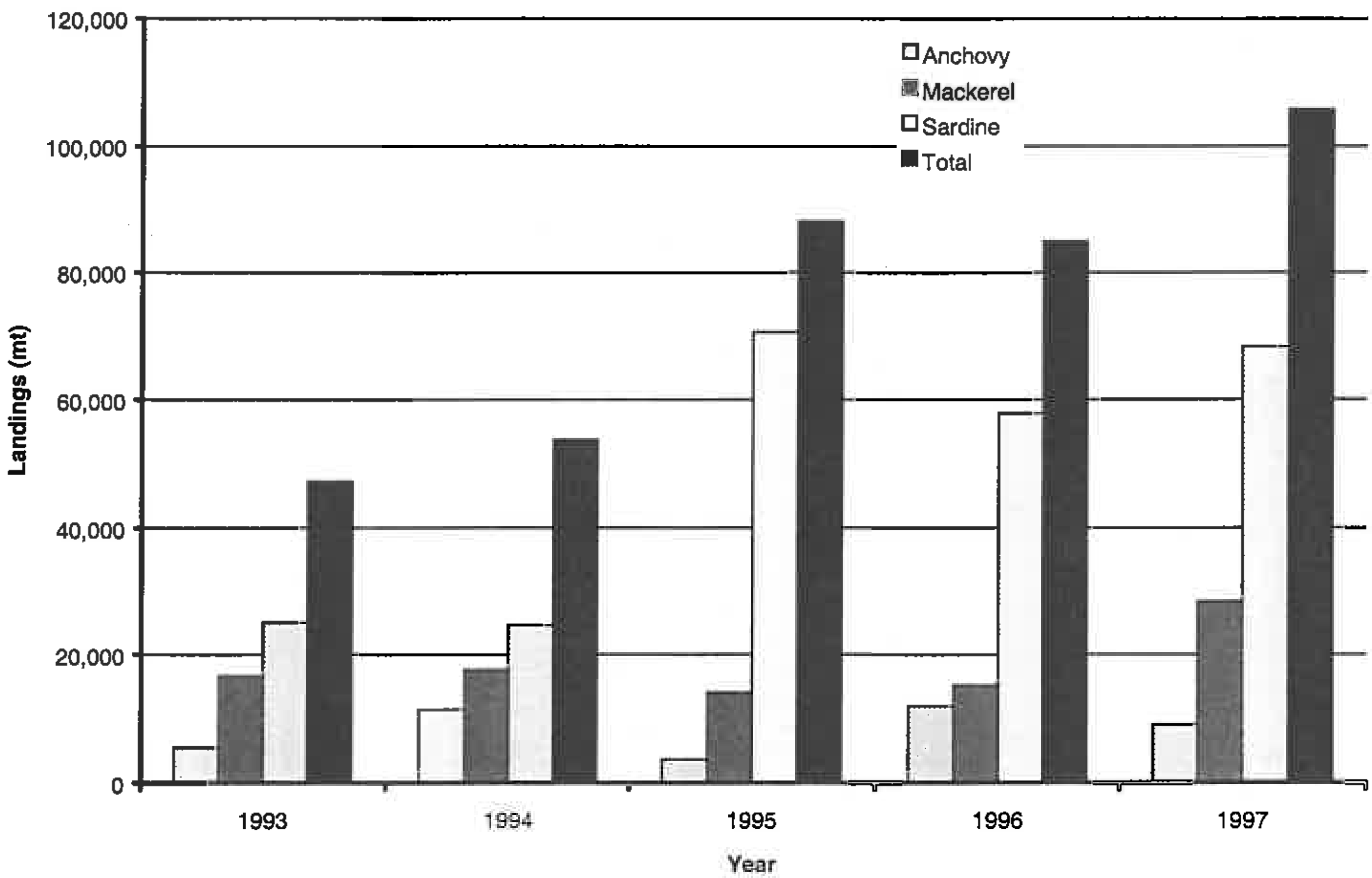

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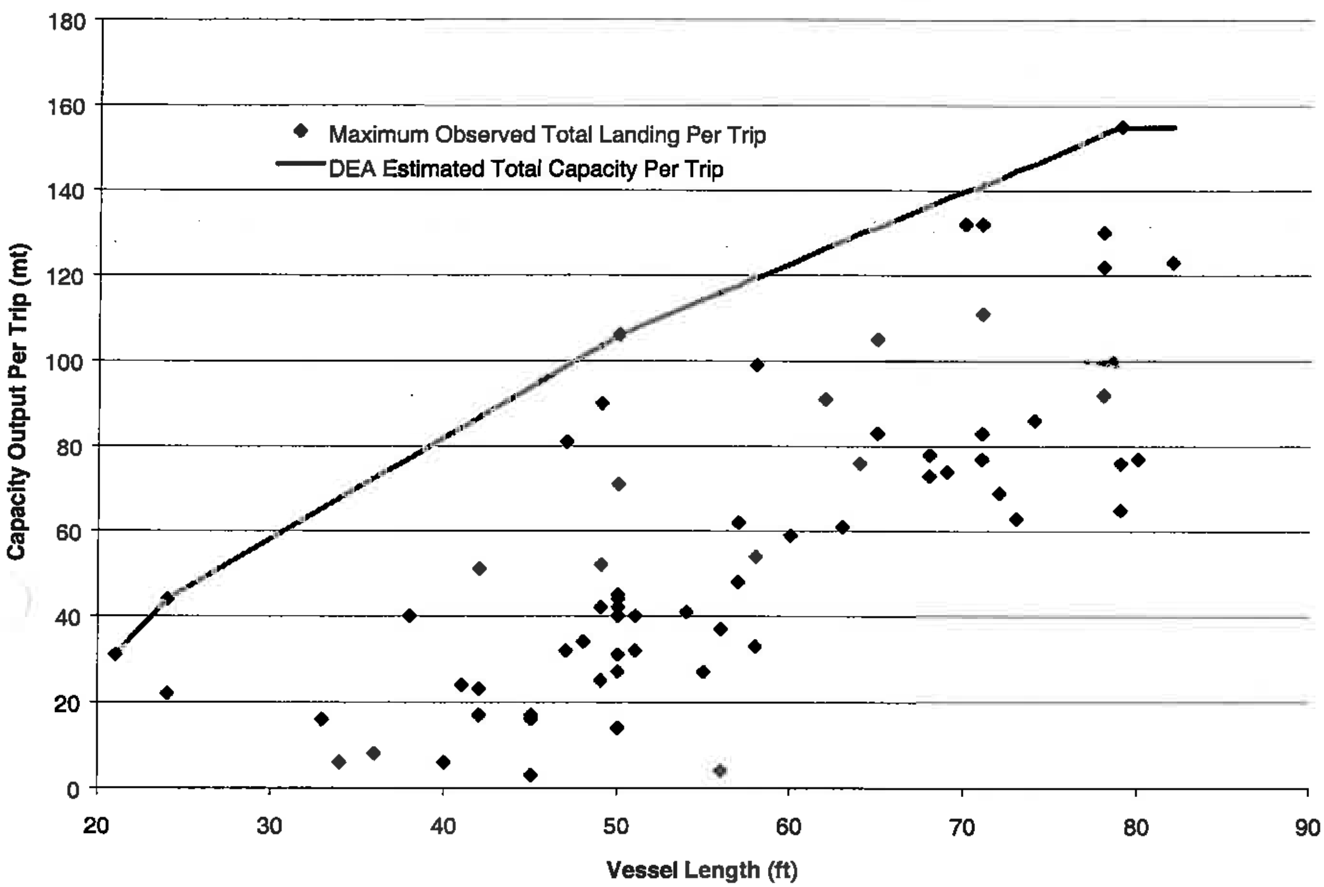
Figure 4. DEA estimates of trip capacity for expected finfish qualifiers, based on their maximum observed finfish landing (all species) over the 1993-97 period.



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Endnotes

1. An analysis of observed vessel landings per trip to evaluate limited entry options proposed in the FMP, indicated that 75 vessels would have sufficient harvesting capacity to take almost all of the CPS finfish likely to ever be available, 400,000 mt per year (FMP, 1999). The 400,000 mt per year estimate is the sum of estimated MSY for each stock reduced by a crude estimate of the fraction of the stock in U.S. waters. It is unlikely that all stocks would be abundant at the same time and that 400,000 mt of catch would be available in any one year.

2. Finfish limited entry permits were to be only transferable during the first year of the Program. An integral part of the Council's choice for a larger than optimal fleet was the presumed attrition in fleet size that would occur gradually because of the transferability constraints placed on permits.

3. The long-run is characterized by all productive inputs being variable inputs, i.e. no constraints, therefore there is no limit on catch from the from the standpoint of utilizing productive inputs.

4. The peak-to-peak method (also called trend line through peaks, Klein and Long 1973) defines capacity by estimating the observed relationship between catch and fleet size. Periods with the highest ratio of catch to the capital stock provide measures of full capacity (maximum attainable output). The method is most seriously limited by the problem that vessel tonnage or numbers are only a rough measure of capital stock.

5. A fishing vessel's technical efficiency is a measure of its ability to produce relative to the fleet's "best-practice frontier". The best-practice frontier determines the maximum output possible from a given set of inputs and production technology. Technical inefficiency is the deviation of an individual vessel's production from this best-practice frontier.

6. One of the 70 vessels initially expected to qualify was identified in PacFIN with "NONE" as its vessel identification number. Because of this it was not possible to compile landings data for this unidentified vessel. Thus the capacity and capacity utilization estimates are based on input and output data for the 69 remaining vessels and are therefore biased downward.

7. The CU measure of observed output divided by capacity output may be downward biased because the numerator, observed output, may be inefficiently produced. Färe *et al.* (1989) demonstrate that an unbiased measure of CU may be obtained by dividing an output-oriented measure of technical efficiency corresponding to observed variable input and fixed factor usage by the technical efficiency measure corresponding to capacity output (i.e., the solution to problem (1)). Lacking data on variable input usage, we were unable to calculate harvesting capacity corresponding to technically efficient production given actual use of variable inputs. Therefore we were unable to calculate an unbiased measure of CU, and instead calculated CU as observed output divided by capacity output.

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL STATEMENT ON LIMITED ENTRY FISHERY - CAPACITY GOAL AND OTHER ISSUES

The Coastal Pelagic Species Advisory Subpanel heard a presentation from Dr. Sam Herrick, National Marine Fisheries Service, and reviewed a corresponding report by Dr. Herrick, entitled "Assessing Fleet Harvesting Capacity in the Pacific Coast Costal Pelagics Species Finfish Fishery."

The CPSAS wishes to remind the Council that the sardine fishery does not operate independently. Several other factors must be considered when attempting to identify an optimum fleet size or goal for the CPS fishery. These other factors include, but are not limited to domestic and international markets, and the availability of other coastal pelagic species, such as squid.

The CPSAS continues to support extending the transfer period for limited entry finfish permits past December 31st, 2000.

Exhibit E.2
Situation Summary
November 2000

PACIFIC SARDINE HARVEST GUIDELINE

Situation: Per the coastal pelagic species (CPS) fishery management plan (FMP) annual cycle, the Council is scheduled to review the Pacific sardine stock assessment and adopt for recommendation to the U.S. Secretary of Commerce a harvest guideline for the 2001 Pacific sardine fishing season. The current harvest guideline (which expires December 31, 2000) is 186,791 mt (based on a biomass estimate of 1,581,346 mt). Annually, the harvest guideline is divided between two northern and southern areas. For the 2000 fishery, the northern allocation was 62,264 mt and the southern allocation was 124,527 mt; the line dividing northern and southern allocation areas is Point Piedreas Blancas, on the central California coast. The 2001 fishery opens January 1, 2001. The current stock assessment and harvest guideline recommendation are summarized in Exhibit E.2.a.

The CPS Management Team (CPSMT) and the CPS Advisory Subpanel (CPSAS) have reviewed the assessment and the recommended harvest guideline. They will present their respective advice to the Council (Exhibit E.2.b and Exhibit E.2.c).

At the June 2000 meeting, the Council directed the CPSMT to develop a set of recommendations for a process to review CPS stock assessments. The Council's recommendation was for a process similar to (but less intensive than) the groundfish Stock Assessment Review (STAR) process. That is, periodic outside review of the modeling procedures used to assess the CPS stocks, rather than an annual stock assessment review cycle. The CPSMT discussed this matter at their October 17 - 18, 2000 meeting and will report their findings to the Council.

Council Action:

1. **Adopt 2001 Pacific sardine harvest guideline.**
2. **Provide guidance to the CPSMT about how to proceed with developing a process for reviewing CPS stock assessments.**

Reference Materials:

1. Exhibit E.2.a, Supplemental Report – *Status of the Pacific Sardine Resource and Fishery in 2000 With Management Recommendations for 2001.*
2. Exhibit E.2.b, Supplemental CPSMT Report.
3. Exhibit E.2.c, Supplemental CPSAS Report.

PFMC
10/16/00

Stock Assessment of Pacific Sardine with Management Recommendations for 2001

Executive Summary

24 October 2000

by

Ramon J. Conser[1], Kevin T. Hill[2], Paul R. Crone[1], and Darrin Bergen[2]

Submitted to
Pacific Fishery Management Council
2130 SW Fifth Avenue, Suite 224
Portland, OR 97201

Addresses for authors:

[1] NOAA/NMFS
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92038

[2] California Department of Fish and Game
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92038

This document is available electronically at http://swfsc.nmfs.noaa.gov/fish_res.html

Introduction

The following summary presents pertinent results and harvest recommendations from a stock assessment conducted on Pacific sardine (*Sardinops sagax*) in 2000. It is intended that this information will be referred to by the Pacific Fishery Management Council (PFMC) when developing management goals for the upcoming fishing season for sardine beginning January 2001. A complete document that describes details regarding data sources, analyses, and modeling used in this assessment will be prepared later this year and will be distributed prior to the PFMC meeting in March 2001; the complete assessment document, as well as the Executive Summary, will be included in the PFMC series *Stock Assessment and Fishery Evaluation (SAFE)* reports.

The assessment results presented here are applicable to the sardine population off the North America Pacific coast from Baja California, Mexico to British Columbia, Canada. The majority of the fishery-independent and fishery-dependent data were collected off northern Mexico and southern California only (Area 1 or *Inside* Area); however, as was done in past assessments, assumptions regarding sample coverage (e.g., representativeness of survey trends to areas outside Area 1) and sardine biology (e.g., recruit emigration out of Area 1) were used to make scientific inferences about the entire population, e.g., to provide fishery managers coastwide estimates of stock biomass, mortality rates, and harvest guidelines.

Methods

An age-structured stock assessment model (CANSAR-TAM, Catch-at-age **AN**alysis for **SAR**dine - Two Area Model, see Hill et al. (1999) was applied to fishery-dependent and fishery-independent data to derive estimates of population abundance and age-specific fishing mortality rates. In 1998, the original CANSAR model (Deriso et al. 1996) was modified to account for the expansion of the population northward to waters off the Pacific northwest (see above). The models are based on a 'forward-simulation' approach (see Megrey (1989) for a description of the general modeling approach), whereby parameters (e.g., population sizes, recruitments, fishing mortality rates, gear selectivities, and catchability coefficients) are estimated after log transformation using the method of nonlinear least squares. The terms in the objective function (to be minimized) included the sum of squared differences in ($\log_e$) observed and ($\log_e$) predicted estimates from the catch-at-age and various sources of auxiliary data used for 'tuning' the model, e.g., indices of abundance from survey (fishery-independent) data. Bootstrap procedures were used to calculate variance and bias (95% confidence intervals) of sardine biomass and recruitment estimates generated from the assessment model. The CANSAR-TAM model was based on two fisheries (California, U.S. and Ensenada, Mexico) and semesters within a year were used as time steps, with ages being incremented between semesters on July 1 and spawning that was assumed to occur on April 1 (middle of the first semester).

Fishery-dependent data from the California and Ensenada fisheries (1983 to first semester 2000) were used to develop the following time series: (1) catch (in mt)-Table 1 and Figure-1; (2) age distributions (catch-at-age in numbers of fish); and (3) estimates of weight-at-age (fishery- and population-specific). Fishery-independent data (time series) from research surveys included the following indices, which were developed from data collected from Area 1 (*Inside Area*, primarily waters off southern California) and used as relative abundance measures (Table 2): (1) index (proportion-positive stations) of sardine egg abundance from California Cooperative Oceanic and Fisheries Investigations (CalCOFI) survey data (*CalCOFI Index*)-Figure 2, see Deriso et al. (1996); (2) index of spawning biomass (mt) based on the Daily Egg Production Method (DEPM) survey data (*DEPM Index*)-Figure 3, see Lo et al. (1996); (3) index of spawning area (Nmi^2) from CalCOFI and DEPM survey data (*Spawning Area Index*)-Figure 4, see Barnes et al. (1997); and (4) index of pre-adult biomass (mt) from aerial spotter plane survey data (*Aerial Spotter Index*)-Figure 5, see Lo et al. (1992). Time series of sea-surface temperatures (Figure 6) recorded at Scripps Pier, La Jolla, California were used to determine appropriate harvest guidelines (*Sea-surface Temperature Index*), see Amendment 8 of the Coastal Pelagic Species Fishery Management Plan, Option J, Table 4.2.5-1, PFMC (1998).

Survey indices of relative abundance were re-estimated using generally similar techniques as was done in previous assessments (e.g., see Hill et al. 1999). The final model configuration was based on equally 'weighted' indices except for the CalCOFI index, which was downweighted to 0.7 (relative to 1.0 for the other indices). The relative weight used for the CalCOFI index (0.7) was consistent with previous assessments in which the proportion of the total spawning area covered by the CalCOFI surveys (~70%) was used to determine its relative weighting in the model. Further the CalCOFI Index has undergone considerable saturation in recent years due to the higher frequency of positive stations as the sardine stock expanded throughout and beyond the southern California Bight. As in the previous assessment, the CalCOFI index was fit with a non-unity exponent (0.3547) to allow for a nonlinear relationship between the index and sardine spawning biomass. This procedure produced a better fit to these data and a more acceptable residual pattern than assuming the classical linear relationship between the index of abundance and population size. Finally, in past assessments the Aerial Spotter Index was assumed to primarily track adult spawning biomass. However, further examination of the sampling design used to collect these data (i.e., sampling space is inshore waters only) indicated this index more likely observed pre-adult fish (mostly age 0-2 fish) than strictly adult spawners and thus, the 'selectivity' ogive was adjusted to reflect this sampling attribute.

It is important to note that survey indices used in fishery assessments are often based on variable and biased data; however, we assumed that biases were generally consistent from year to year, which in effect, allows the trend indicated in an index to be interpreted in relative terms and ultimately, useful in statistical modeling. Additionally, sensitivity analysis included alternative model configurations that were based on differentially weighted indices, which produced generally similar results from the modeling. For example, reduced weighting of the Aerial Spotter Index and CalCOFI Index (see Hill et al. 1999) resulted in similar model predicted fits to these survey data, as well as similar trends in estimated spawning biomass ($\geq$1-year old fish).

Results

Pacific sardine landings for the directed fisheries off California, U.S. and Ensenada, Mexico remained at the high levels that were reached last year (115,000 mt), with a total harvest of roughly 114,000 mt (Table 1, Figure 1); note that semester 2 landings in 2000 reflect projected estimates based on landing patterns observed in the fisheries during the mid to late 1990s (Table 1). California landings in 2000 (59,925 mt) are expected to increase slightly (6% or 3,200 mt) from the 1999 estimated landings (56,747), while Ensenada landings in 2000 (53,579 mt) are forecasted to decrease slightly (9% or 5,000 mt) from landings made in 1999 (58,569 mt). Currently, the U.S. fishery (California landings) is regulated using a quota (harvest guideline) management scheme and the Mexico fishery (Ensenada landings) is essentially unregulated. Since the mid 1990s, actual landings from the California fishery have been less than the recommended quotas.

As was the case in recent years, landings from the U.S. Pacific sardine fishery (California, Oregon, and Washington) are well below the harvest guideline recommended for 2000 (186,791 mt), with roughly 55,543 mt (30% of harvest guideline) landed through September 2000 and over 131,000 mt of the quota remaining (the fishing year ends on December 31, 2000).

Estimated stock biomass ($\geq$1-year old fish on July 1, 2000) from the assessment conducted this year indicated the sardine population has remained at a relatively high abundance level, with a bias-corrected estimate of nearly 1.2 million mt (Table 3 and Figure 7). Estimated recruitment (age-0 fish on July 1, 2000), albeit more variable than stock biomass statistics, also remained at relatively high abundance, with number of recruits increasing slightly from last year to nearly 14 billion (Table 3 and Figure 8).

Harvest Guideline for 2001

The harvest guideline recommended for the U.S. (California, Oregon, and Washington) Pacific sardine fishery for 2001 is 134,737 mt. Statistics used to determine this harvest guideline are discussed below and presented in Table 4. To calculate the proposed harvest guideline for 2001, we used the maximum sustainable yield (MSY) control rule defined in Amendment 8 of the Coastal Pelagic Species-Fishery Management Plan, Option J, Table 4.2.5-1, PFMC (1998). This formula is intended to prevent Pacific sardine from being overfished and maintain relatively high and consistent catch levels over a long-term horizon. The Amendment 8 harvest formula for sardine is:

$$HG_{2001} = (\text{TOTAL STOCK BIOMASS}_{2000} - \text{CUTOFF}) \cdot \text{FRACTION} \cdot \text{U.S. DISTRIBUTION},$$

where HG_{2001} is the total U.S. (California, Oregon, and Washington) harvest guideline recommended for 2001, TOTAL STOCK BIOMASS_{2000} is the estimated stock biomass (ages 1+) from the current assessment conducted in 2000 (see above), CUTOFF is the lowest level of estimated biomass at which harvest is allowed, FRACTION is an environment-based percentage of biomass above the CUTOFF that can be harvested by the fisheries (see below), and U.S. DISTRIBUTION is the percentage of TOTAL STOCK BIOMASS_{2000} in U.S. waters.

The value for FRACTION in the MSY control rule for Pacific sardine is a proxy for F_{msy} (i.e., the fishing mortality rate that achieves equilibrium MSY). Given F_{msy} and the productivity of the sardine stock have been shown to increase when relatively warm-water ocean conditions persist, the following formula has been used to determine an appropriate (sustainable) FRACTION value:

$$\text{FRACTION or } F_{msy} = 0.248649805(T^2) - 8.190043975(T) + 67.4558326,$$

where T is the running average sea-surface temperature at Scripps Pier, La Jolla, California during the three preceding years. Ultimately, under Option J (PFMC 1998), F_{msy} is constrained and ranges between 5% and 15%. The F_{msy} is equal to 15% under current oceanic conditions (T_{2000} = 17.73 °C; Figure 6).

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Table 1. Pacific sardine time series of landings (mt) by semester (1 is January-June and 2 is July-December) in California and Baja California (Ensenada), 1983-2000. Semester 2 (2000) estimates are projections.

	CALIFORNIA			ENSENADA			
Year	Semester 1	Semester 2	Total	Semester 1	Semester 2	Total	Grand Total
83	245	244	489	150	124	274	762
84	188	187	375	<1	<1	0	375
85	330	335	665	3,174	548	3,722	4,388
86	804	483	1,287	99	143	243	1,529
87	1,625	1,296	2,921	975	1,457	2,432	5,352
88	2,516	1,611	4,128	620	1,415	2,035	6,163
89	2,161	1,561	3,722	461	5,763	6,224	9,947
90	2,272	1,033	3,305	5,900	5,475	11,375	14,681
91	5,680	3,354	9,034	9,271	22,121	31,392	40,426
92	8,021	13,216	21,238	3,327	31,242	34,568	55,806
93	12,953	4,889	17,842	18,649	13,396	32,045	49,887
94	9,040	5,010	14,050	5,712	15,165	20,877	34,927
95	29,565	13,925	43,490	18,227	17,169	35,396	78,886
96	17,896	18,161	36,057	15,666	23,399	39,065	75,121
97	11,865	34,331	46,196	13,499	54,941	68,439	114,636
98	21,841	19,215	41,055	20,239	27,573	47,812	88,868
99	31,791	24,956	56,747	34,760	23,810	58,569	115,316
00	34,518	25,407	59,925	25,800	27,779	53,579	113,504

Table 2. Pacific sardine time series of survey indices of relative abundance and sea-surface temperature, 1983-00.

Year	CalCOFI (% positive)	DEPM (mt)	Spawning area (Nmi^2)	Spotter plane (mt)	Sea-surface temperature (C)
83	na	na	40	na	17.25
84	4.362	na	480	na	17.58
85	2.715	na	760	na	17.80
86	1.316	7,659	1,260	43,478	17.87
87	4.286	15,705	2,120	15,430	17.71
88	6.716	13,526	3,120	85,266	17.55
89	9.140	na	3,720	47,847	17.24
90	3.623	na	1,760	29,723	17.19
91	12.805	na	5,550	54,242	17.35
92	10.825	na	9,697	60,442	17.61
93	6.061	na	7,685	104,223	17.84
94	17.010	111,493	24,539	253,270	17.97
95	10.811	na	23,816	249,428	18.04
96	28.000	83,176	25,889	151,646	18.06
97	17.949	356,300	40,592	86,121	18.06
98	17.447	313,986	33,447	150,258	18.44
99	16.667	282,248	55,173	52,652	18.04
00	5.556	1,063,837	32,785	74,410	17.73

Table 3. Pacific sardine time series of stock biomass (≥age-1 fish in mt) and recruitment (age-0 fish in 1,000s) estimated at the beginning of semester 2 of each year. Stock biomass estimates are presented for Area 1 (*Inside*) and the Total Area of the stock. The 95% Cis for Total Area biomass and recruitment estimates are also presented.

	Stock biomass				Recruitment		
Year	Area 1	Total Area	Lower CI	Upper CI	Total Area	Lower CI	Upper CI
83	5,056	5,056	2,957	10,099	141,403	88,847	246,958
84	12,816	12,878	9,063	21,581	226,169	147,229	371,294
85	20,961	21,439	15,673	33,385	219,856	155,365	352,332
86	29,917	31,484	24,446	46,926	846,294	615,775	1,287,227
87	72,083	75,573	59,772	108,304	832,040	617,653	1,190,540
88	105,088	114,408	94,477	152,212	1,461,068	1,063,523	2,219,947
89	160,457	178,912	148,464	239,814	1,158,867	810,564	1,894,887
90	175,762	208,108	173,068	282,917	4,709,570	3,090,489	8,018,753
91	222,968	258,856	198,733	394,671	5,902,130	3,685,261	10,226,905
92	350,673	416,435	308,879	643,578	4,105,231	2,593,962	7,299,626
93	331,202	438,385	336,054	655,658	8,927,805	6,324,826	14,328,381
94	482,639	635,350	511,046	912,435	10,906,645	7,633,095	16,934,560
95	511,541	720,733	580,872	1,013,478	6,785,885	4,781,041	10,792,603
96	537,008	789,746	654,219	1,076,120	5,565,890	3,820,403	9,088,025
97	483,698	765,450	644,562	1,032,142	8,135,807	5,105,778	13,574,897
98	435,700	738,098	601,127	1,030,048	19,021,736	12,389,294	33,111,696
99	693,865	1,084,814	818,716	1,654,253	11,581,850	6,958,572	22,728,400
00	718,662	1,182,465	834,879	1,896,204	13,584,794	6,940,772	28,942,209

Table 4. Proposed harvest guideline for Pacific sardine for the 2001 fishing season. See the **Harvest Guideline for 2001** section for methods used to derive harvest guideline.

Total stock biomass (mt)	Cutoff (mt)	Fraction (%)	U.S. Distribution (%)	Harvest guideline (mt)
1,182,465	150,000	15%	87%	134,737

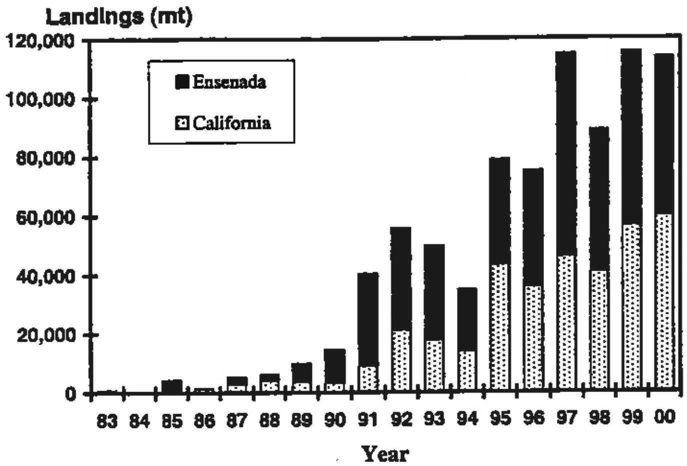

Figure 1. Pacific sardine landings (mt) in California and Baja California (Ensenada), 1983-00.

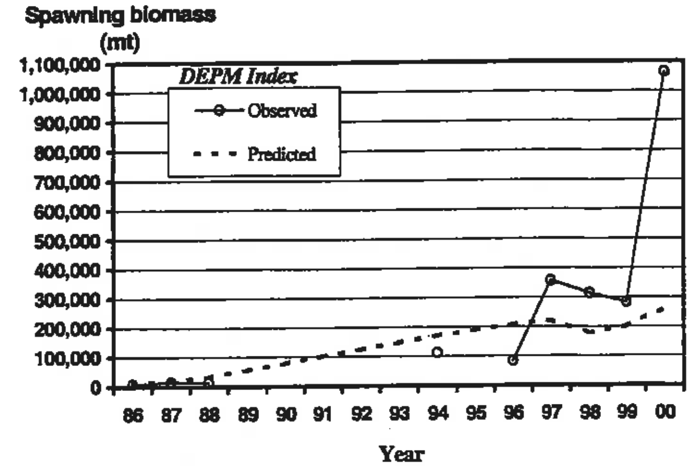

Figure 3. Index of relative abundance of Pacific sardine spawning biomass (mt) off California based on daily egg production method (DEPM) estimates from ichthyoplankton survey data (1986-00). Note no sample data (Observed estimates) were available for years 1989-93 and 1995.

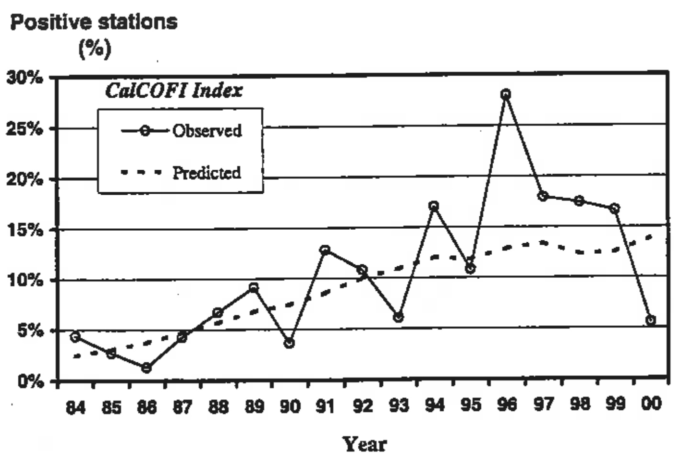

Figure 2. Index of relative abundance of Pacific sardine eggs (proportion-positive stations) off southern California based on CalCOFI bongo-net survey (1984-00).

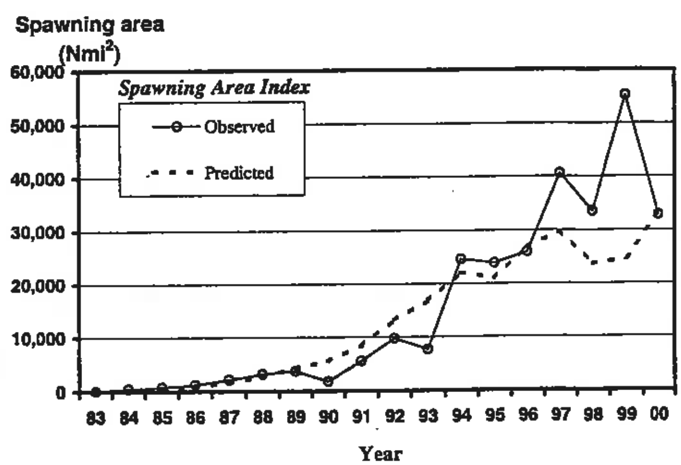

Figure 4. Index of relative abundance of Pacific sardine spawning stock size based on estimates of spawning area (Nmi^2) calculated from CalCOFI and DEPM survey data (1983-00).

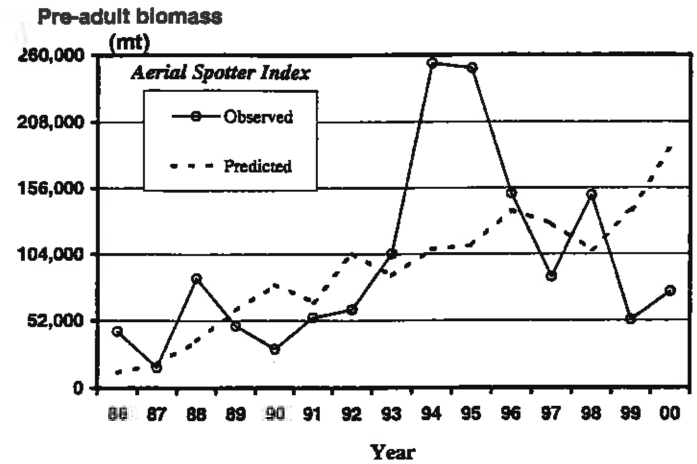

Figure 5. Index of relative abundance of Pacific sardine pre-adult biomass (mt) off California based on aerial spotter plane survey data (1986-00).

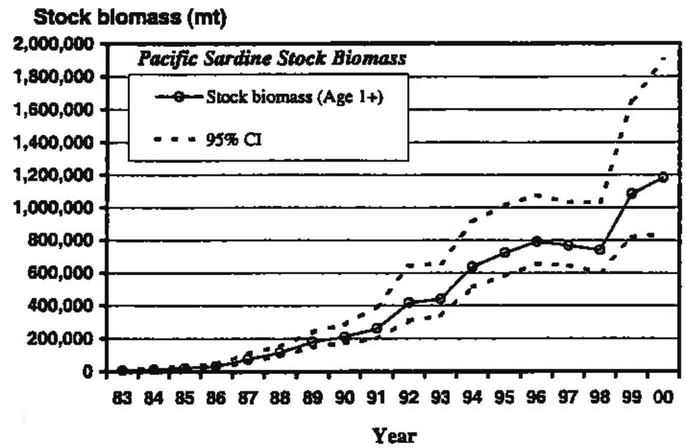

Figure 7. Time series (1983-00) of Pacific sardine stock biomass (≥ 1-yr old fish on July 1 of each year in mt) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

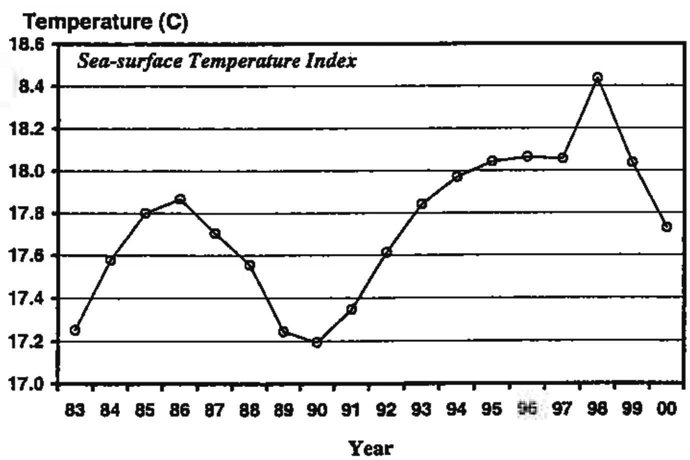

Figure 6. Time series of sea-surface temperature (C) recorded at Scripps Pier, La Jolla (1983-00). Annual estimates reflect 3-year 'running' averages, see Jacobson and MacCall (1995).

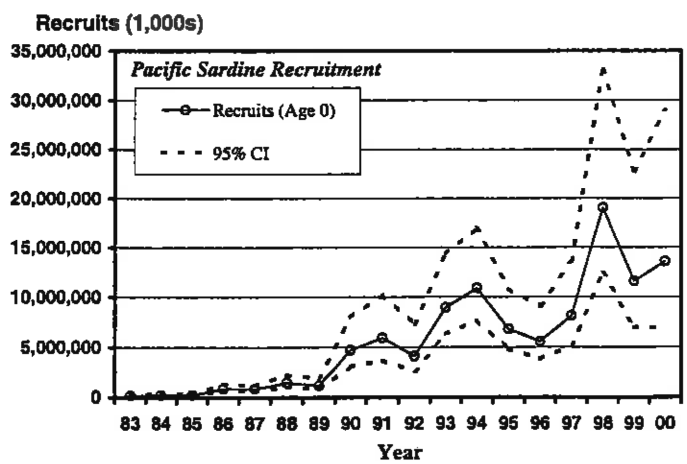

Figure 8. Time series (1983-00) of Pacific sardine recruitment (0-yr old fish on July 1 of each year in 1,000s) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

Exhibit E.2.b
Supplemental CPSMT Report
November 2000

COASTAL PELAGIC SPECIES MANAGEMENT TEAM STATEMENT ON STOCK ASSESSMENT REVIEW PROCESS

The Coastal Pelagic Species Management Team (CPSMT) discussed various options for independent review of stock assessments for actively managed species. Stock assessments for Pacific sardine and Pacific mackerel are currently conducted on an annual basis. The CPSMT recommends continuing assessments with this frequency due to the highly dynamic nature of coastal pelagic species (CPS) stocks. The Team recommends implementing periodic review of the assessments in a Groundfish stock assessment review (STAR) panel setting, but intensive reviews of this nature are probably not warranted on an annual basis. STAR panel reviews of sardine and Pacific mackerel stock assessments could be conducted triennially, with a less formal review by the CPSMT and Scientific and Statistical Committee (SSC) during interim years. Full stock assessment reports should be developed and distributed following each STAR panel review. Details from interim-year assessments could be documented in comprehensive Executive Summaries which include relevant changes to data and the modeling approach. Executive Summaries for interim years will be available for review prior to setting harvest guidelines and will be included as an appendix to the annual stock assessment and fishery evaluation (SAFE) document. In the event that entirely new assessment models are developed, the CPSMT would request a STAR panel to review the models prior to implementation of results for setting harvest guidelines.

Should the Council concur with this recommendation, the Team suggests organizing the first joint STAR panel for sardine and Pacific mackerel during latter half of 2001 after the groundfish STAR process is completed. The STAR panel can be composed of one representative each from the CPSMT, CPS Advisory Subpanel and SSC, and an independent group of stock assessment experts. The CPSMT would like to work with the SSC in developing a Terms of Reference document for the CPS STAR panel process as well as guidelines for preparation of stock assessment documents.

SCIENTIFIC AND STATISTICAL COMMITTEE COMMENTS ON PACIFIC SARDINE HARVEST GUIDELINE

A summary of the Pacific sardine stock assessment for 2001 was presented to the Scientific and Statistical Committee (SSC) by Dr. Ray Conser. The SSC finds the assessment and recommendations to be adequate for setting harvest levels at this stage of the fishery. Future assessments may be inadequate for the northern range of the stock if appropriate time series data for the northern areas are not incorporated into the assessment.

The discussion that followed was a good update on the status of Pacific sardines and the assessment methodology, but was not an in-depth peer review. The data sources for sardine are limited to geographic areas off Baja California, Mexico, and the State of California (particularly the area from San Diego to Monterey Bay). A migration model parameterized with historical estimates of sardine migration rates is used to extrapolate the stock assessment to the northern areas of the sardine distribution. With the recent expansion of the sardine population off Oregon, Washington, and British Columbia, there is an urgent need to incorporate fishery-dependent data for northern areas into the stock assessment and to initiate resource surveys to establish a fishery-independent time series for those areas. It will be very important that monitoring be coordinated, consistent, and compatible between northern and southern areas.

In response to an earlier SSC request, the Coastal Pelagic Species Management Team (CPSMT) has recommended a peer review process for the coastal pelagic species similar to the groundfish STAR process. The CPSMT suggests that full sardine and Pacific mackerel stock assessments and reviews be conducted on a triennial cycle, with a less formal review by the CPSMT and SSC during interim years. Full stock assessment reports would be developed and distributed following each STAR panel review. Details from interim-year assessments could be documented in executive summaries similar to the one produced for this year's sardine assessment. As entirely new assessments are developed, a STAR panel would be convened to review the assessment prior to implementation of results for setting harvest guidelines. The SSC supports the CPSMT's proposal. The SSC Coastal Pelagic Subcommittee is willing to work with the CPSMT to develop the terms of reference for a STAR process and guidelines for stock assessment documents. The SSC suggests that the first such review be scheduled for 2002, given that a major review of squid assessment methodology is scheduled for 2001. A 2002 CPS review should be scheduled to avoid overlap with the groundfish STAR review process.

PFMC
11/02/00

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL STATEMENT ON PACIFIC SARDINE HARVEST GUIDELINE

The CPSAS heard a presentation for Dr. Ray Conser on the 2000 stock assessment and the accompanying 2001 harvest guideline for Pacific sardine. The CPSAS agreed with the findings of the stock assessment and support the proposed harvest guideline of 134,747 metric tons for the 2001 fishery.

Exhibit E.3
ODFW Proposal
November 2000

Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

FISH DIVISION

February 9, 2000

FEB 1 8 2

Dr. Doyle Hanan
Chair, Coastal Pelagic Species Management Team
California Dept. Fish and Game
Marine Resources Div.
PO Box 271
La Jolla, CA 92038

Dear Dr. Hanan;

With the implementation of the new Coastal Pelagic Species Fishery Management Plan and the inclusion of Oregon and Washington sardine landings under the harvest guideline, members of the Oregon sardine industry are interested in establishing a separate allocation of the harvest guideline for the area north of California. We are interested in pursuing this subject and have prepared the attached summary paper to open the discussion. The Management Plan does allow for additional allocations and we would like the Pelagic Species Management Team to discuss the issue as we plan to introduce a proposal at a future Council meeting. We are open to team recommendations regarding the issue of re-allocation of the harvest guideline in the fall. Thank you for your consideration of this matter.

Sincerely,

Burnell Bohn

Burnell Bohn
Fish Division

cc: L.B. Boydstun, CDFG
P. Anderson, WDFW
D. Waldeck, PFMC
J. Bornstein, Bornstein Seafoods, Inc.
Oregon sardine permit holders

John A. Kitzhaber
Governor

2501 SW First Avenue
PO Box 59
Portland, OR 97207
(503) 872-5252
FAX (503) 872-5632
TDD (503) 872-5259
Internet WWW: http

ALLOCATION OF PACIFIC SARDINE HARVEST GUIDELINE

Background

Prior to 2000, sardines were managed by the individual states. There has been no fishery in Oregon or Washington since the late 1940's. In the recent years, California has managed their sardine fishery under an annual harvest quota. The quota was divided two-thirds to the southern California fishery and one-third to the northern fishery (a dividing line at San Simeon Point, San Luis Obispo County, approximately 35° 40'N). In addition, in October, any uncaught portion of the quota was re-allocated, 50/50, between the north and south areas (PFMC 1998).

Since 1993, the quota was based on biomass estimates calculated using the CANSAR model. The model uses both fishery-dependant and fishery-independent data to obtain annual estimates of sardine abundance, year class strength, and age-specific fishing mortality (Hill et.al. 1999a). Beginning with the 1998 quota, the model was modified (CANSAR-TAM) to account for sardines that were outside the range of the fishery (north or offshore)(Figure 1), calculating biomass estimates for both within and outside the range of the fishery and survey data. Even though data from outside the range of the fishery and survey data were used in calculating the biomass estimates, the quota was based on the biomass of sardines within the range of the fishery (Table 1 -" inside area")(Hill et al 1999a).

In 1999, amendment 8 to the Pacific Fishery Management Council's Northern Anchovy Fishery Management Plan (FMP) was approved, to take effect in 2000. The plan is now the Coastal Pelagic Species Fishery Management Plan, and includes sardines. Under the FMP, The harvest guideline for sardines is calculated and allocated in a similar manner as it was in California, with two changes: 1) the northern border for the northern area is extended to the Washington/Canada border. The division between northern and southern areas continues to be Point Piedreas Blancas (35°40'N) and the unused harvest guideline will still be re-allocated in October (PFMC 1998). 2) The harvest guideline is based on the biomass estimate of the entire management area under the FMP (Table 1 - "total area)(Hill 1999b).

The first major landings of sardines into Oregon in fifty years occurred in 1999. Three vessels made directed landings of just over 1.7 million pounds (775.7 mt). In Oregon, sardines are managed under the Developmental fishery program which limits the number of harvest permits to 15. In 1999, as of mid-July, only three permits had been issued; by mid-August, all 15 permits were issued. In 2000, ten permits were renewed from 1999 and the other five permits were issued through a lottery in February. Harvest is expected to begin in late spring/early summer.

Situation

Historically, the bulk of sardine landings off Oregon occurred in July through September (OFC 1951). Members of the Oregon industry feel any new fishery will occur in the same general time frame. Their concern is, if they share a portion of the harvest guideline with the northern California fishery, that fishery will have an opportunity to harvest a significant portion of the harvest guideline before the fishery off Oregon begins for the year. Presently, this may not be a major problem. Given the high biomass and harvest guideline in the last few years, the fishery off northern California has not harvested their entire portion of the quota. Also, presently, the bulk of their fishery doesn't begin until June/July. However, if the biomass begins to decrease or the nature of the northern California fishery changes (i.e. reduction is allowed), there is potential for the northern California fishery to harvest a significant portion of the harvest guideline before the fishery off Oregon begins for the year. The Oregon industry is investing a lot of money to upgrade facilities to process sardines and would like to be assured of some amount of product in the future. Also, since the estimated biomass on which the harvest guideline is based, now includes sardines north of California, the Oregon industry feels part of the harvest should be allocated to fisheries north of California. Data for sardines north of California are limited but will improve as a fishery develops.

<u>Options to allocate a portion of the sardine harvest guideline to area north of California</u>. The numbers in the examples below are based on 2000 data.

<u>Option A.</u> Status quo - total harvest guideline is based on biomass of total area, split 66/33 between S area/ N area (N area includes northern California, Oregon, and Washington).

	Biomass (mt)	Harvest guideline (mt)			
		Total	S CA	N CA	OR/WA
Total	1,581,346	186,791	124,527	62,264	

<u>Option B.</u> Since the OR/WA area is similar in size to the northern California area, and the southern California area portion of the harvest guideline has historically been twice that of northern California, the total harvest guideline could be split 50% southern California, 25% northern California, and 25% OR/WA.

	Biomass (mt)	Harvest guideline (mt)			
		Total	S CA	N CA	OR/WA
Total	1,581,346	186,791	93,396	46,698	46,698

<u>Option C.</u> The harvest guideline for the area off California as a whole could be calculated as it has until this year: based on the estimated biomass for the "inside area" and split 66/33 between southern California and northern California. The harvest guideline for the area north of California could then be based on some portion (ie. 50%) of the differences between the harvest guideline for the "inside area" and the total area".

	Biomass (mt)	Harvest guideline (mt)			
		Total	S CA	N CA	OR/WA
Total	1,581,346	186,791			
Inside	1,058,807	118,599	79,106	39,493	
outside		186,791 - 118,599 = 68,192			34,096 (50% of 68,192)

Option C would be more conservative for the stocks. Both B and C retain similar historical proportions between the areas, i.e. southern California receives the major portion of the harvest guideline, and twice that of northern California. We prefer option ~~C~~ because, in addition to retaining historical propotions, it is a simple formula there is no reliance on "inside/outside" distinctions of the biomass.

B

References

Hill, K.T., L.D. Jacobson, N.C.H. Lo, M. Yaremko, and M. Dege. 1999a. Stock assessment of Pacific sardine for 1998 with management recommendations for 1999. California Dept. Fish and Game. Marine Region Admin. Rpt. 99-4. 30pp.

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OFC. 1951. Fishery statistics of Oregon. Oregon Fish Commission, Contribution No. 16.

PFMC. 1998. Amendment 8 (to the northern anchovy fishery management plan) incorporating a name change to: the coastal pelagic species fishery management plan. Pacific Fishery Management Council, Portland, OR.

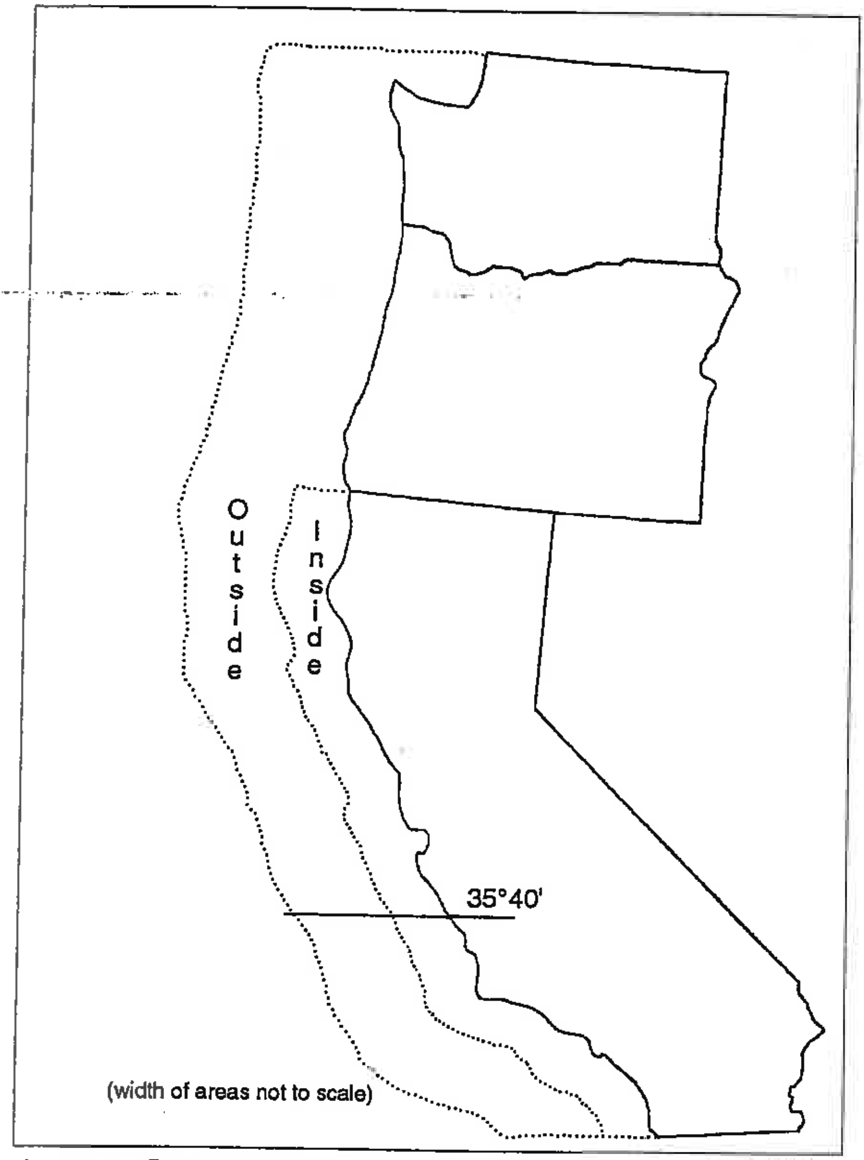


Figure 1. Representation of inside and outside areas used in calculating sardine biomass estimate.

Table 1. Biomass estimates, harvest guidelines or quotas, and total landings for sardines, 1995-2000.

	Biomass estimate (mt)[a]			Initial harvest guideline or quota (mt)			Total Landings (mt)		
Year	inside area	outside area	total area	total	southern area	northern area[b]	total	southern area	northern area[b]
1995	**330,493**		330,493	47,306	31,538	36,562	41,480	36,562	4,928
1996	**320,909**		320,909	31,818	21,212	10,606	34,128	25,224	8,904
1997	**462,664**		462,664	48,988	32,658	16,329	43,632	32,785	10,847
1998	**420,847**	151,093	571,940	43,545	29,030	14,515	41,056	31,975	9,081
1999	**1,073,091**	544,825	1,617,916	120,474	80,356	40,118	56,322	42,440	13,882
2000	1,058,807	522,539	**1,581,346**	186,791	124,527	62,264			

[a] The **bold type** was the biomass used to calculated the harvest guideline or quota.

[b] Prior to 2000, the northern area was only northern California. Beginning in 2000, the northern area included Oregon and Washington.

PACIFIC SARDINE SUBALLOCATION

Situation: Concern has been noted that northern participants in the Pacific sardine fishery could be disadvantaged during years of lower sardine abundance, particularly, if sardines are not available in the North until later in the fishing season. Specifically, Oregon Department of Fish and Wildlife (ODFW) put forward a proposal for a suballocation of the Pacific sardine harvest guideline for the area north of California (Exhibit E.3, ODFW Proposal). ODFW requested the Coastal Pelagic Species Management Team (CPSMT) review the proposal and provide recommendations to the Council.

At the June 2000 meeting, the CPSMT and Coastal Pelagic Species Advisory Subpanel (CPSAS) provided preliminary recommendations to the Council regarding the suballocation issue. To further refine analysis of management measures to prevent preemption of the northern fishery, the Council directed the CPSMT to analyze several items related to the sardine fishery: 1) seasonal distribution of the Pacific sardine stock along the West Coast; 2) suballocation options proposed by the ODFW; and 3) the effects of delaying the start of the sardine fishery. Because information about the northern component of the sardine stock is sparse, the Council also requested a review of catch data to assess how much of the northern part of the harvest guideline is taken from January through May. This historical perspective of the amount harvested during the first five months of the fishery could be a basis for establishing a seasonal adjustment to the northern harvest guideline (i.e., limit the amount available during the first five months of the fishery).

The CPSMT has prepared an analysis of management options to address preemption concerns and will report their findings to the Council. In addition, the CPSAS has reviewed the CPSMT analysis and will provide comments to the Council.

Council Action:

1. **At the Council's discretion, provide guidance to the CPSMT and CPSAS for developing alternatives for suballocation of the Pacific sardine harvest guideline.**

Reference Materials:

1. February 9, 2000 letter from ODFW to Dr. Doyle Hanan (CPSMT Chair); includes ODFW suballocation proposal (Exhibit E.3, ODFW Proposal).
2. Exhibit E.3.b, Supplemental CPSMT Report.
3. Exhibit E.3.b, Supplemental CPSAS Report.

PFMC
10/13/00

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL STATEMENT ON PACIFIC SARDINE SUBALLOCATION

The Coastal Pelagic Species Advisory Subpanel (CPSAS) held a lengthy discussion regarding a possible suballocation of Pacific sardine to the states of Oregon and Washington. While the panel does not wish to preclude northern fishermen and processors from developing a productive fishery, members of the CPSAS are divided on how best to proceed with specific management measures in terms of a completely separate northern allocation. Due to time constraints, the CPSAS was unable to identify and/or develop possible allocation options. Some members of the panel believe that fishers in Oregon and Washington should be federally regulated (as opposed to leaving management up to the individual states) since they are fishing off a coast-wide federal quota.

For the year 2001, the majority of the CPSAS recommends suspending the current allocation scheme outlined in Amendment 8 (two-thirds for the area south of 35° N latitude or Pt. Pedras Blancas, California and one-third to the north of Pt Pedras Blancas to the Canadian border). With a harvest guideline of 134,747 metric tons, this allocation would work out to 89,824 metric tons south and 44,912 metric tons north. Instead, the majority of the panel believes that a coast-wide quota of 134,747 metric tons would better serve all participants in the fishery. Based on historic and recent participation, a coast-wide quota will eliminate the possibility of Oregon and Washington fishers precluding Monterey fishers and visa-versa.

The CPSAS puts forth this recommendation for the 2001 fishery only. The CPSAS realizes that a long-term solution must be developed for the fishery and we are ready to work with the CPS Management Team and the Council in order to come up with a sufficient allocation scheme that addresses concerns from all user groups.

COASTAL PELAGIC SPECIES MANAGEMENT TEAM STATEMENT ON PACIFIC SARDINE HARVEST GUIDELINE SUBALLOCATION

At the June Council meeting, the Coastal Pelagic Species Management Team (CPSMT) was directed to examine several items related to suballocation of the annual Pacific sardine harvest guideline (HG). Specifically, we were asked to: 1) analyze seasonal distribution of sardine biomass along the West Coast, 2) revisit the suballocation options proposed by Oregon Department of Fish and Wildlife (ODFW), 3) study effects of delaying start of the season, 4) review catch data to determine how much of the northern allocation is taken Jan-May.

Data on the seasonal coast-wide distribution of sardine biomass are not available in a form suitable for resolving fishery allocation questions. Historical tagging studies have demonstrated regular seasonal movement northward in the late-spring/early-summer and southward again in autumn. North-south movements were thought to be a feeding-spawning migration typical of older/larger individuals, as was evidenced by abbreviated summer fishing season to the north. Unfortunately, seasonal biomass distribution cannot be derived from these early studies. While sardine have re-occupied waters north of California, there is no clear evidence to date that a regular north-south migration pattern has resumed. Even if reliable coast-wide biomass distribution were available, distribution is likely to vary widely within and among years. Since we have no current information on relative biomass distribution off of California, Oregon, and Washington, it is not possible for the CPSMT to provide an objective opinion regarding the relative merit of ODFW's proposed allocation options.

The ODFW report raises a concern over the possibility of northern California's fishery preempting the northern suballocation before Oregon and Washington have an opportunity to prosecute their summer fisheries. To examine this likelihood, we reviewed historical (1935-1948) and recent landings data for the Oregon and California fisheries. Monthly catch data from Washington's sardine fishery were not available at the time of this analysis. Historically, the State of California imposed seasonal closures on their northern fishery from March through July and the southern fishery from March through August, therefore, evaluating availability information for California during the historical period is not appropriate. For this reason, only California catch data for 1992-1999 were applicable.

Oregon's monthly landings for 1999 and 2000 were identical in pattern to their seasonal catch for the period 1935-1948. Ninety-eight percent of Oregon's landings are made from July through September, peaking in August, with only minor quantities taken in other months (Figure 1). California sardine landings for the 1992-1999 period reflect a different seasonality than the Oregon fishery (Figure 2). The northern California fishery has a pronounced season beginning in mid-summer and peaking in the early fall, with landings tapering off in November and December. The southern California season is spread more evenly throughout the calendar year, with peaks in late winter and fall and a low during mid-summer months (Figure 2).

Catch data were also examined with respect to average cumulative percentage taken by each region throughout the calendar year in recent years (Figure 3). For the January-May period in question, Oregon had landed no sardine, northern California landed only 19% of their total annual take, and southern California landed 55% of the annual yield. By the end of August, Oregon's fishery took 99% of their landings, and northern California had landed 46% of their annual yield. With the exception of Jan-Feb 1999, the majority of northern California catch during the first semester amounts to only a few hundred tons per month (Table 1) where quality is relatively poor (e.g. small fish, low oil content). Hence, the incentive for northern California catch to increase in this time period is unlikely given current information.

Based on past experience, the northern fishery (OR/WA/Canada) will probably not persist once biomass drops below 700,000 tons (Table 2). It is unlikely that the northern California fishery will take all of the northern allocation before Oregon/Washington fisheries have a chance to complete their season. Moreover, if a significant fishery builds up in the open access region (north of 39 N), there is a chance that the Oregon/Washington fisheries could take the bulk of the northern allocation before the Monterey fishery has an opportunity to fish during its fall peak season. As an example, the combined Oregon and Washington fisheries landed at least 14,309 mt by the conclusion of their 2000 fishing season, but the northern California fishery had only taken 4,976 mt though September 2000.

The catch data analyses presented in this report address ODFW's concern regarding preemption from the northern suballocation. The data also highlight other potential problems with respect to north-south allocation which may arise when HGs are lowered. The Council may wish to consider avoiding these eventualities by considering alternatives to the current subarea allocation schemes. For example, in years when the HG is more than sufficient to accommodate the coast-wide fishery, the Council may consider removing all suballocations to avoid preemption of localized fisheries. When HGs are lowered, subarea HG preemption may be addressed by timing the release of the coast-wide HG to accommodate regional seasons.

Table 1. Monthly sardine landings (metric tons) in Washington, Oregon, and northern California and southern California, 1992-2000.

WASHINGTON LANDINGS (MT)

MONTH	1992	1993	1994	1995	1996	1997	1998	1999	2000
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.3
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	912.8
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2239.2
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1455.2
Oct	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	122.4
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4,791.9

OREGON LANDINGS (MT)

MONTH	1992	1993	1994	1995	1996	1997	1998	1999	2000
Jan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.8	50.4	205.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	238.5	2,456.8
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	383.0	3,959.5
Sep	3.7	0.0	0.0	0.0	0.0	0.0	0.0	103.5	2,593.2
Oct	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	302.8
Nov	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Dec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
TOTAL	3.9	0.2	0.0	0.0	0.0	0.0	1.0	775.6	9,517.2

NORTHERN CALIFORNIA LANDINGS (MT)

MONTH	1992	1993	1994	1995	1996	1997	1998	1999	2000
Jan	0.0	0.0	10.5	0.0	75.1	90.8	61.4	5,833.3	376.2
Feb	0.0	15.0	11.1	112.0	163.6	0.0	0.0	1,815.7	0.0
Mar	18.4	205.7	29.2	50.8	121.5	0.0	103.8	225.1	0.0
Apr	41.9	26.2	109.1	0.0	532.6	76.2	231.8	102.3	0.0
May	378.6	122.4	255.5	1.8	176.8	98.3	657.8	59.6	119.1
Jun	674.4	0.0	127.9	232.9	969.4	76.7	1,319.2	13.9	640.5
Jul	84.0	18.9	200.9	136.6	406.3	831.4	1,372.3	507.2	1,216.3
Aug	317.6	21.2	393.6	297.3	948.4	1,003.1	5,043.6	908.7	1,590.6
Sep	386.9	257.5	768.9	2,535.5	1,299.7	2,568.8	1,201.8	2,400.2	1,033.3
Oct	862.7	2.9	321.6	1,587.4	1,140.8	4,333.7	348.8	2,462.5	n/a
Nov	285.8	0.4	42.5	555.9	1,069.4	2,381.0	0.0	602.8	n/a
Dec	77.4	5.5	24.3	171.0	1,084.5	1,899.7	132.0	2,123.0	n/a
TOTAL	3,127.6	675.6	2,295.0	5,681.2	7,988.1	13,359.7	10,472.4	17,054.4	4,976.0

SOUTHERN CALIFORNIA LANDINGS (MT)

MONTH	1992	1993	1994	1995	1996	1997	1998	1999	2000
Jan	2,256.9	2,716.1	507.6	5,900.0	3,533.7	1,754.2	2,198.1	5,702.8	7,071.4
Feb	1,118.7	2,676.1	1,356.9	5,037.7	2,606.7	2,316.8	2,293.3	6,402.0	10,760.3
Mar	1,280.1	3,180.0	2,608.2	2,622.2	3,475.7	2,286.7	5,558.9	6,902.6	11,951.2
Apr	450.8	2,430.0	2,145.0	3,942.9	2,790.9	2,268.9	7,869.6	2,279.3	5,154.1
May	31.0	537.0	884.6	5,824.8	432.4	1,379.3	509.8	1,843.8	2,636.9
Jun	80.9	10.4	16.6	3,613.9	1,489.1	180.3	114.7	169.1	1,071.4
Jul	5.1	6.3	65.5	824.9	679.6	1,080.2	117.1	2,766.5	582.6
Aug	59.9	8.6	0.3	58.9	18.0	799.5	168.8	2,998.0	1,503.6
Sep	244.1	3.1	26.1	222.1	1,395.9	3,343.1	980.7	3,989.2	841.5
Oct	1,649.3	2,700.5	1,284.4	4,581.5	7,033.0	7,494.9	3,423.7	3,327.4	n/a
Nov	5,871.6	279.1	328.1	773.6	1,038.0	4,441.3	3,440.3	2,375.9	n/a
Dec	1,765.2	122.5	204.6	1,508.6	71.4	2,178.2	5,789.9	3,265.1	n/a
TOTAL	14,813.6	14,669.6	9,428.0	34,911.1	24,564.5	29,523.3	32,464.7	42,021.8	41,573.1

Table 2. Historical sardine biomass and harvest (metric tons) for the 1933-34 to 1950-51 fishing seasons (June-May). Biomasses from MacCall (1979); Landings from Radovich (1981).

Season	Biomass	Canada	Washington	Oregon	California	Total
1933-1934	3,414,000	3,674	0	0	347,845	351,519
1934-1935	3,624,000	39,009	0	0	539,829	578,839
1935-1936	2,844,000	41,114	9	23,796	508,480	573,399
1936-1937	1,688,000	40,325	5,951	12,882	658,735	717,893
1937-1938	1,206,000	43,618	15,513	15,114	377,904	452,149
1938-1939	1,201,000	46,965	24,023	15,440	521,897	608,325
1939-1940	1,607,000	5,008	16,112	20,258	487,405	528,782
1940-1941	1,760,000	26,100	735	2,867	417,839	447,541
1941-1942	2,457,000	54,477	15,513	14,379	532,861	617,230
1942-1943	2,064,000	59,766	526	1,769	457,825	519,887
1943-1944	1,677,000	80,504	9,471	1,651	433,756	525,382
1944-1945	1,206,000	53,633	18	0	503,407	557,058
1945-1946	720,000	31,117	2,096	82	366,219	399,513
1946-1947	566,000	3,620	5,570	3,593	212,104	224,886
1947-1948	405,000	445	1,234	6,287	110,080	118,045
1948-1949	740,000	0	45	4,826	166,675	171,547
1949-1950	793,000	0	0	0	307,471	307,471
1950-1951	780,000	0	0	0	320,319	320319

Figure 1. Historical and recent landings in Oregon's sardine fishery.

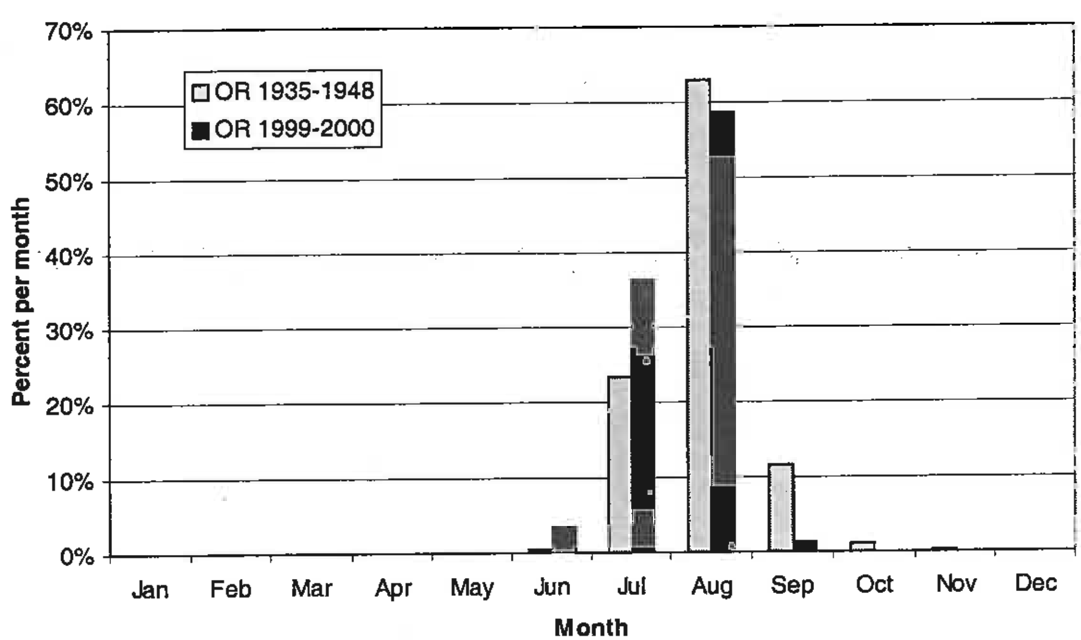


Figure 2. Recent landings in northern and southern California's directed sardine fishery.

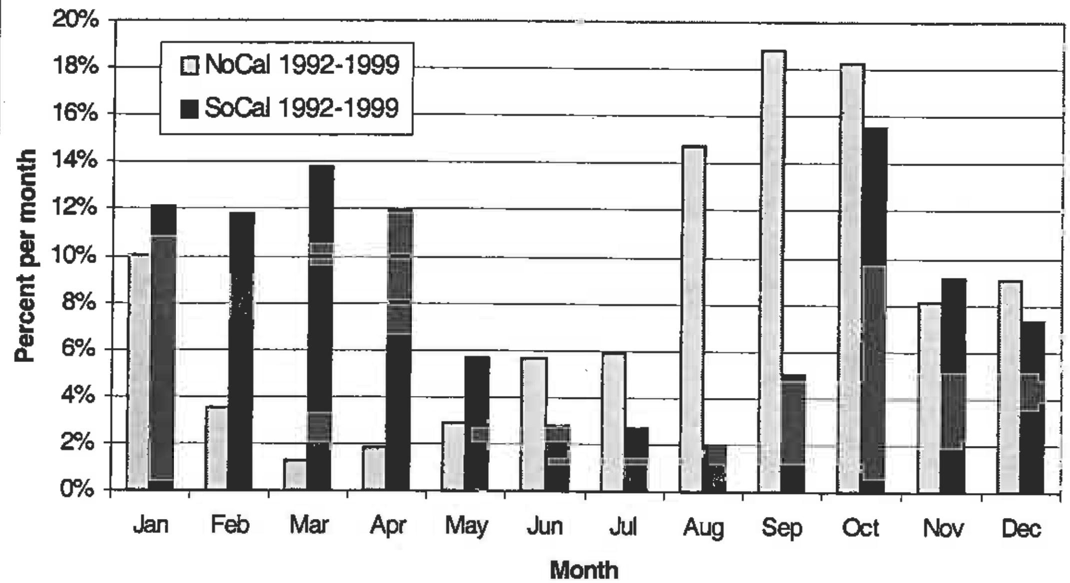
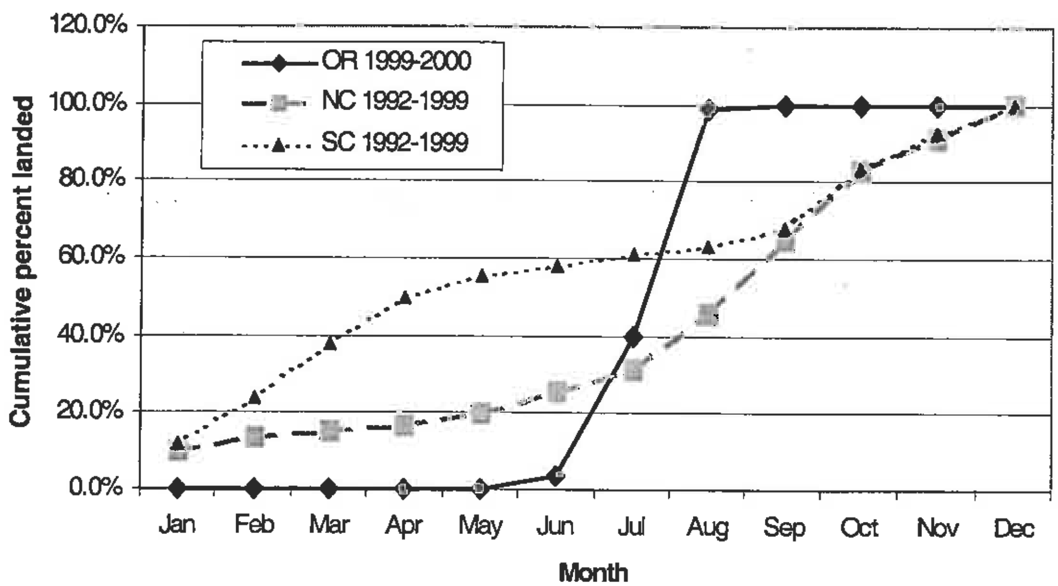


Figure 3. Percent cumulative landings by the directed sardine fisheries in Oregon and California.



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1222 Merrill Street / Salinas, CA 93901 / 831-422-9407 / Fax: 831-755-1924

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Mr. James Lone, Chairman
Pacific Fishery Management Council
2130 SW 5th Avenue, Suite 244
Portland, OR 97201

Dear Chairman Lone & Council Members:

I am the vice-president of Monterey Fish Company Inc., based in Salinas, California. Monterey Fish Company is a third-generation family-owned and run seafood packing company originally established in 1941. We have a state-of-the-art cannery in Salinas, that employs 400 employees. Monterey Fish Company, Inc. also own and fish two boats in both the sardine and squid fisheries. We have made, and continue to make, significant investments in the sardine fishery that benefit our community as well as the State of California. I also serve as a processor representative on the Council's Coastal Pelagic Species (CPS) Advisory Subpanel.

I am writing this letter to voice concerns for the future of our very important sardine fishery in California.

As you know, the CPS Fishery Management Plan (FMP) implemented a limited-entry program south of Pt Arena, California. Originally, we had to qualify for limited entry fishing permits and the qualifications were set up so as to restrict the fishery to approximately 70 boats. I am aware that members of the Council favored a smaller fleet, specifically 41 boats. Forty-one boats are not sufficient to successfully support the industry. In addition, we must be able to upgrade the boats that we have. First to make them safe and secondly to assure the quality of sardines by being able to carry a significant amount of chilled seawater along with the fish. Now the Council has directed the CPS Management Team to go back and reevaluate the goals of the finfish limited entry fishery.

With all of this unsettled, here comes a fishery in Oregon and Washington, where fishing permits are not federally regulated. Due to a sizeable demand in Japan for large sardines, the processing and fishing capacity in Oregon and Washington may triple within the next two years. Additional boats could be added through the state programs, which could lead to substantial fishing pressure in both of these states. Currently there is a sardine allocation set in the FMP that allows two-thirds of the harvest guideline for the south (Pt Pedras Blancas, California to the Mexican border) and one-third for the north (north of Pt Pedras Blancas to the Canadian border, including Oregon and Washington). For 2001,

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the 134,737 metric ton harvest guideline would be allocated 44,912 metric tons to the north, and 89,824 metric tons to the south. This allocation could preclude historic Monterey fishermen and processors from participating in this important fishery. It is entirely possible that Oregon and Washington could harvest significant amounts of sardine during their season (typically June/July through August/ September). The main fishing season in Monterey begins in August and continues through February. However, due to inclement weather, January and February are generally not productive months.

Those of us who are major participants in this fishery are having a hard time understanding the current management process and the thinking behind it. Those of us who rejuvenated and developed the current fishery were forced into a federally controlled limited entry program. There is a federal, coast-wide quota with a set number of boats. If CDFG has their way, this number of boats will be further reduced, with no transferability of permits or upgrades on boats after December 31st, 2000. Managers claim this situation will only prevail until this yet-to-be-determined "goal" is reached. Now, here comes Oregon and Washington with a seemingly "open access" fishery. They are fishing off the same coast-wide federal quota, but they are being encouraged to develop their fishery while we in the south are being controlled by increasingly strict regulations.

While we in no way want to preclude Oregon and Washington from developing successful fisheries, we believe it is imperative to develop a sufficient long-range plan that will address *all* of the users concerns. This may mean developing a separate quota for the northern states to be allocated in years when the biomass is over a specific threshold.

As I stated above, we have invested a significant amount of money developing this fishery and we need some further assurances of its stability. For the 2001 fishery we recommend that the current "two-thirds / one-third" allocation be abolished, and that a coast-wide quota be implemented. This, in itself, will prevent user conflicts for the upcoming year. However, we do not feel this is the ultimate solution. We should begin work now on how best to address these critical issues and potential user conflicts for the following years.

Thank you for your consideration,

Sal Tringali

Sal Tringali
Vice President
Monterey Fish Company, Inc