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JANUARY 1999

TRENDS IN STANDARDIZED CATCH RATE OF SOME ROCKFISHES (*Sebastes* spp.) FROM THE CALIFORNIA TRAWL LOGBOOK DATABASE

By

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ADMINISTRATIVE REPORT SC-99-01

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Trends in Standardized Catch Rate of Some Rockfishes (*Sebastes* spp.) from the California Trawl Logbook Database

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November 1998

NOT FOR PUBLICATION

INTRODUCTION

On the west coast of the United States commercial trawl fisheries logbook data have been recorded and collected by fishermen in the States of Washington, Oregon, and California for many years. One of the primary uses of such data is to study trends in catch rate or catch-per-unit-effort (CPUE). For example, results presented in Fox and Starr (1996) showed that, at least for certain species, spatial distributions of catch rate using trawl logbook data coincided with spatial distributions of catch rate from the Alaska Fisheries Science Center's (AFSC) triennial shelf trawl survey, a major fishery-independent research survey. They also argued that long-term declines in stock biomass can be revealed from the study of trawl logbook data. Other authors have also analyzed west coast trawl logbook data with the specific goal of developing time series of stock abundance for use in assessments of exploited stocks (e.g., Brodziak 1997; Sampson 1997).

Rockfishes of the genus *Sebastes* are particularly difficult to assess due to the multitude of species, contagious distributional patterns, and occurrences in habitats that are difficult to sample or survey. The Pacific Fishery Management Council (PFMC), in its **Research and Data Needs for 1998-2000**, has identified the need to "continue evaluation of the use of trawl logbook data to measure relative abundance of groundfish." Moreover, the Scientific and Statistical Committee of the PFMC has, in its recent **Guidelines to Assessment Authors**, required that all groundfish stock assessments include an analysis of commercial logbook data when they are available.

The objective of this report is to conduct a comprehensive and rigorous analysis of the California trawl logbook data set to evaluate whether or not it provides a coherent picture of species-specific trends in the abundance of exploited rockfish stocks. Of particular interest are those species that the PFMC manages with trip or bimonthly cumulative limits to achieve optimum yield (OY), including bocaccio (*Sebastes paucispinis*), chilipepper (*S. goodei*), widow rockfish (*S. entomelas*), canary rockfish (*S. pinniger*), and yellowtail rockfish (*S. flavidus*). In addition, most of the species investigated by Pearson and Ralston (1990) are examined, including darkblotched rockfish (*S. crameri*), splitnose rockfish (*S. diploproa*), bank rockfish (*S. rufus*), and blackgill rockfish (*S. melanostomus*). Taken together these nine species comprise over 90% of all the rockfish that have been landed by the California trawl fishery since 1980.

MATERIALS AND METHODS

The State of California requires that if one fishes commercially with trawl gear a logbook must be maintained and periodically submitted to the California Department of Fish & Game (CDF&G). The data from the logbooks are structured so that each record (i.e., observation) represents the information concerning one trawl haul. Consequently, variables in the logbook database include: haul number, vessel number, date fished, the geographic CDF&G reporting block where the trawling occurred, port of landing, hours fished, and the pounds captured of 27 distinct taxa. The logbook data are extensive, representing the results of over 380,000 hauls (records) that have been conducted over a nineteen-year period (1978-96) (Figure 1).

Due to the very large number of ports of landing in the State of California, some of which are responsible for trivial groundfish catches, it was desirable to reduce the data to the essential ports responsible for the preponderance of trawling activity. The logbook data were therefore subsetted to include only observations from the following ports of landings: Crescent City [201], Field's Landing [217], Eureka [220], Fort Bragg [223], San Francisco [440], Princeton [452], Bodega Bay [473], Monterey [550], Moss Landing [592], Avila [602], or Morro Bay [606]. Although this reduced the number of ports in the data set from 277 to 11, only 10.3% of all the records were deleted. Moreover, to further streamline and consolidate the information, records from Field's Landing, Princeton, Moss Landing, and Avila were reassigned and merged with the ports of Eureka, San Francisco, Monterey, and Morro Bay, respectively.

Among the many taxa are four nominal categories representing certain *Sebastes* species, including widow rockfish (*S. entomelas*), Pacific ocean perch (*S. alutus*), splitnose rockfish (*S. diploproa*), and other "rockfish." However, due to low catches of *S. alutus* in California and to changing practices by industry in the sorting of *S. diploproa* into various economic market categories (Figure 2), neither of those two species can be analyzed reliably on a species-specific basis using the logbook data. Moreover, the incidence of positive occurrences of nominal widow rockfish in the logbook data set did not stabilize until 1982 (Figure 3), after the fishery went through a dramatic expansion (Gunderson 1984). For these reasons, in the analysis that follows I have attempted to estimate the species-specific catch rate of widow rockfish from the logbook data alone for the period 1982-96. Also presented is a procedure for estimating the catch rate of other rockfish species using the logbook data in an aggregated form, in conjunction with commercial landings statistics to decompose the data to the species level. Such a calculation was used by Ralston *et al.* (1998) in a stock assessment of chilipepper rockfish.

The latter procedure is based on the idea that the unstandardized catch rate (θ) of the aggregate of rockfish species taken during a single trawl tow can be calculated as:

$$\theta_{ypvmbt} = \frac{C_{ypvmbt}}{f_{ypvmbt}},$$

where C_{ypvmbt} is the total catch in pounds of "rockfish" taken during year **y** at port **p** by vessel **v** fishing in month **m** within CDF&G reporting block **b** during tow **t**. Similarly, f_{ypvmbt} is the fishing effort (hours trawled) required to capture the fish. Throughout this analysis the trawl logbook data were restricted to include only those hauls that produced a positive rockfish catch from a positive fishing effort. Next, the data were stratified by port and fitted to an analysis of variance model of the form:

$$\log_e[\theta_{ypvmbt}] = \mu_p + \zeta_{yp} + \upsilon_{vp} + \psi_{mp} + \beta_{bp} + \varepsilon_{ypvmbt},$$

where μ_p is the mean of the natural logarithm of the catch rate at port **p**, ζ_{yp} is a port-specific year effect, υ_{vp} is a port-specific vessel effect, ψ_{mp} is the port-specific effect due to month of capture, β_{bp} is the port-specific effect attributable to reporting block, and ε_{ypvmbt} is a port-specific normally distributed error term ($\sim\mathcal{N}[0,\sigma_p^2]$). To ensure that all effects in the model were well estimated, the data were censored on a port-by-port basis to include only those CDF&G reporting blocks with at least 500 catch records and those vessels with at least 200 hauls.

More complex models involving interaction terms were also evaluated during initial exploratory analyses, but these were ultimately discarded in favor of the simple model, primarily due to a consideration of parsimony versus realism (Table 1). Note that port-specific r^2 values generally increased as the complexity of the ANOVA model grew, with complexity gauged by the number of parameters estimated (i.e., model degrees of freedom). However, the increased explanatory power of Models 2-4 came at substantial cost. For example, at San Francisco the best fitting model (#4) accounted for only 4% more of the variance in log-catch rate than did the simple model (#1), and yet it required estimation of an additional 433 parameters. Upon consideration of these tradeoffs and the relatively good predictive capability of the simple non-interactive model, I decided to use Model 1 in all subsequent analyses.

The data were fitted using the General Linear Model (GLM) procedure available in the SAS Institute Inc. (1987) software system. Port-specific least-square means (Searle *et al.* 1980) were estimated for all year effects in the model (i.e., $\hat{Y}_{yp}$), as well as the standard errors of the estimates (s_Y). That is:

$$\hat{Y}_{yp} = \log_e[\hat{\theta}_{yp}] = \mu_p + \zeta_{yp} + \overline{\upsilon}_{vp} + \overline{\psi}_{mp} + \overline{\beta}_{bp},$$

where all terms are as before, except that $\overline{\upsilon}_{vp}$ is the simple average of all port-specific vessel effects, $\overline{\psi}_{mp}$ is the mean port-specific monthly effect, and $\overline{\beta}_{bp}$ is the average of the various port-specific CDF&G reporting block effects. Finally, year and port specific estimates of "rockfish" catch rate ($\hat{\Theta}_{yp}$), corrected for back-transformation bias, were calculated according to:

$$\hat{\theta}_{yp} = \exp(\hat{Y}_{yp} + \tfrac{1}{2}\sigma_p^2),$$

where σ_p^2 is the mean-squared error term of the model estimated for port **p** (Johnson and Kotz 1970). Those authors also show that the coefficient of variation (CV) of the $\hat{\Theta}_{yp}$ is given by:

$$CV = \sqrt{\exp(s_y^2) - 1},$$

so that the variance of $\hat{\Theta}_{yp}$ is:

$$VAR[\hat{\theta}_{yp}] = \hat{\theta}_{yp}^2 \cdot CV^2 = \hat{\theta}_{yp}^2 \cdot [\exp(s_y^2) - 1].$$

To decompose these aggregated "rockfish" catch rates into species-specific estimates, the $\hat{\Theta}_{yp}$ were multiplied by the proportion the various species of *Sebastes* comprised in the landings at each port, i.e.,

$$\hat{\theta}_{yps} = \hat{\theta}_{yp} \cdot \hat{\pi}_{yps},$$

where $\hat{\Theta}_{yps}$ is the standardized catch rate of species **s** at port **p** during year **y** and $\hat{\pi}_{yps}$ is the estimated proportion that rockfish species **s** comprises in the landings at port **p** during year **y**. That is,

$$\hat{\pi}_{yps} = \frac{L_{yps}}{\sum_s L_{yps}},$$

where L_{yps} is the landings of "rockfish" species **s** in year **y** at port **p**. These proportions were calculated from trawl landings statistics in the COM_LANDS table contained in the Santa Cruz/Tiburon Laboratory's groundfish relational database.

Due to the manner in which the landings are expanded through merging of observer port-sampled data to the landing receipt data (Erwin *et al.* 1997; Pearson and Erwin 1997), it is not possible to obtain an exact variance estimate of the individual $\hat{\pi}_{yps}$. Therefore, to obtain a proxy estimate of the variance, when possible, a 3-year running variance of the proportion was calculated for all possible combinations of years, ports, and species. That is,

$$\mathrm{VAR}[\hat{\pi}_{yps}] \cong \mathrm{VAR}[\hat{\pi}_{(y-1)ps}, \hat{\pi}_{yps}, \hat{\pi}_{(y+1)ps}].$$

Because this variance estimate includes both within- and among-year sources of variability it will overestimate the true within-year error variance. The logarithm of the proxy variance estimate was then regressed against the logarithm of $\hat{\pi}_{yps}$, providing an equation that could be used to predict the variance of any particular proportion. The final error estimate of the individual $\hat{\Theta}_{yps}$, being the product of the estimates of two random variables (Goodman 1960), was calculated as:

$$\mathrm{VAR}[\hat{\theta}_{yps}] = \hat{\pi}^2_{yps} \cdot \mathrm{VAR}[\hat{\theta}_{yp}] + \hat{\theta}^2_{yp} \cdot \mathrm{VAR}[\hat{\pi}_{yps}] - \mathrm{VAR}[\hat{\theta}_{yp}] \cdot \mathrm{VAR}[\hat{\pi}_{yps}].$$

Catch rate estimates were then combined over ports, yielding species-specific time series of standardized catch rate. For this purpose, two weighting schemes were explored. First, the $\hat{\Theta}_{yps}$ were weighted by landings, i.e.,

$$w_{ps} = \frac{\sum_y L_{yps}}{\sum_p \sum_y L_{yps}}$$

where L_{yps} is as defined previously and w_{ps} is the weight used for species **s** at port **p**. In simple terms, the w_{ps} represent the proportion of the total historic trawl landings of a species that were produced at a particular port. The second weighting scheme used the number of CDF&G reporting blocks to weight the $\hat{\Theta}_{yps}$. Namely,

$$w_p = \frac{N_p}{\sum_p N_p}$$

where N_p is the number of blocks entering into the ANOVA model at port **p**, i.e., those blocks with at least 500 records of positive rockfish catch with positive effort (see above). In this scheme each block was assigned a total weight of one. Consequently, if multiple ports accessed the same fishing grounds, the weight for that block was evenly divided and apportioned to the ports that utilized the area. Note that when the $\hat{\Theta}_{yps}$ are weighted by area, the weights are the same for all species ($w_{ps} = w_p$).

In either case, the $\hat{\Theta}_{yps}$ and the $\mathrm{VAR}[\hat{\Theta}_{yps}]$ were combined over ports as a weighted sum according to,

$$\hat{\theta}_{ys} = \sum_p w_{ps} \cdot \hat{\theta}_{yps}$$

and

$$\mathrm{VAR}[\hat{\theta}_{ys}] = \sum_p w^2_{ps} \cdot \mathrm{VAR}[\hat{\theta}_{yps}].$$

RESULTS

The analysis was stratified on a port-specific basis because the species composition of the trawl landings of rockfish varies markedly from one port to the next (Table 2). Note, for example, the relative importance of *Sebastes entomelas*, *S. crameri*, *S. pinniger*, and *S. flavidus* in the northern ports of Crescent City, Eureka and Fort Bragg, and the much reduced contribution of these species to trawl landings in the southern ports of Monterey and Morro Bay. Conversely, *S. rufus*, *S. diploproa*, *S. melanostomus* are much more significant species in the south than in the north. Although two of the rockfishes produce significant landings coastwide (*S. goodei* and *S. paucispinis*), their relative importance does vary from port to port.

Nominal Widow Rockfish (*Sebastes entomelas*)

A separate and distinct analysis was conducted for *S. entomelas* because it is nominally identified in the trawl logbook data. As a consequence, there is no need to decompose an aggregated catch rate to the species-specific level. Rather, the data were analyzed on a port-specific basis using the previously described general linear ANOVA model with year, vessel, CDF&G reporting block, and month effects. However, due to the reduced number of records positive for nominal widow rockfish, the criterion for inclusion in the analysis was reduced from 500 records per reporting block to 100 records per block and from 200 observations per vessel to 100 observations per vessel. Back-transformation of the year effects from the model ($\hat{Y}_{yp}$), with bias-correction, then yielded port-specific standardized time series of nominal widow rockfish catch rates, which in turn were combined as weighted averages using the previously described catch and area weighting schemes.

Detailed results pertaining to the five ANOVA models that were fitted to nominal widow rockfish data from Crescent City, Eureka, Fort Bragg, San Francisco, and Bodega Bay are presented in Appendix A. There were insufficient data available from the ports of Monterey and Morro Bay with which to conduct an analysis. Results presented in Table 3 and Figure 4 provide time series of standardized nominal widow rockfish catch rates using catch- and area-weighted approaches. In the figure note that each estimated value is bracketed by ± 1.0 standard error of the estimate.

"Other" Rockfish

To estimate the standardized catch rates of *Sebastes* species other than widow rockfish, the reported catch of the three other nominal *Sebastes* taxa in the logbook data (i.e., "splitnose", "Pacific ocean perch", and "rockfish") were summed for each logbook observation, yielding the catch of non-widow rockfish in a tow (C_{ypvmbt}). These aggregated catch statistics were then analyzed as outlined in the Methods section, after invoking the 500 records/reporting block and 200 records/vessel inclusion criteria.

Detailed results of the seven ANOVA models that were applied to the "other" rockfish catch data from all seven ports are presented in Appendix B. Results shown in Figure 5 reveal the port-specific trends in $\hat{Y}_{yp}$ ($\log_e [\hat{\Theta}_{yp}]$). With the exception of Bodega Bay and possibly

Crescent City, results from all localities show clear evidence of long-term declines in the catch rate of "other" rockfish.

The $\hat{\Theta}_{yp}$ were decomposed into species-specific estimates using estimated non-widow rockfish trawl catch proportions ($\hat{\pi}_{yps}$), and the variance of that statistic was approximated using a 3-year running variance (see Methods section). Results presented in Figure 6 show that $\log_e[VAR(\hat{\pi}_{yps})]$ was linearly related to $\log_e[\hat{\pi}_{yps}]$, with a least-squares regression fit to the data yielding an intercept equal to -2.4292, a slope of 1.6932, and a residual variance of 1.9698. Those statistics were then used to predict $VAR(\hat{\pi}_{yps})$ from the individual $\hat{\pi}_{yps}$.

Time series of standardized, decomposed catch rates of bocaccio, chilipepper, bank rockfish, canary rockfish, darkblotched rockfish, splitnose rockfish, yellowtail rockfish, and blackgill rockfish are presented in Tables 4-11 and Figures 7-14, respectively. Note that both catch- and area-weighted results are provided and that, in the figures, estimates are bracketed by $\pm$ 1.0 standard error.

DISCUSSION

In this study two different weighting schemes were used to pool catch rate estimates over ports. It is perhaps not surprising that the catch-weighted statistics were consistently higher than their area-weighted counterparts (Figure 15), because, all other things being equal, higher catches should result from higher catch rates. However, in evaluating the relative merits of the two different approaches, it is important to consider the spatial distribution of the stock. If a stock of rockfish is distributed in a uniform manner along the coastline prior to exploitation, then weighting by area is most appropriate. In that case, catch rates estimated from ports that sample relatively large areas of coastline represent relatively larger segments of the population. As a consequence they should be weighted more heavily than ports representing smaller coastal areas. Alternatively, if the initial distribution of a stock is variable, as for example if there are spatially discrete high density pockets of fish, and after targeting these sites the fishery increasingly exploits lower density areas as stock biomass declines, then weighting CPUE statistics by catch seems more appropriate. That is because catch-weighting, which was based on observed port-specific cumulative removals from 1982-96, should be directly proportional to the cumulative effect on stock biomass. In either event, the two weighting schemes in some sense represent opposite ends of a hypothetical continuum, with reality lying somewhere in between.

The decomposition of the aggregated "rockfish" CPUE statistic into species-specific values entails the fundamental assumption that, on a port-by-port basis, these species represent a pure assemblage and that there have been no modifications in the targeting of individual species in the assemblage over time. Stated otherwise, when a vessel operator decides to conduct a trawl at any particular location, it is done with the expectation that a mix of species will be caught, with the species composition of the catch matching that of the port where he lands his catch. Obviously this is a simplifying assumption, because fishers are known to be able to target on several different rockfish assemblages, including widow rockfish, a slope rockfish group, and a shelf rockfish assemblage (Rogers and Pikitch 1992). It is significant, however, that in this study the catch rate of widow rockfish was estimated through the nominal assignment of landings in the logbook data, obviating the need to decompose the widow rockfish results. Moreover, all the other rockfish in the Rogers and Pikitch (1992) study were considered members of either the slope rockfish group (*S. alutus*, *S. crameri*, *S. diploproa*, and *S. reedi*) or the shelf rockfish group (*S. flavidus*, *S. paucispinis*, *S. pinniger*, *S. ruberimmus*, and *S. zacentrus*). Thus, although the classification of all non-widow rockfishes into a single homogeneous assemblage is a simplification, it is also true that data exist to show that these species are members of perhaps no more than two broad assemblages.

Temporal alterations in the proportion of total trawl landings that each of the nine species studied here comprise, can be taken as *prima facie* evidence that a unit of trawling effort does not target all species equally. Such alterations are certainly evident (Figure 16), i.e., a diminishing importance of *S. paucispinis* and *S. entomelas* to total landings, with a concomitant increase in the relative importance of *S. goodei*, *S. rufus*, *S. melanostomus*, *S. diploproa*, and *S. crameri*. Changes of this kind could plausibly be attributed to differences in targeting or even species succession over the long-term. Alternatively, they could be due to species-specific differences in catchability coefficient (**q**), with the former rockfishes representing high catchability stocks and the latter species exhibiting reduced catchability. Under increasing exploitation, the proportion a low-catchability species constitutes in the total landings will increase over time, irrespective of targeting differences. Thus, temporal change in the mix of rockfish species is not a sufficient condition to conclude that these species are not a homogeneous assemblage.

At least two species appear to show long-term declines in catch rate, i.e., bocaccio and canary rockfish. In addition, the area-weighted statistic for bank rockfish also declined. Even so, the analysis performed here did not reveal any consistent overall pattern of decline among the nine species as a whole. This general result occurred in spite of the fact that port-specific year effects from most sites did fall (see Figure 5).

Any study of temporal change in logbook CPUE data must acknowledge the tendency for those data to be biased. Specifically, there is ample evidence from the literature to show that catch rate statistics obtained from commercial logbooks usually underestimate the rate of decline of exploited fish stocks. Particularly noteworthy in this regard is the finding of Walters and Maguire (1996) who, in reviewing the collapse of the northern cod fishery off the maritime provinces of Canada, conclude that "stock size overestimation is a major risk when commercial catch per effort is used as an abundance trend index" (see also Arreguín-Sánchez [1996]).

Given this tendency for logbook data to misrepresent the rate of decline of exploited stocks, we make two observations concerning the study by Fox and Starr (1996), who advocated the use of logbook data to document declines in stocks of west coast groundfish. First, their analysis is based on the trawl logbook data gathered by the Oregon Department of Fish and Game, an agency that routinely reconciles Oregon logbooks with port sample and landing receipt data to ensure the accuracy of the logbook information. This reconciliation step is not routinely conducted in California. Second, their conclusions are based on comparisons with results from the fishery-independent AFSC triennial shelf survey and were influenced to a great extent by results for non-rockfish species, including especially English sole (*Parophrys vetulus*).

In similar fashion, it is possible to directly compare the standardized logbook CPUE statistics developed here with results from the triennial shelf survey (Wilkins 1996). That comparison shows (Figure 17) that the estimated swept-area biomass for each of the eight shared species, when summed over the Monterey and Eureka INPFC areas, shows relatively poor correspondence with the standardized California logbook catch rate data. While it is true that rockfish abundance estimates from the triennial survey are far from precise, with coefficients of variation in the range of 30-70%, the triennial survey has been used routinely as the primary source of auxiliary trend information in the rockfish stock assessments that have been conducted for the Pacific Fishery Management Council (Ralston 1998).

ACKNOWLEDGMENTS

I would like to thank Pete Adams, Larry Jacobson, Alec MacCall, Michael Mohr, Don Pearson, and Jean Rogers for providing valuable suggestions in their reviews of a preliminary version of this report. Notwithstanding their helpful comments, however, the methods, ideas, and opinions that are presented here are solely my own, i.e., these reviewers should not be construed as having condoned the analytical approach or approved the findings. This is Santa Cruz Laboratory Contribution No. 101.

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Table 1. Performance of four different ANOVA models of trawl logbook CPUE statistics with respect to realism (total model r^2) and parsimony (total model degrees of freedom). Note that Model 1 incorporated year, month, vessel, and reporting block factors as simple main effects. In contrast, the three other models also included an interaction term, i.e., a month×block interaction (Model 2), a month×boat interaction (Model 3), or a block×boat interaction (Model 4).

Model	Crescent City	Eureka	Fort Bragg	San Francisco	Bodega Bay	Monterey	Morro Bay
Model r^2							
1	0.37	0.37	0.34	0.58	0.26	0.38	0.43
2	0.44	0.39	0.35	0.60	0.29	0.41	0.46
3	0.44	0.41	0.36	0.60	0.32	0.44	0.48
4	0.42	0.48	0.40	0.62	0.28	0.43	0.52
Model Degrees of Freedom							
1	69	96	69	79	31	48	86
2	212	325	245	310	75	136	317
3	348	571	328	380	64	179	471
4	371	763	430	512	43	136	620

Table 2. Percentage composition of the trawl catch of *Sebastes* spp. by port (1982-96 data).

Species	Crescent City	Eureka	Fort Bragg	Bodega Bay	San Francisco	Monterey	Morro Bay
entomelas	64.3106	47.0683	15.1625	40.0189	22.2155	12.5106	3.0694
goodei	1.8666	6.5563	29.7171	17.4026	30.5987	35.5817	27.7834
paucispinis	3.8660	6.6616	19.6208	20.4739	25.8238	24.9547	24.2887
rufus	0.3200	1.2435	7.3365	8.8035	6.8875	6.8870	20.5194
crameri	3.6493	15.9053	6.9491	3.0835	1.0655	2.1456	2.0213
diploproa	2.0636	1.6981	3.3760	2.2513	6.1584	10.5629	7.0570
flavidus	12.4207	3.6741	4.5165	1.7793	1.5751	0.7843	0.4466
pinniger	4.6966	5.2267	6.6783	2.2963	1.2629	0.3688	0.1793
melanostomus	0.0875	0.3158	1.2113	1.3573	1.3495	2.4830	8.3315
aurora	0.3159	0.3896	0.3544	0.1591	0.4755	1.0066	3.3313
chlorostictus	0.1756	0.4967	1.7010	0.6141	0.7469	0.4572	0.2406
zacentrus	0.6534	2.9656	0.2239	0.0701	0.0570	0.0285	0.0092
melanops	1.8856	1.9277	0.0181	0.0012	0.0040	0.0019	0.0056
alutus	0.8570	2.0346	0.1539	0.0288	0.0070	0.0067	0.0169
babcocki	0.8843	0.6815	0.4515	0.3222	0.1548	0.0776	0.3504
elongatus	0.6338	0.7570	0.1593	0.4014	0.1208	0.3010	0.0700
ruberrimus	0.5735	0.2137	1.1361	0.2273	0.1312	0.0393	0.0773
saxicola	0.2969	1.0136	0.5376	0.1074	0.1102	0.1764	0.0180
miniatus	0.0352	0.2065	0.0651	0.0531	0.0508	0.2883	1.0321
levis	0.0088	0.0012	0.2365	0.2053	0.4751	0.3524	0.3327
auriculatus	0.1654	0.0152	0.0454	0.2173	0.2157	0.0244	0.1831
jordani	0.0245	0.0325	0.1202	0.0565	0.1018	0.4179	0.0206
ovalis	0.0000	0.0000	0.0015	0.0016	0.0258	0.0790	0.4376
proriger	0.0301	0.4116	0.0212	0.0001	0.0006	0.0014	0.0000
rosenblatti	0.0230	0.0254	0.0022	0.0117	0.1579	0.0036	0.0609
helvomaculatus	0.0411	0.1973	0.0129	0.0004	0.0005	0.0119	0.0007
nebulosus	0.0034	0.0024	0.0005	0.0003	0.0019	0.2246	0.0000
reedi	0.0000	0.1624	0.0414	0.0000	0.0000	0.0000	0.0000
rubrivinctus	0.0054	0.0005	0.0252	0.0141	0.0686	0.0212	0.0394
brevispinis	0.0255	0.0226	0.0312	0.0163	0.0358	0.0000	0.0000
serranoides	0.0000	0.0000	0.0000	0.0099	0.0000	0.1135	0.0007
gilli	0.0000	0.0148	0.0000	0.0000	0.0796	0.0001	0.0045
aleutianus	0.0146	0.0611	0.0126	0.0012	0.0000	0.0002	0.0000
rosaceus	0.0253	0.0046	0.0034	0.0091	0.0074	0.0012	0.0251
borealis	0.0356	0.0000	0.0186	0.0000	0.0000	0.0000	0.0000
caurinus	0.0018	0.0020	0.0054	0.0012	0.0023	0.0048	0.0230
eos	0.0000	0.0002	0.0000	0.0000	0.0060	0.0170	0.0138
carnatus	0.0000	0.0000	0.0005	0.0013	0.0002	0.0324	0.0000
mystinus	0.0008	0.0032	0.0165	0.0000	0.0024	0.0072	0.0024
ensifer	0.0000	0.0000	0.0284	0.0000	0.0001	0.0000	0.0000
wilsoni	0.0000	0.0007	0.0000	0.0000	0.0000	0.0114	0.0052
phillipsi	0.0000	0.0000	0.0000	0.0020	0.0105	0.0007	0.0000
simulator	0.0027	0.0000	0.0076	0.0001	0.0018	0.0000	0.0000
chrysomelas	0.0000	0.0000	0.0000	0.0000	0.0088	0.0000	0.0016
nigrocinctus	0.0000	0.0000	0.0000	0.0000	0.0000	0.0070	0.0000
hopkinsi	0.0000	0.0012	0.0000	0.0002	0.0021	0.0026	0.0000
serriceps	0.0000	0.0000	0.0000	0.0000	0.0000	0.0033	0.0000
rastrelliger	0.0000	0.0022	0.0000	0.0000	0.0000	0.0000	0.0006
rufinanus	0.0000	0.0026	0.0000	0.0000	0.0000	0.0000	0.0000
maliger	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
atrovirens	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
umbrosus	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000
vexillaris	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

Table 3. Standardized catch rates of nominal widow rockfish (*Sebastes entomelas*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	4,898	2,043	2,558	779
83	1,137	302	476	91
84	976	376	646	221
85	732	191	355	60
86	1,488	506	651	155
87	2,771	1,185	1,039	357
88	2,336	1,310	1,008	473
89	455	177	332	70
90	843	426	445	129
91	188	135	140	41
92	3,383	4,299	1,101	1,282
93	508	164	225	50
94	1,816	1,188	597	354
95	3,063	1,082	1,049	346
96	1,280	814	433	243

Table 4. Standardized catch rates of "inferred" bocaccio (*Sebastes paucispinis*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	190.1	60.7	166.4	49.5
83	65.9	21.2	73.1	21.5
84	148.3	49.9	72.3	18.3
85	76.3	32.1	30.7	7.7
86	55.0	17.2	31.2	8.8
87	77.8	23.8	44.4	11.7
88	159.3	67.5	51.6	13.7
89	43.3	14.7	35.8	11.0
90	37.5	11.8	37.1	11.2
91	54.1	20.0	26.9	7.7
92	50.4	22.3	20.4	5.9
93	52.1	21.9	19.7	5.2
94	80.3	40.1	23.9	7.6
95	40.7	18.5	15.2	4.5
96	24.0	10.9	8.7	2.8

Table 5. Standardized catch rates of "inferred" chilipepper (*Sebastes goodei*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	132.3	49.8	95.3	32.6
83	34.9	13.1	34.7	11.4
84	89.9	27.0	56.8	16.4
85	100.9	31.3	50.5	13.1
86	56.5	17.7	35.4	10.0
87	102.5	30.3	54.5	14.2
88	174.7	59.2	76.6	18.6
89	92.2	28.4	66.3	18.0
90	102.9	31.8	73.5	20.0
91	131.0	41.3	70.0	17.0
92	120.4	45.8	44.6	11.5
93	69.1	19.0	44.8	11.0
94	102.5	32.6	51.2	13.6
95	119.3	34.5	59.3	15.6
96	95.4	28.1	44.6	11.7

Table 6. Standardized catch rates of "inferred" bank rockfish (*Sebastes rufus*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	38.2	16.4	27.9	11.8
83	35.9	15.8	28.8	12.2
84	96.3	40.4	33.6	10.6
85	90.1	46.3	19.0	6.2
86	64.1	26.5	39.4	18.3
87	55.9	24.3	19.7	6.9
88	19.6	7.8	15.9	5.8
89	18.5	8.8	14.8	6.5
90	14.3	6.3	12.0	5.1
91	94.2	49.1	20.4	7.2
92	30.6	15.7	11.4	3.3
93	18.6	10.4	5.2	1.8
94	101.9	55.6	17.2	6.5
95	43.3	21.0	14.2	4.5
96	20.6	6.7	13.9	4.4

Table 7. Standardized catch rates of "inferred" canary rockfish (*Sebastes pinniger*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	96.7	56.2	49.0	26.8
83	21.1	10.2	11.6	5.2
84	15.6	6.7	7.0	2.7
85	20.1	9.0	8.0	2.7
86	9.4	4.0	4.9	2.1
87	8.8	4.6	4.2	2.2
88	18.7	9.2	6.4	2.8
89	13.4	6.7	7.3	3.4
90	20.4	10.5	11.0	5.1
91	8.0	3.6	4.6	1.9
92	15.7	7.6	9.1	4.4
93	4.3	2.2	3.2	1.3
94	10.5	4.6	4.9	1.7
95	6.2	2.6	3.9	1.4
96	5.7	2.2	4.1	1.4

Table 8. Standardized catch rates of "inferred" darkblotched rockfish (*Sebastes crameri*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	16.7	9.7	9.0	4.1
83	15.6	7.7	10.9	4.7
84	21.8	8.6	14.8	5.5
85	42.8	15.9	20.7	6.7
86	20.0	8.4	11.1	3.6
87	71.8	31.4	25.8	10.9
88	46.3	21.2	20.8	8.1
89	30.9	15.7	13.6	5.9
90	14.1	6.4	11.4	4.0
91	22.0	8.9	13.1	4.1
92	14.9	6.2	9.1	3.4
93	25.2	9.6	12.8	3.9
94	19.9	7.7	9.9	3.8
95	24.2	11.4	11.3	4.5
96	20.8	10.1	9.6	3.7

Table 9. Standardized catch rates of "inferred" splitnose rockfish (*Sebastes diploproa*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	17.8	8.6	12.9	5.4
83	7.4	3.2	8.7	3.6
84	28.1	12.1	16.3	5.2
85	32.4	11.9	19.0	5.4
86	21.1	9.5	11.7	3.7
87	3.6	1.4	3.7	1.4
88	18.6	8.1	10.8	3.7
89	10.5	4.8	8.0	2.9
90	20.7	10.6	10.7	4.2
91	26.8	11.9	14.6	5.1
92	15.5	5.8	9.8	2.8
93	34.0	12.6	15.1	4.4
94	16.1	5.5	11.6	3.7
95	21.2	9.1	11.2	3.6
96	23.2	11.0	11.4	3.9

Table 10. Standardized catch rates of "inferred" yellowtail rockfish (*Sebastes flavidus*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	27.6	16.2	21.2	12.0
83	13.8	5.3	8.9	3.3
84	16.1	5.5	8.9	3.2
85	6.3	2.7	3.4	1.2
86	19.4	9.2	7.8	3.2
87	28.3	13.5	10.4	4.7
88	6.2	3.3	3.7	2.0
89	33.4	12.5	21.0	7.9
90	22.5	9.1	11.8	4.2
91	21.4	9.1	10.0	3.8
92	18.6	6.6	9.9	3.1
93	7.9	3.3	4.9	1.8
94	10.2	4.0	5.5	2.0
95	10.7	4.4	5.0	1.7
96	11.2	4.2	5.5	1.9

Table 11. Standardized catch rates of "inferred" blackgill rockfish (*Sebastes melanostomus*) from the California trawl logbook database.

	Catch Weighted		Area Weighed	
Year	lbs/hr	SE	lbs/hr	SE
82	4.1	2.6	3.0	1.8
83	9.0	5.7	5.9	3.2
84	3.2	1.8	1.5	0.8
85	6.8	3.2	4.3	1.9
86	21.4	10.9	10.0	5.2
87	8.9	4.9	3.0	1.3
88	20.9	10.7	10.7	5.1
89	4.3	2.7	2.4	1.3
90	6.9	3.4	5.5	2.3
91	12.9	5.9	6.1	2.7
92	16.4	7.1	7.6	3.3
93	9.8	5.1	5.1	2.5
94	8.4	4.7	4.3	2.3
95	13.8	6.2	5.4	2.3
96	11.9	5.6	6.3	2.7

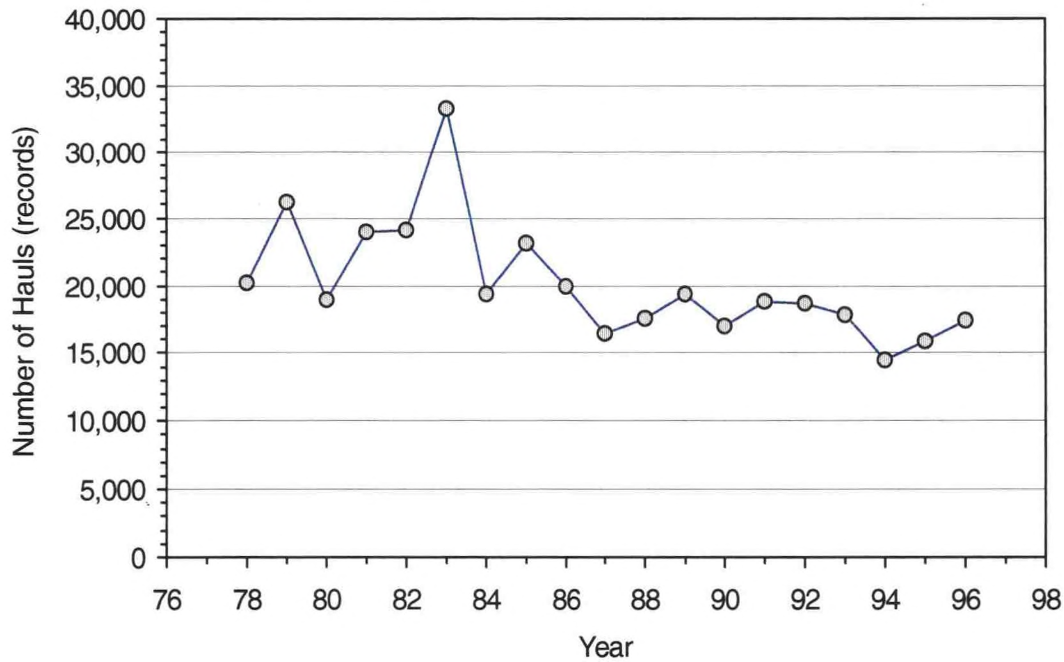

Figure 1. Extent and availability of the CDF&G trawl logbook data.

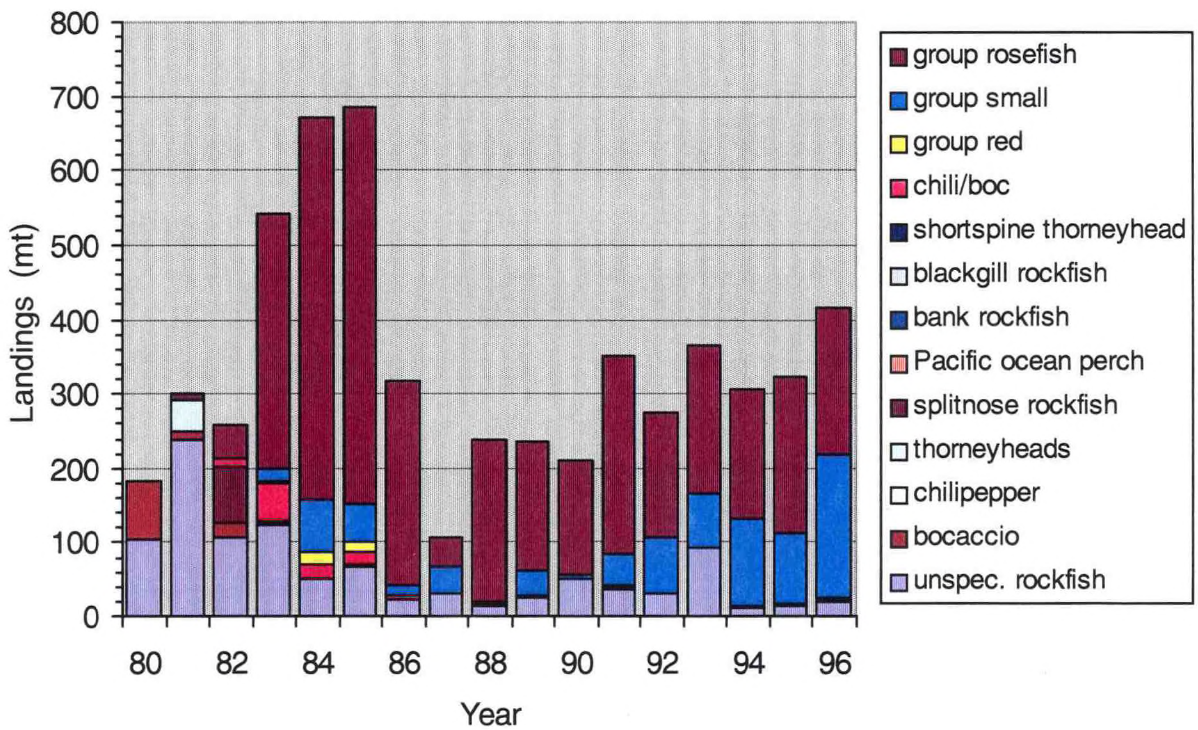

Figure 2. Interannual variation in the distribution of the market categories that splitnose rockfish (*Sebastes diploproa*) is landed under. Note the increased utilization of the "group small" market category during the 1990s.

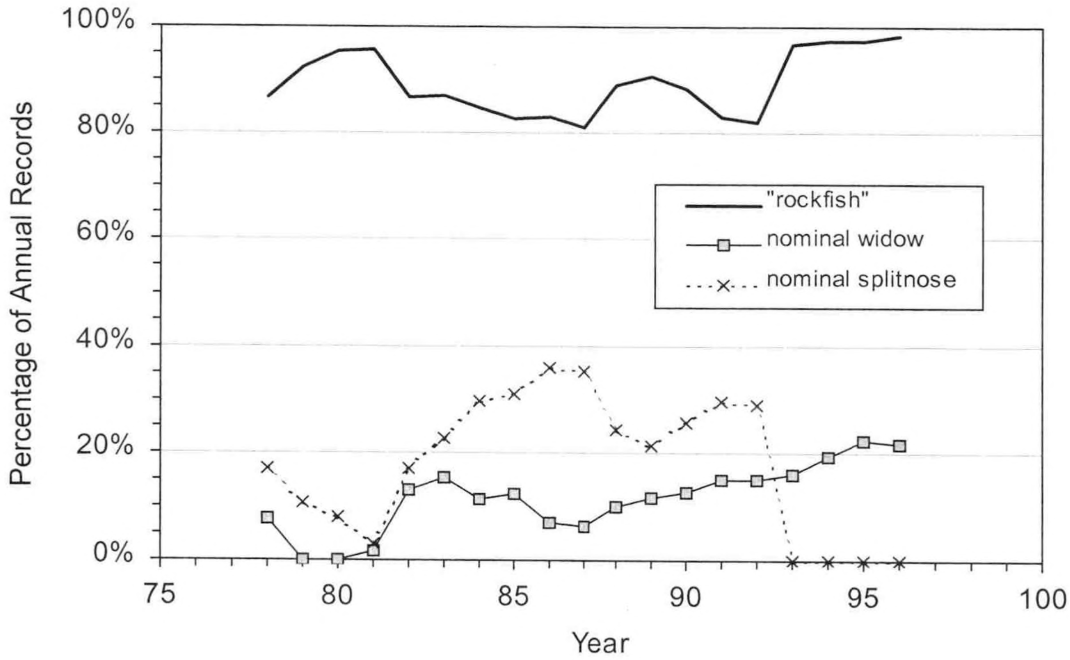

Figure 3. Relative frequency of occurrence of different *Sebastes* taxa over time in the logbook database. Note that nominal Pacific ocean perch is not displayed due to its consistent low representation.

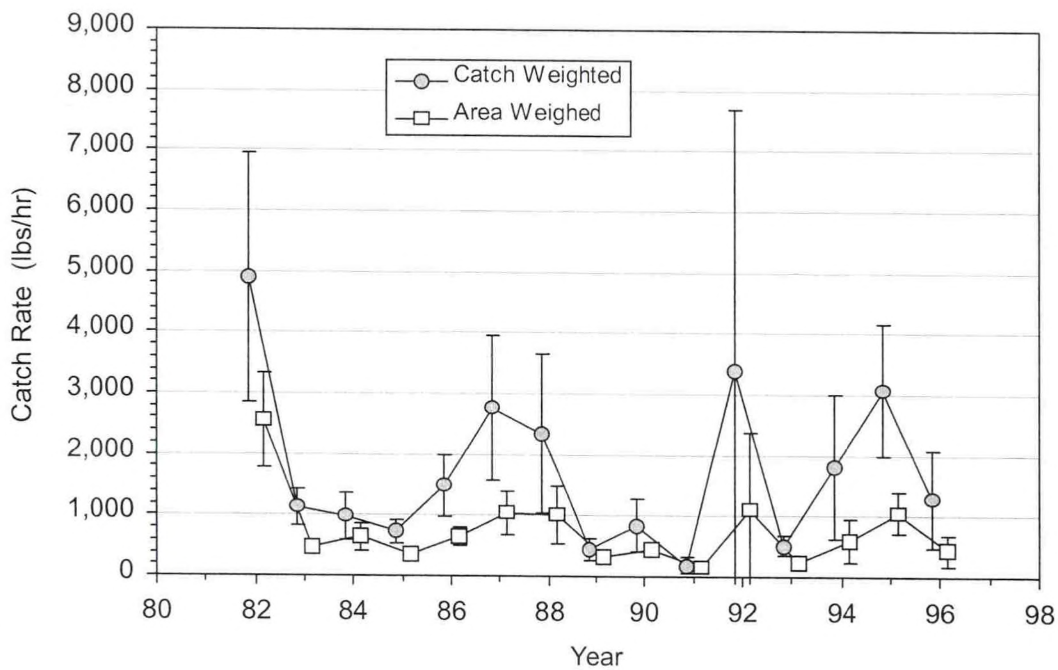

Figure 4 . Trend in the catch rate of nominal widow rockfish from the commercial trawl logbook data. Error bars represent one standard error of the estimate.

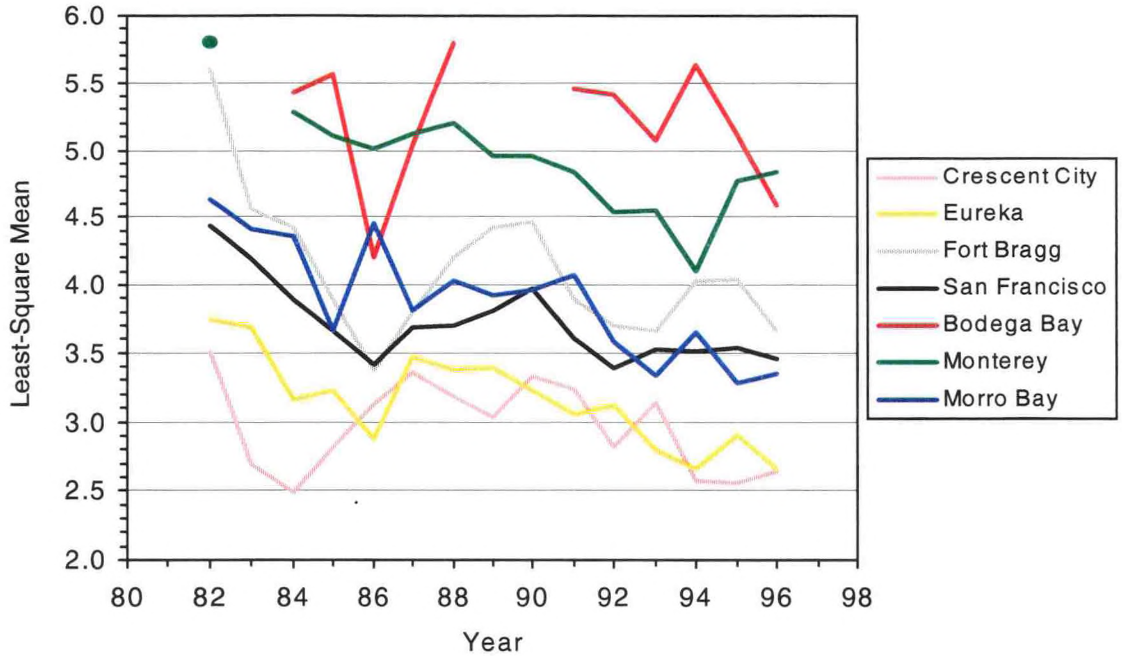

Figure 5. Port-specific year effects ($\hat{Y}_{yp}$) on the catch rate of "other" (i.e., non-widow) rockfish.

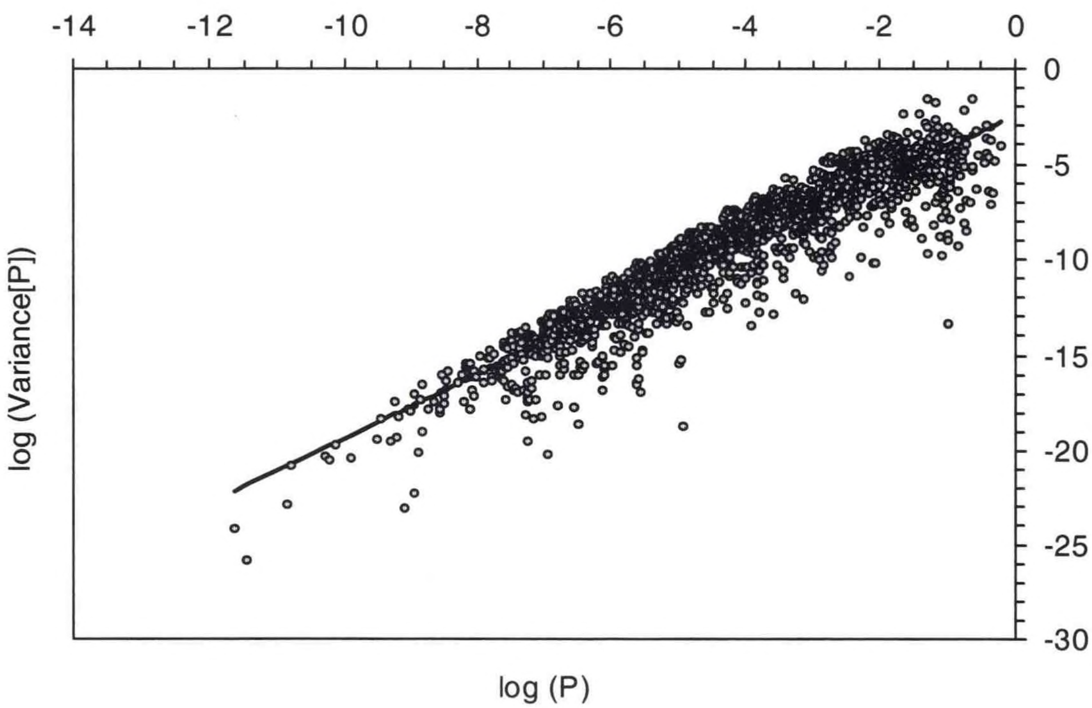

Figure 6. Relationship between the logarithm of the approximate variance of the proportion $\hat{\pi}_{yps}$ and the logarithm of $\hat{\pi}_{yps}$.

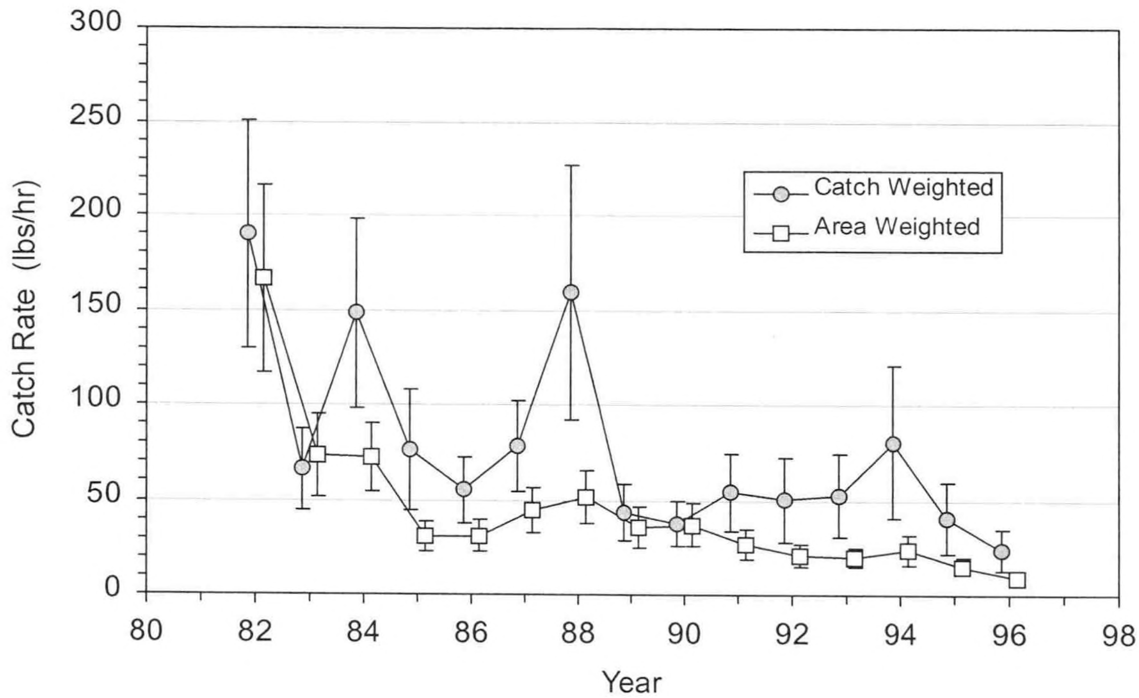

Figure 7. Time series of standardized catch rates for *Sebastes paucispinis* (bocaccio).

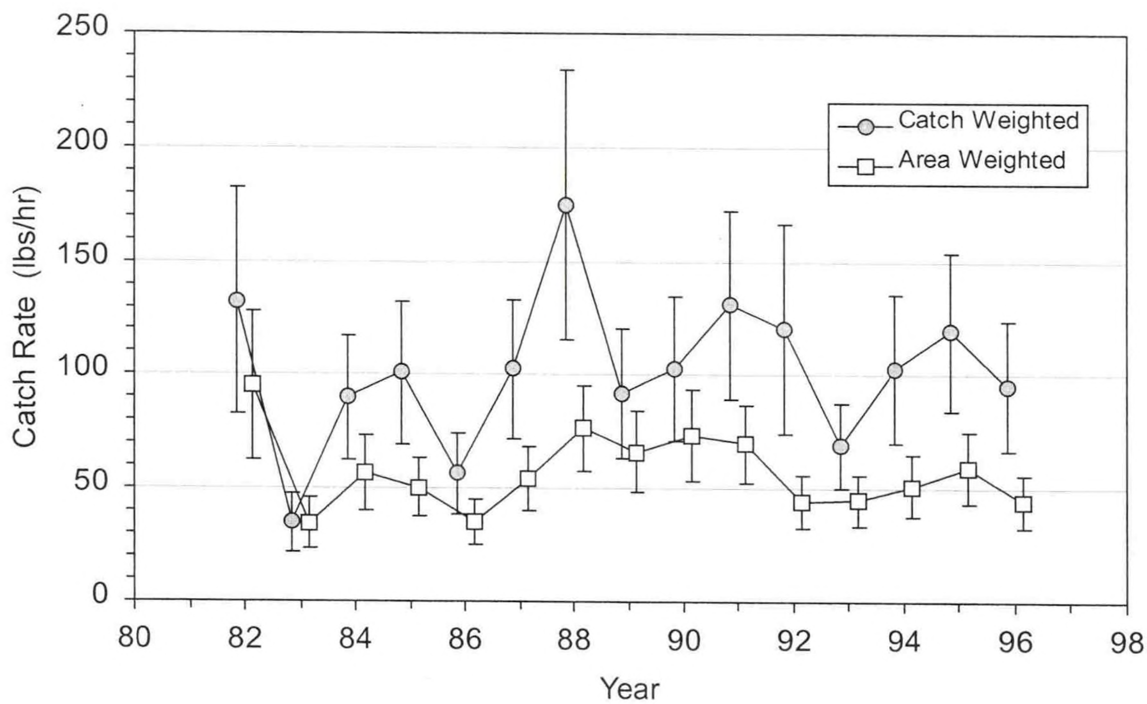

Figure 8. Time series of standardized catch rates for *Sebastes goodei* (chilipepper).

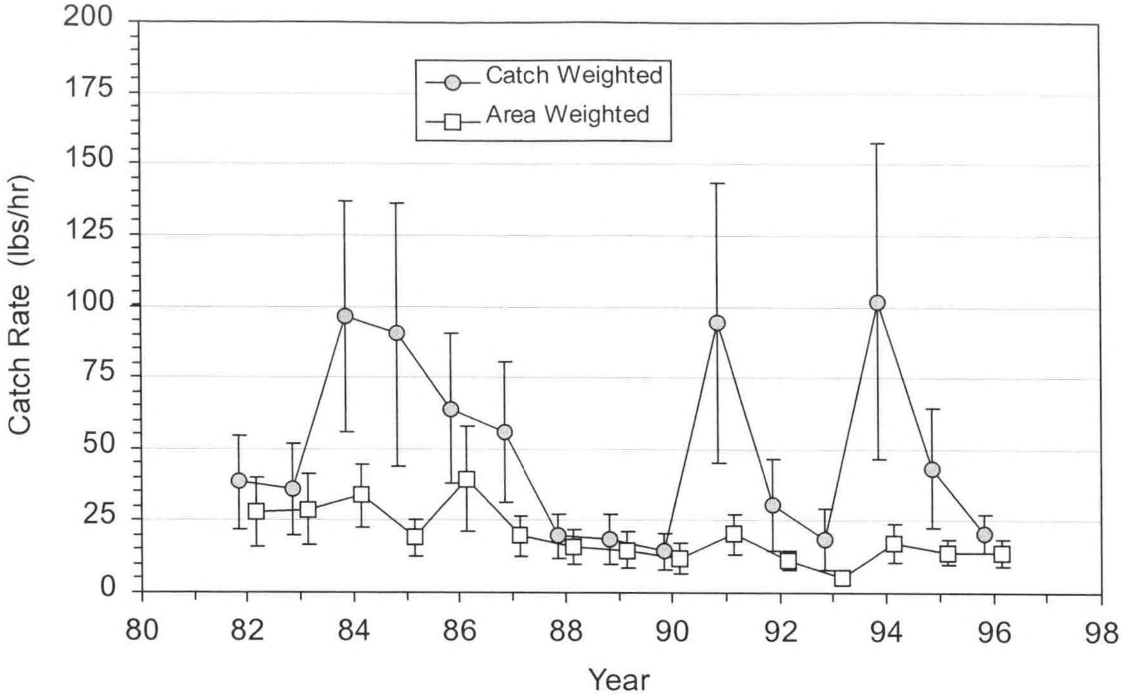

Figure 9. Time series of standardized catch rates for *Sebastes rufus* (bank rockfish).

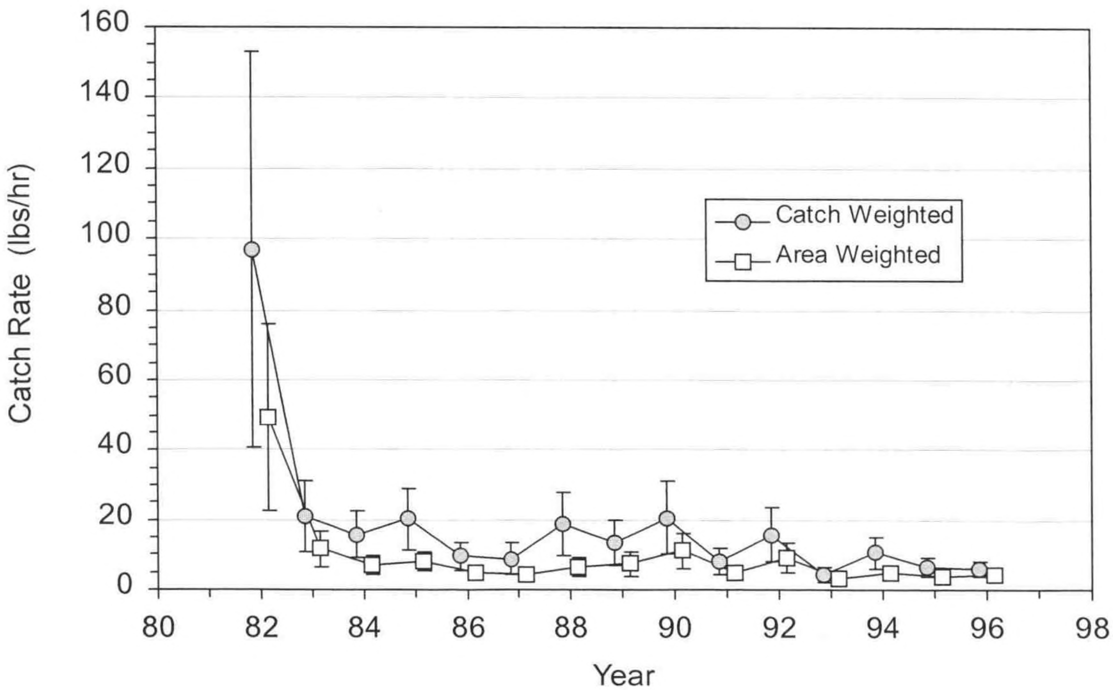

Figure 10. Time series of standardized catch rates for *Sebastes pinniger* (canary rockfish).

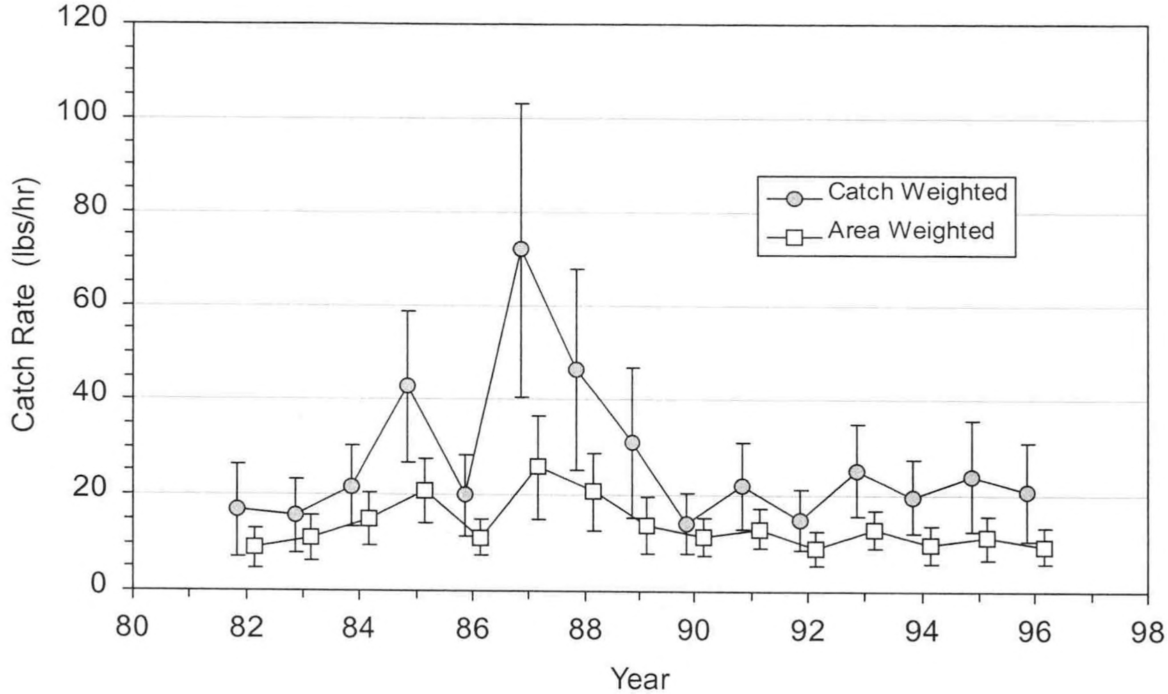

Figure 11. Time series of standardized catch rate for *Sebastes crameri* (darkblotched rockfish).

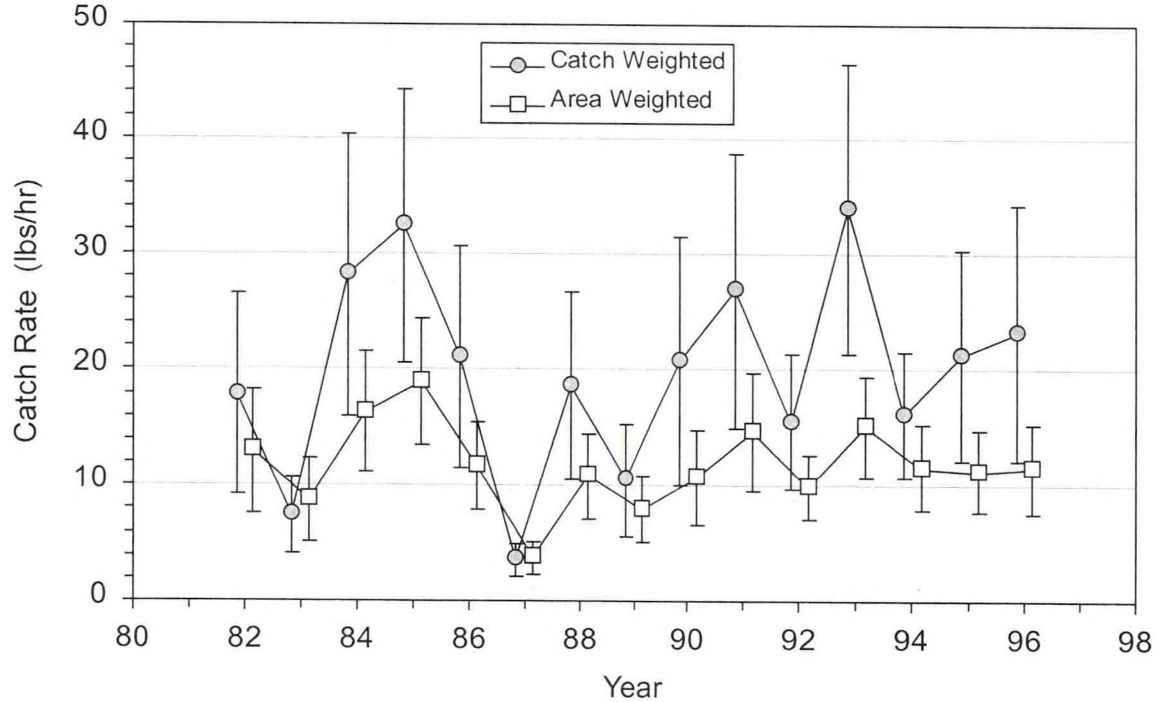

Figure 12. Time series of standardized catch rate for *Sebastes diploproa* (splitnose rockfish).

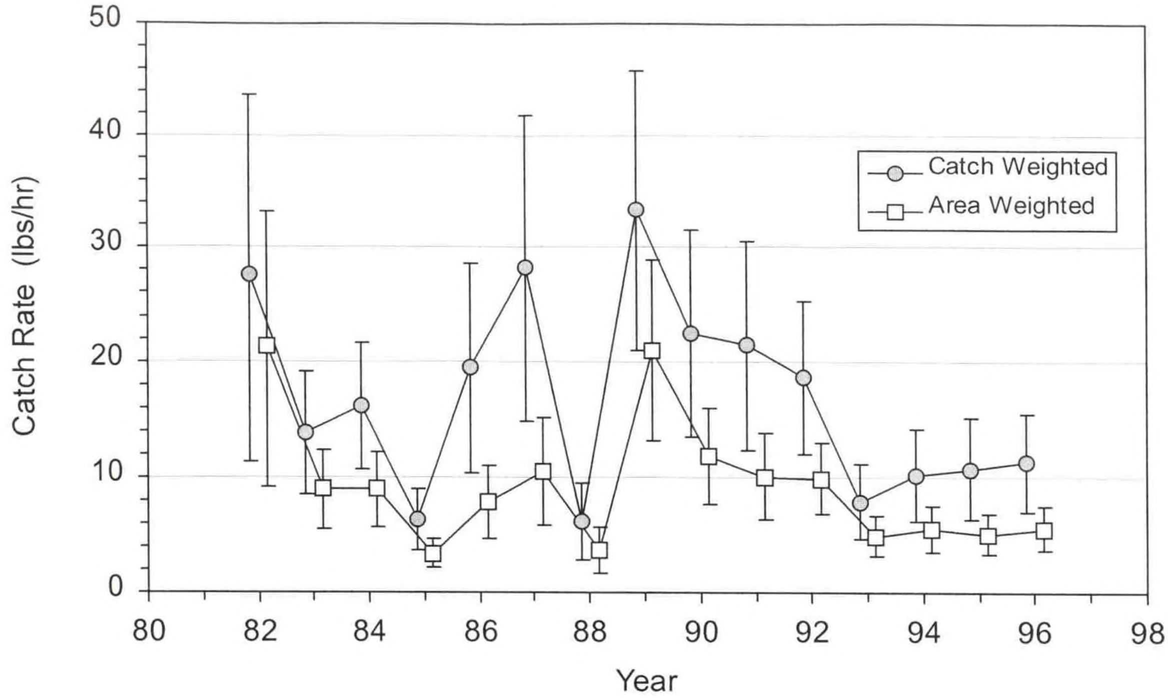

Figure 13. Time series of standardized catch rates of *Sebastes flavidus* (yellowtail rockfish).

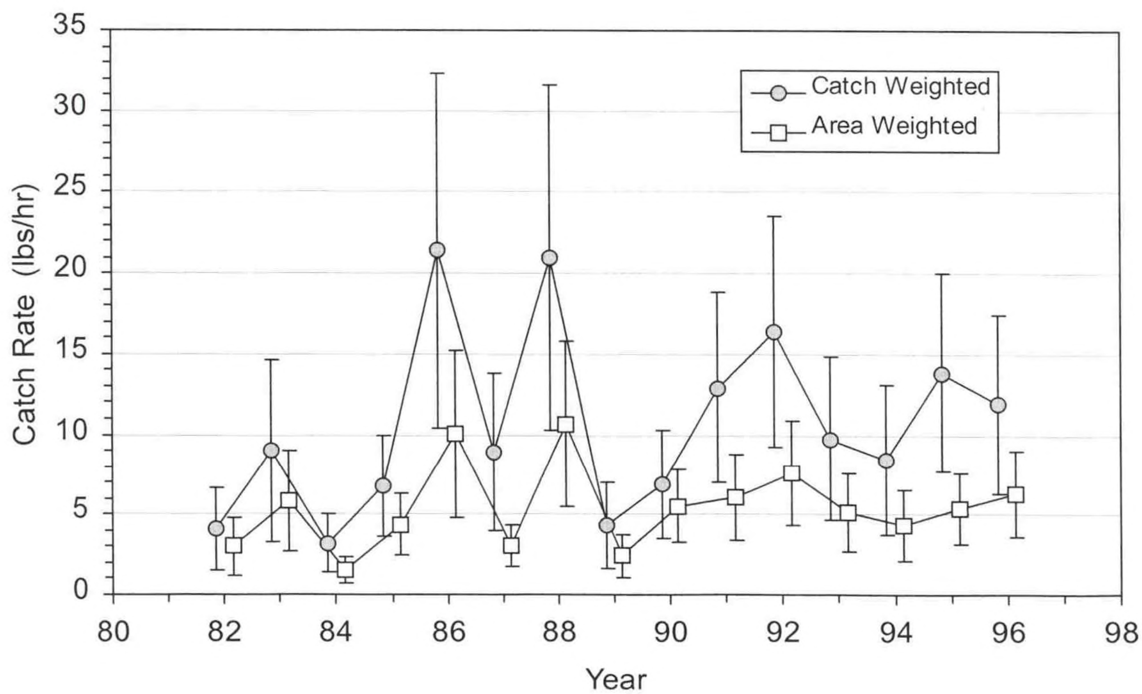

Figure 14. Time series of standardized catch rates for *Sebastes melanostomus* (blackgill rockfish).

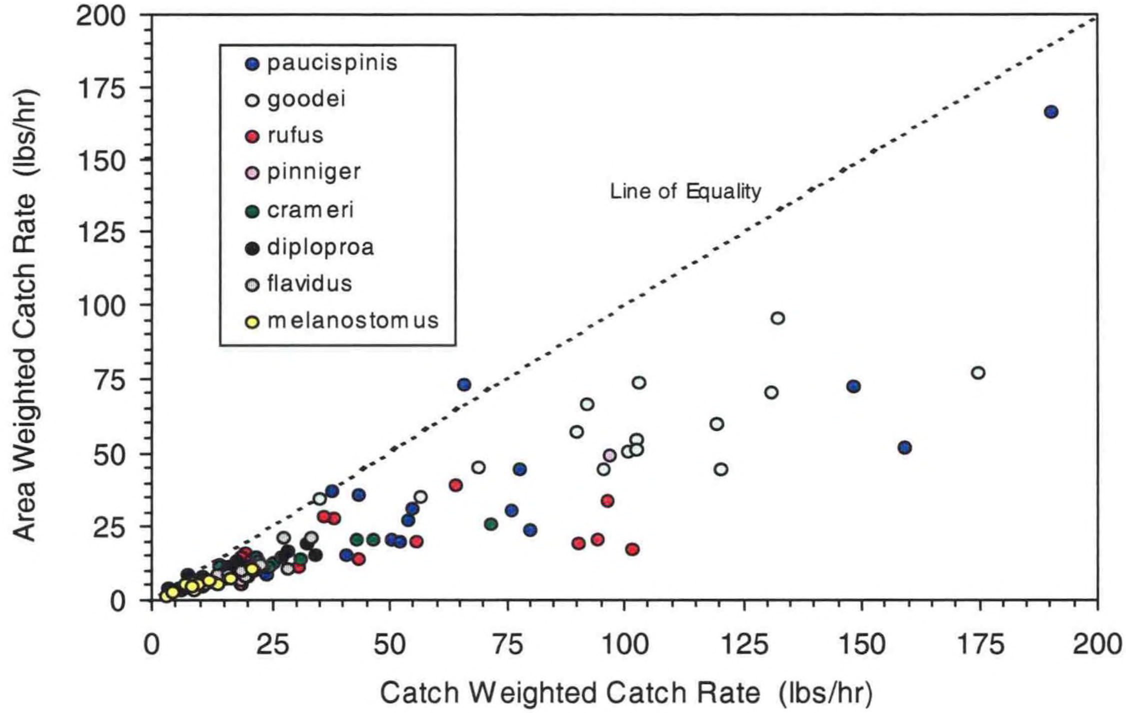

Figure 15. Relationship between catch weighted and area weighted CPUE statistics.

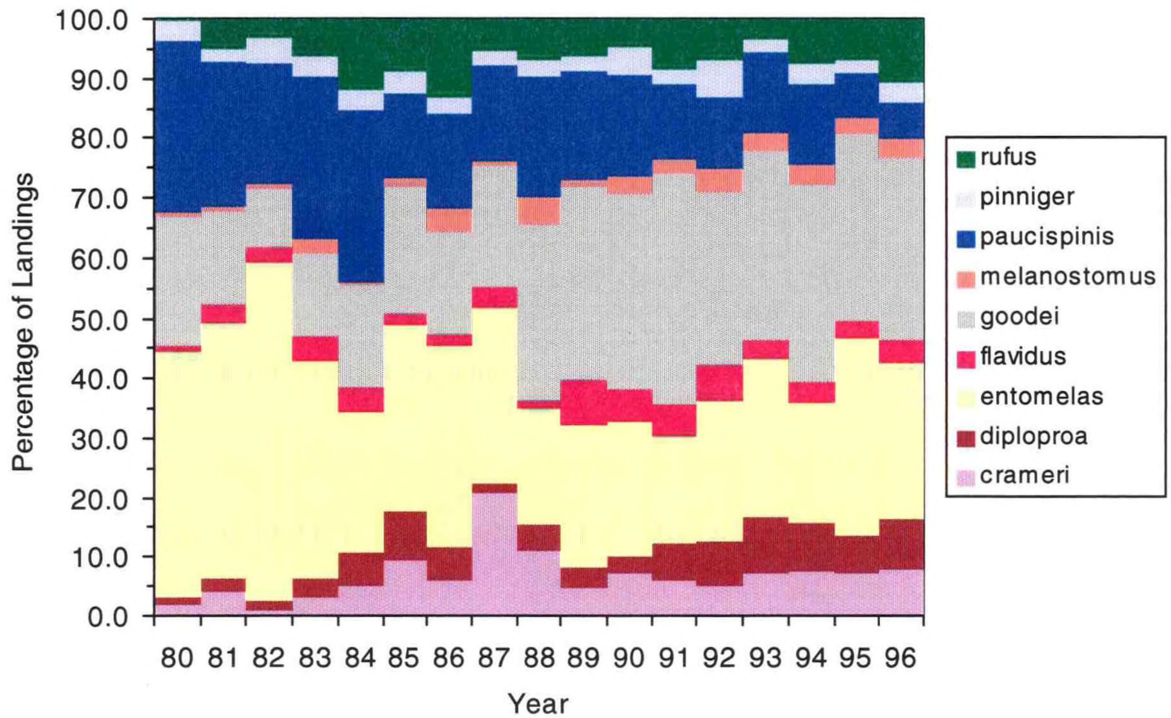

Figure 16. Temporal distribution of the relative contribution to total landings among the nine major trawl-caught rockfish species.

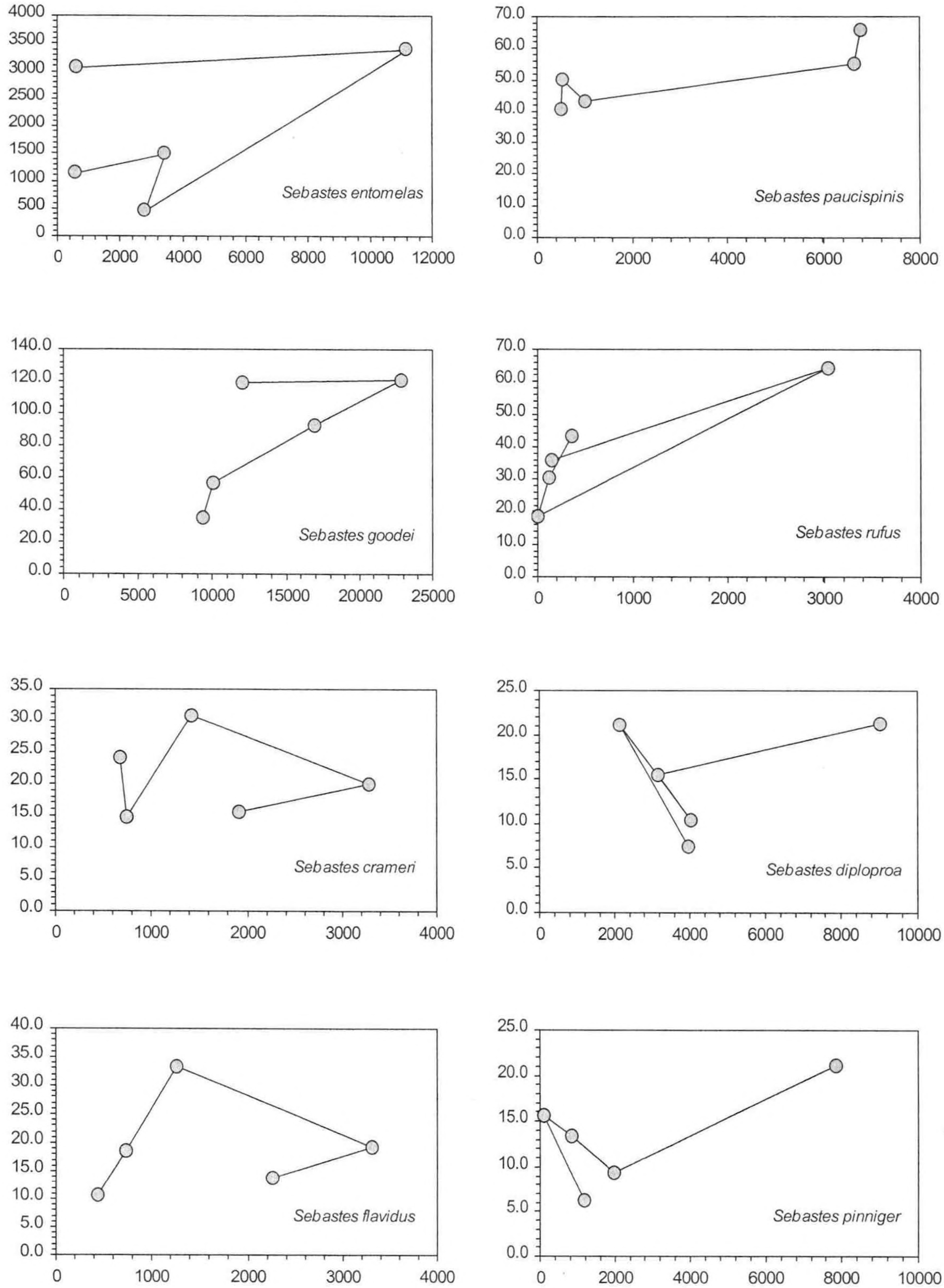

Figure 17. Relationship between catch-weighted estimates of abundance from the trawl logbook data (Y-axis [lbs/hr]) and AFSC triennial shelf survey estimates of abundance (X-axis [mt]) in the Eureka and Monterey INPFC areas (data from the years 1983, 1986, 1989, 1992, and 1995).

Appendix A.

Port-Specific Analysis of Variance Tables for Nominal Widow Rockfish

NOMINAL WIDOW ROCKFISH

--------------------------- PORT=Crescent City ---------------------------

Class	Levels	Values
YEAR	14	82 83 84 85 86 87 88 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	2[$]	Confidentiality provisions prohibit listing of boat numbers
BLOCK	4	104 122 128 218

Number of observations in by group = 280

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	28	407.830432	14.565373	5.98	0.0001
Error	251	611.760088	2.437291		
Corrected Total	279	1019.590520			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.399994	20.84140	1.56118	7.49078

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	13	186.190972	14.322382	5.88	0.0001
BOAT	1	31.652859	31.652859	12.99	0.0004
MONTH	11	70.458149	6.405286	2.63	0.0034
BLOCK	3	119.528452	39.842817	16.35	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	13	111.664932	8.589610	3.52	0.0001
BOAT	1	0.984610	0.984610	0.40	0.5256
MONTH	11	48.417567	4.401597	1.81	0.0534
BLOCK	3	119.528452	39.842817	16.35	0.0001

[$] These vessels selected from a much larger pool of participants

NOMINAL WIDOW ROCKFISH

------------------------------- PORT=Eureka -------------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	22	Confidentiality provisions prohibit listing of boat numbers
BLOCK	14	122 128 134 202 203 204 211 212 217 218 219 223 228 234

Number of observations in by group = 5250

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	59	33800.1264	572.8835	138.05	0.0001
Error	5190	21538.2354	4.1499		
Corrected Total	5249	55338.3618			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.610790	47.38320	2.03714	4.29929

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	7526.8196	537.6300	129.55	0.0001
BOAT	21	19772.1577	941.5313	226.88	0.0001
MONTH	11	873.5219	79.4111	19.14	0.0001
BLOCK	13	5627.6272	432.8944	104.31	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	789.91196	56.42228	13.60	0.0001
BOAT	21	8448.00751	402.28607	96.94	0.0001
MONTH	11	613.48004	55.77091	13.44	0.0001
BLOCK	13	5627.62722	432.89440	104.31	0.0001

NOMINAL WIDOW ROCKFISH

---------------------------- PORT=Fort Bragg ------------------------------

Class	Levels	Values
YEAR	14	83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	13	Confidentiality provisions prohibit listing of boat numbers
BLOCK	13	234 243 244 249 250 256 263 269 275 403 409 416 425

Number of observations in by group = 4040

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	48	5671.18358	118.14966	33.40	0.0001
Error	3991	14118.93004	3.53769		
Corrected Total	4039	19790.11362			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.286566	64.04196	1.88088	2.93694

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	13	802.18159	61.70628	17.44	0.0001
BOAT	12	3730.87029	310.90586	87.88	0.0001
MONTH	11	377.04268	34.27661	9.69	0.0001
BLOCK	12	761.08902	63.42409	17.93	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	13	519.07081	39.92852	11.29	0.0001
BOAT	12	3343.83688	278.65307	78.77	0.0001
MONTH	11	278.22655	25.29332	7.15	0.0001
BLOCK	12	761.08902	63.42409	17.93	0.0001

NOMINAL WIDOW ROCKFISH

---------------------------- PORT=San Francisco ----------------------------

Class	Levels	Values
YEAR	14	82 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	5	Confidentiality provisions prohibit listing of boat numbers
BLOCK	9	416 425 441 451 466 467 475 480 481

Number of observations in by group = 1636

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	36	6655.47438	184.87429	59.44	0.0001
Error	1599	4973.10353	3.11013		
Corrected Total	1635	11628.57791			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.572338	40.85867	1.76356	4.31624

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	13	4292.14213	330.16478	106.16	0.0001
BOAT	4	1410.37907	352.59477	113.37	0.0001
MONTH	11	242.05611	22.00510	7.08	0.0001
BLOCK	8	710.89707	88.86213	28.57	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	13	794.899660	61.146128	19.66	0.0001
BOAT	4	903.460318	225.865079	72.62	0.0001
MONTH	11	232.087864	21.098897	6.78	0.0001
BLOCK	8	710.897075	88.862134	28.57	0.0001

NOMINAL WIDOW ROCKFISH

---------------------------- PORT=Bodega Bay ------------------------------

Class	Levels	Values
YEAR	10	84 85 88 89 90 91 92 93 94 95
MONTH	11	1 2 3 4 6 7 8 9 10 11 12
BOAT	3[§]	Confidentiality provisions prohibit listing of boat numbers
BLOCK	5	409 416 417 425 441

Number of observations in by group = 785

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	1621.93023	64.87721	23.72	0.0001
Error	759	2075.69962	2.73478		
Corrected Total	784	3697.62985			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.438641	35.84880	1.65372	4.61303

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	9	293.146888	32.571876	11.91	0.0001
BOAT	2	707.836361	353.918181	129.41	0.0001
MONTH	10	400.469338	40.046934	14.64	0.0001
BLOCK	4	220.477638	55.119410	20.15	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	9	269.745820	29.971758	10.96	0.0001
BOAT	2	247.481096	123.740548	45.25	0.0001
MONTH	10	337.969452	33.796945	12.36	0.0001
BLOCK	4	220.477638	55.119410	20.15	0.0001

[§] These vessels selected from a much larger pool of participants

Appendix B.

Port-Specific Analysis of Variance Tables for "Other" Rockfish

"OTHER" ROCKFISH

--------------------------- PORT=Crescent City ---------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	26	Confidentiality provisions prohibit listing of boat numbers
BLOCK	14	103 104 109 110 115 116 117 121 122 127 128 1102 1107 1118

Number of observations in by group = 10013

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	63	15835.0813	251.3505	108.03	0.0001
Error	9949	23147.7899	2.3266		
Corrected Total	10012	38982.8712			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.406206	52.66404	1.52533	2.89635

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	1518.8246	108.4875	46.63	0.0001
BOAT	25	12118.7933	484.7517	208.35	0.0001
MONTH	11	601.4354	54.6759	23.50	0.0001
BLOCK	13	1596.0280	122.7714	52.77	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	915.76127	65.41152	28.11	0.0001
BOAT	25	6766.32128	270.65285	116.33	0.0001
MONTH	11	727.64539	66.14958	28.43	0.0001
BLOCK	13	1596.02802	122.77139	52.77	0.0001

"OTHER" ROCKFISH

------------------------------ PORT=Eureka ------------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	45	Confidentiality provisions prohibit listing of boat numbers
BLOCK	21	122 123 127 128 133 134 202 203 204 210 211 212 213 217 218 219 222 223 228 229 234

Number of observations in by group = 31414

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	89	57004.5813	640.5009	201.19	0.0001
Error	31324	99721.7678	3.1836		
Corrected Total	31413	156726.3491			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.363720	48.15736	1.78425	3.70505

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	2562.0367	183.0026	57.48	0.0001
BOAT	44	37288.9273	847.4756	266.20	0.0001
MONTH	11	3019.2211	274.4746	86.22	0.0001
BLOCK	20	14134.3962	706.7198	221.99	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	2313.6340	165.2596	51.91	0.0001
BOAT	44	28180.9516	640.4762	201.18	0.0001
MONTH	11	2185.4076	198.6734	62.41	0.0001
BLOCK	20	14134.3962	706.7198	221.99	0.0001

"OTHER" ROCKFISH

---------------------------- PORT=Fort Bragg -----------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	22	Confidentiality provisions prohibit listing of boat numbers
BLOCK	17	234 243 244 250 256 263 264 269 270 275 403 404 409 410 416 417 425

Number of observations in by group = 20475

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	62	30983.9173	499.7406	169.75	0.0001
Error	20412	60091.3161	2.9439		
Corrected Total	20474	91075.2334			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.340201	38.46327	1.71579	4.46084

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	2655.0449	189.6461	64.42	0.0001
BOAT	21	16411.1477	781.4832	265.46	0.0001
MONTH	11	1129.3254	102.6659	34.87	0.0001
BLOCK	16	10788.3993	674.2750	229.04	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	1918.2937	137.0210	46.54	0.0001
BOAT	21	9337.6889	444.6519	151.04	0.0001
MONTH	11	858.2757	78.0251	26.50	0.0001
BLOCK	16	10788.3993	674.2750	229.04	0.0001

"OTHER" ROCKFISH

---------------------------- PORT=San Francisco ----------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	27	Confidentiality provisions prohibit listing of boat numbers
BLOCK	21	433 440 441 450 451 456 457 458 459 464 465 466 467 473 474 475 479 480 481 503 504

Number of observations in by group = 17103

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	71	45001.7139	633.8270	345.44	0.0001
Error	17031	31249.5831	1.8349		
Corrected Total	17102	76251.2970			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.590176	33.23590	1.35457	4.07563

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	2492.2947	178.0210	97.02	0.0001
BOAT	26	36980.6983	1422.3346	775.17	0.0001
MONTH	11	556.7901	50.6173	27.59	0.0001
BLOCK	20	4971.9308	248.5965	135.48	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	1069.5095	76.3935	41.63	0.0001
BOAT	26	14101.4597	542.3638	295.59	0.0001
MONTH	11	200.3160	18.2105	9.92	0.0001
BLOCK	20	4971.9308	248.5965	135.48	0.0001

"OTHER" ROCKFISH

----------------------------- PORT=Bodega Bay ------------------------------

Class	Levels	Values
YEAR	11	84 85 86 87 88 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	3[§]	Confidentiality provisions prohibit listing of boat numbers
BLOCK	4	417 425 433 441

Number of observations in by group = 1507

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	26	1672.11751	64.31221	19.87	0.0001
Error	1480	4791.05158	3.23720		
Corrected Total	1506	6463.16909			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.258715	33.40223	1.79922	5.38653

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	10	976.572003	97.657200	30.17	0.0001
BOAT	2	406.394170	203.197085	62.77	0.0001
MONTH	11	270.813081	24.619371	7.61	0.0001
BLOCK	3	18.338257	6.112752	1.89	0.1296

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	10	167.241197	16.724120	5.17	0.0001
BOAT	2	417.717289	208.858645	64.52	0.0001
MONTH	11	277.572119	25.233829	7.79	0.0001
BLOCK	3	18.338257	6.112752	1.89	0.1296

[§] These vessels selected from a much larger pool of participants

"OTHER" ROCKFISH

------------------------------ PORT=Monterey ------------------------------

Class	Levels	Values
YEAR	14	82 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	12	Confidentiality provisions prohibit listing of boat numbers
BLOCK	9	503 504 510 511 517 518 532 533 540

Number of observations in by group = 5709

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	43	4844.42837	112.66112	64.22	0.0001
Error	5665	9938.34787	1.75434		
Corrected Total	5708	14782.77623			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.327708	25.78862	1.32452	5.13605

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	13	982.11729	75.54748	43.06	0.0001
BOAT	11	3540.54425	321.86766	183.47	0.0001
MONTH	11	107.57953	9.77996	5.57	0.0001
BLOCK	8	214.18730	26.77341	15.26	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	13	513.68449	39.51419	22.52	0.0001
BOAT	11	2936.69498	266.97227	152.18	0.0001
MONTH	11	95.04824	8.64075	4.93	0.0001
BLOCK	8	214.18730	26.77341	15.26	0.0001

"OTHER" ROCKFISH

------------------------------ PORT=Morro Bay ------------------------------

Class	Levels	Values
YEAR	15	82 83 84 85 86 87 88 89 90 91 92 93 94 95 96
MONTH	12	1 2 3 4 5 6 7 8 9 10 11 12
BOAT	35	Confidentiality provisions prohibit listing of boat numbers
BLOCK	21	561 602 603 608 609 615 616 617 623 624 625 632 633 634 636 638 639 640 641 644 645

Number of observations in by group = 19722

Dependent Variable: LNCPUE

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	79	36330.8012	459.8836	190.91	0.0001
Error	19642	47315.7019	2.4089		
Corrected Total	19721	83646.5030			

R-Square	C.V.	Root MSE	LNCPUE Mean
0.434337	34.65728	1.55206	4.47832

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	14	4516.0849	322.5775	133.91	0.0001
BOAT	34	20075.4164	590.4534	245.11	0.0001
MONTH	11	569.8859	51.8078	21.51	0.0001
BLOCK	20	11169.4139	558.4707	231.84	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	14	1701.6391	121.5456	50.46	0.0001
BOAT	34	8227.0596	241.9723	100.45	0.0001
MONTH	11	311.5811	28.3256	11.76	0.0001
BLOCK	20	11169.4139	558.4707	231.84	0.0001