SSC Requests from the November PFMC meeting.

INTRODUCTION

This document was prepared in response to requests made by the Scientific and Statistical Committee (SSC) of the Pacific Fishery Management Council regarding the recent stock assessment of cabezon (Cope et al., 2003). There were two requests to the Statistical Team:

1) re-analyze the data on which the CPFV logbook CPUE index is based to include data for the years prior to 1960 (the start of this CPUE series in the present assessment), and
2) re-examine the time-series of historical recreational catches using the CPFV logbook data and other published and unpublished information to estimate catches back to 1930.

This document shows the results of those analyses (including the effects on the outputs of the base case model of Cope et al. (2003)) and discusses the merits and disadvantages of the additional analyses. Within this document we use 'old' to refer to the assessment specifications and results from Cope et al. (2003) and 'new' to refer to the results from the analyses requested by the SSC.

METHODS

Analyze CPFV logbook CPUE index

Three alternative CPFV logbook CPUE series were derived using the same methods as described in the assessment document, except for the following differences:

1. Data prior to 1960 were used. Three alternative CPUE indices were developed (1936-present, 1947 present, and 1957-present).
2. The effort prior to 1960 was converted from angler hours to numbers of anglers using a linear relationship based on data for 1960-65 (linear regression, r^2=0.92, slope=0.0162, intercept =36.95). The uncertainty about this relationship was, however, not carried forward into the variance estimates for the CPUE indices.

Analysis of Recreational Catch Prior to 1980

A new time-series of recreational catches (1930-79; **Table 1.SSC**) was derived primarily from the ratio of the reported numbers of cabezon in the CPFV logbooks to the total recreational catch, as suggested to the STAT team by Dr Kevin Hill (pers. Comm. Kevin Hill, NMFS SWFSC), i.e.:

$$C_y^N = \sum_a \frac{C_y^{CPFV,N,a}}{P_y^{CPFV,a}} \qquad (1)$$

where C_y^N is the recreational catch (in numbers) for year y ($1947 \le y \le 1979$),

$C_y^{CPFV,N,a}$ is the catch (in numbers) by the CPFV fleet in area a (southern and northern California) during year y, and

$P_y^{CPFV,a}$ is the fraction that the catch by the CPFV fleet represents of the total recreational catch in area a during year y.

The CPFV catches were taken from the CPFV logbooks and yearly summaries (Kevin Hill, SWFSC, pers. comm.). The catches for the years 1930-47 were taken from O'Connell (1953) assuming that the weight of an average fish in the catch is 1 kg.

Values for $P_y^{CPFV,a}$ are not available for all years unlike the values for $C_y^{CPFV,N,a}$. Therefore, the values for $P_y^{CPFV,a}$ are calculated for two time periods (1947-69 and 1970-79) as follows:

- 1947-69: 0.789 shore, 0.079 CPFV, and 0.132 private boat (northern California) and 0.549 shore, 0.254 CPFV, and 0.198 private boat (southern California; Miller and Gotshall 1965; Karpov et al. 1995; Pinkas et al. 1968).
- 1970-79: 0.522 shore, 0.041 CPFV, and 0.437 private boat (northern California) and 0.242 shore, 0.122 CPFV, and 0.636 private boat (southern California); based on average catch per mode from RecFIN (1980-89).
- The average weight of an individual fish (1947-79) was assumed to be: 0.85kg shore, 1.97 CPFV and 1.57 kg private boat (Northern California) and 0.76kg shore, 0.8kg CPFV and 0.93kg private boat (Southern California).

RESULTS and DISCUSSION

New CPUE Series

For the years after 1959, the "new" CPUE indices are virtually identical to the "old" CPUE indices (**Figure 1.SSC**). The CPUE indices for the years prior to 1959 are almost independent of the first year of the analysis (1936, 1947, or 1957) although there are some differences in the coefficients of variation estimated using bootstrapping (**Table 2.SSC**). CPUE increases from 1936 to a maximum in 1955 and drops off rapidly thereafter (**Figure 1.SSC; Table 2.SSC**). The CPUE indices for the years prior to 1957 are based solely on catches reported from south of Pt. Conception; i.e. the data before 1957 are highly unbalanced. It should also be noted that effort was recorded differently before and after 1960 (angler hours prior to 1960 and angler days and number of anglers thereafter).

The STAT team has some concern regarding the validity of the data prior to the change in the effort measure in 1960. Cabezon show a marked decline in numbers of fish caught after 1957 (**Figure 2.SSC**) resulting in a dramatic drop in CPUE. This same trend is seen not just in cabezon, but also across all rockfishes and all fishes in the CPFV data. It seems highly unlikely that all fish would show similar dramatic decreases in reported catch even as effort increased (**Figure 3.SSC**). This drop is possibly a result of differences in reporting practices or of CPFV fishing behavior. Further research should be conducted to investigate this. The STAT team also notes that the CPUE shows what appears to be an anomalous spike during the 1950s, something that is inconsistent with the dynamics of this fairly long-lived animal.

New Historical Recreational Catch

The "new" historical catch differs substantially from that used in the assessment (**Figure 4.SSC**). The largest differences between the "new" catch series (based on the CPFV catches and the split of the total recreational catch among fishing modes) and "old" catch series (based on the assumption of increasing recreational catch through time) occur during the 1950s when very large catches (and indeed all fish) were reported in the CPFV logbooks. The "new" catch series produced the two 5-year periods with the largest average catches over the entire time-series, even though total recreational effort increased from the 1950's to the 1980's (**Figure 5.SSC**). We also note here that no statistical sampling program was used to estimate catch prior to 1980 and no verified samples were reported prior to 1980. We also note that the CPFV logbook estimates for 1980-99 are poor predictors of total recreational catch over the same period (linear regression, r^2=0.27). This is likely because the CPFV fleet generally fishes outside cabezon habitat (deeper) and catches of cabezon are most likely influenced by the years when the CPFV fleet moved inshore (documented in the CPFV observer fleet). Further work in the area of historical catch is clearly warranted.

Modeling Results.

The modeling results (using the base-case model configuration of Cope et al. (2003) and based on maximum likelihood rather than Bayesian methods) were largely unaffected by the changes to the CPFV logbook CPUE and to the historical recreational catch (**Table 3.SSC**). The range of depletion levels (32.2% [CPUE 1947-present and old recreational catch] to 34.6% [New recreational catch and CPUE 1936-present] are very slightly less than that for the original base-case model (34.7%). However, the original base-case estimate of spawning biomass in 2003 (313 t) is bounded by the values from the sensitivity tests (282 t [CPUE 1947-present and old recreational catch] to 353 t [New recreational catch and CPUE 1937-present]). The estimates of 2004 OY ($F_{45\%}$ and 40-10 adjusted) were most affected by the changes to the catch and CPUE series, primarily because both the depletion level and the 2003 spawning biomass impact the calculation of these estimates.

CONCLUSIONS

There is little difference between the new modeling results (**Table 3.SSC**) and the assessment results from Cope et al. (2003), especially when the overall uncertainty of the modeling is considered. The STAT team notes that the effects of the new catch series on the model results were largely already indicated in the original assessment document through the sensitivity analyses conducted. The effect of a different CPUE series was not evaluated in the original assessment document, but is relatively small. Regardless of the data combinations used, the impression of stock status is very consistent.

The question of which version of the data to use in a base-case assessment is, however, difficult to address. This is because expert judgment must be used as (unfortunately) almost no actual sampling was done prior to the 1980s and therefore the data available are self-reported and unverified. In developing the original assessment model, the STAT team debated whether the CPFV catch series should be used as a basis to estimate total recreational catches (i.e. the basis for the "new" catch series) but rejected this because:

a) producing the largest catches without any sampling to verify this was judged by the STAT team to be questionable;
b) the reported catch by the CPFV fleet is only a small proportion of the total recreational catch so using this as a basis for extrapolation is questionable as minor reporting errors may be magnified substantially;
c) the CPFV catch is a very poor predictor of the total recreational catch in recent years raising the question why it should be considered to be a good predictor of this catch in the past; and
d) the assumption that recreational catches should increase through time reflecting the increasing recreational fishing effort (**Figure 5.SSC**) was judged more plausible.

In relation to the question of how to deal with the CPFV logbook CPUE series, the STAT team still believes that ignoring the data prior to 1960 is the most scientifically defensible approach, primarily because of the change in how effort is reported from 1960, the unusual peak in catch in the late 1950s of all species and our inability to account for the added variance due to effort conversion prior to 1960.

LITERATURE CITED

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Table 1.SSC. Estimates of new and old California cabezon recreational catch.

	Rrecreational Catch (f)							
year	new	old	year	new	old	year	new	old
1930	1	25	1961	25	50	1992	88.7	88.7
1931	2	25	1962	35	50	1993	79	79
1932	3	25	1963	74	50	1994	55	55
1933	3	25	1964	44	50	1995	69	69
1934	5	25	1965	58	50	1996	85	85
1935	5	25	1966	75	50	1997	60	60
1936	9	25	1967	38	50	1998	73	73
1937	9	25	1968	34	50	1999	43	43
1938	18	25	1969	35	50	2000	41	41
1939	9	25	1970	124	50	2001	57	57
1940	12	25	1971	69	50	2002	39	39
1941	11	25	1972	234	50			
1942	11	25	1973	149	50			
1943	11	25	1974	130	50			
1944	11	25	1975	78	100			
1945	11	25	1976	116	100			
1946	11	25	1977	118	100			
1947	108	25	1978	191	100			
1948	164	25	1979	81	100			
1949	149	25	1980	291	291			
1950	179	25	1981	121	121			
1951	208	25	1982	122	122			
1952	107	25	1983	104	104			
1953	75	25	1984	113	113			
1954	54	25	1985	77	77			
1955	49	25	1986	145	145			
1956	110	25	1987	117	117			
1957	98	25	1988	96	96			
1958	68	25	1989	101	101			
1959	54	25	1990	99.3	99.3			
1960	25	50	1991	94.3	94.3			

Table 2.SSC. Estimates of new CPFV CPUE for 1936-, 1947- and 1957-present.

series year	1936- cpue	cv	1947- cpue	cv	1957- cpue	cv
1936	8.13	0.33				
1937	3.88	0.30				
1938	7.81	0.29				
1939	3.77	0.24				
1940	3.35	0.27				
1947	3.35	0.19	3.35	0.19		
1948	5.68	0.16	5.67	0.16		
1949	5.52	0.16	5.52	0.16		
1950	7.10	0.16	7.10	0.16		
1951	6.62	0.14	6.61	0.14		
1952	8.55	0.15	8.54	0.15		
1953	11.63	0.14	11.62	0.14		
1954	25.61	0.12	25.59	0.12		
1955	29.37	0.13	29.34	0.13		
1956	39.85	0.11	39.81	0.11		
1957	21.45	0.09	21.44	0.09	22.00	0.09
1958	13.01	0.10	13.01	0.10	13.37	0.09
1959	5.95	0.10	5.95	0.10	6.15	0.11
1960	3.77	0.11	3.76	0.11	3.91	0.12
1961	4.81	0.11	4.81	0.11	4.99	0.09
1962	7.59	0.11	7.59	0.11	7.87	0.12
1963	11.72	0.09	11.73	0.09	12.13	0.08
1964	13.15	0.09	13.15	0.09	13.61	0.10
1965	12.53	0.09	12.54	0.09	12.88	0.09
1966	13.36	0.08	13.36	0.08	13.71	0.08
1967	9.58	0.09	9.58	0.09	9.83	0.09
1968	5.34	0.10	5.34	0.10	5.51	0.09
1969	4.76	0.10	4.75	0.10	4.89	0.11
1970	6.22	0.10	6.22	0.10	6.41	0.09
1971	5.96	0.10	5.95	0.10	6.12	0.11
1972	9.73	0.08	9.73	0.08	9.97	0.08
1973	7.20	0.09	7.19	0.09	7.38	0.10
1974	7.66	0.09	7.66	0.09	7.87	0.09
1975	6.93	0.09	6.92	0.09	7.08	0.09
1976	6.31	0.09	6.31	0.09	6.49	0.08
1977	5.45	0.10	5.45	0.10	5.63	0.10
1978	8.36	0.09	8.36	0.09	8.60	0.09
1980	7.01	0.10	7.01	0.10	7.22	0.08
1981	5.16	0.09	5.15	0.09	5.30	0.09
1982	3.66	0.11	3.66	0.11	3.79	0.10
1983	4.13	0.11	4.12	0.11	4.26	0.10
1984	1.62	0.13	1.62	0.13	1.68	0.13
1985	1.97	0.11	1.98	0.11	2.08	0.11
1986	5.34	0.10	5.34	0.10	5.55	0.09
1987	7.20	0.10	7.20	0.10	7.46	0.09
1988	7.08	0.09	7.09	0.09	7.34	0.08
1989	9.38	0.10	9.38	0.10	9.68	0.08
1990	9.70	0.09	9.70	0.09	10.06	0.08
1991	7.51	0.09	7.51	0.09	7.80	0.10
1992	6.01	0.09	6.02	0.09	6.24	0.09
1993	3.28	0.10	3.28	0.10	3.40	0.11
1994	2.04	0.11	2.04	0.11	2.11	0.13
1995	2.74	0.11	2.74	0.11	2.81	0.10
1996	5.67	0.09	5.67	0.09	5.80	0.09
1997	4.72	0.09	4.72	0.09	4.85	0.09
1998	2.76	0.11	2.76	0.11	2.85	0.10
1999	2.60	0.11	2.60	0.11	2.67	0.11
2000	3.43	0.10	3.42	0.10	3.53	0.11
2001	5.15	0.11	5.14	0.11	5.26	0.11

Table 3.SSC. Selected Model outputs from all sensitivities done to the inclusion of new data series. The old model results are given and labeled as Base Case.

Trial	$\ln S_0$	S_{2003} (t)	Depletion	ABC	40-10 adjusted
New catch	14,51	341	34.0%	98.1	74.1
CPFV CPUE Index					
Old catch + 1936-	14.38	286	32.5%	77.5	50.1
Old catch + 1947-	14.38	282	32.2%	76.4	48.5
Old catch + 1957-	14.39	294	33.2%	79.7	53.2
New Catch + CPUE index					
New catch & 1936-	14.53	353	34.6%	103.5	82.5
New catch & 1947-	14.52	337	33.4%	98.7	74.5
New catch & 1957-	14.51	331	33.1%	96.3	70.9
Base Case	14.41	313	34.7%	84.5	60.5

Note:
$\ln S_0$ is natural log of intial stock size
S_{2003} is spawning stock biomass in 2003
Depletion is S2003/initial spawing stock size
ABC results from the application of an F45%
40-10 adjusted is the F45% rate adjusted by the 40-10 rule

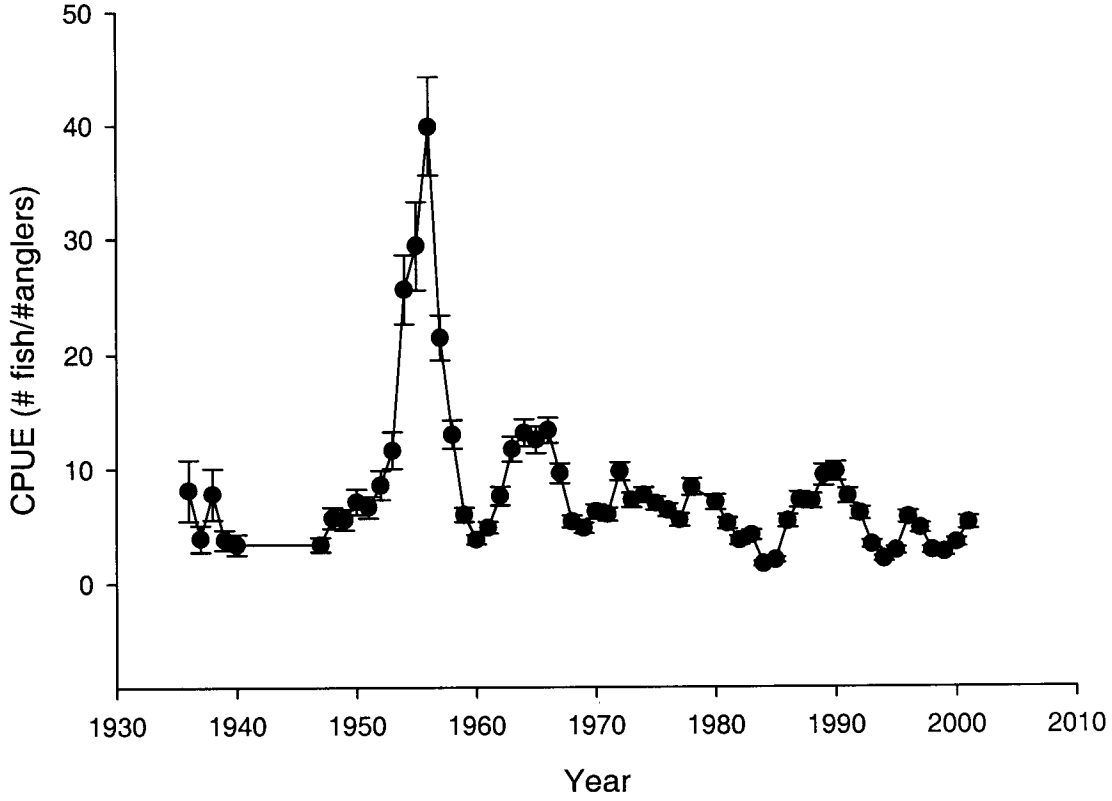


Figure 1.SSC. Plot of the CPFV recreational CPUE series. Errors bars are ± S.E.

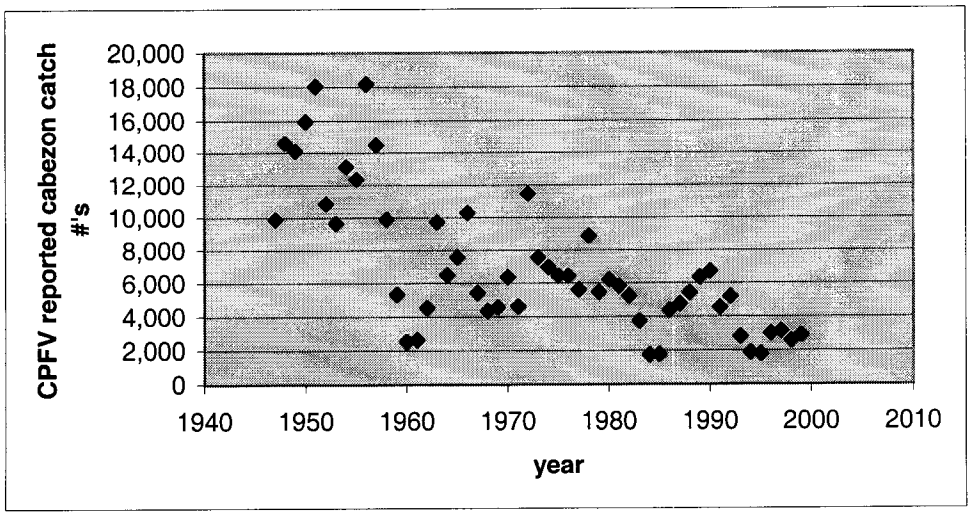
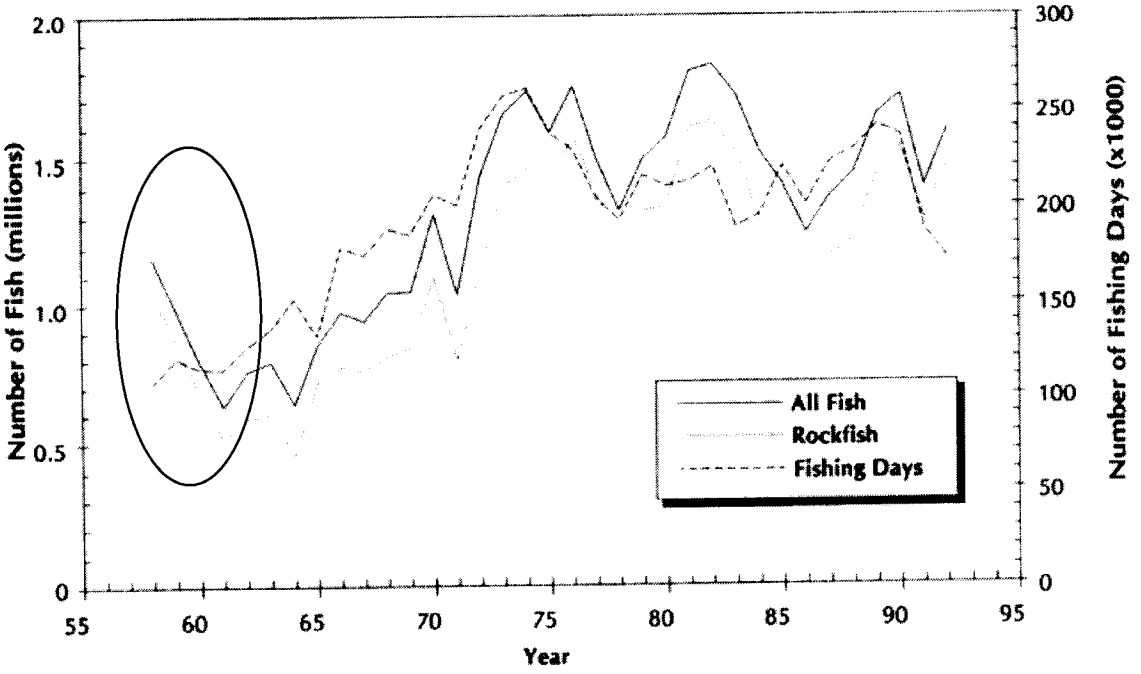


Figure 2.SSC. Numbers of reportedly caught cabezon by CPFV skippers from 1947-present.



Total fish catch, rockfish catch, and effort from northern and central California CPFV log data, 1958–92.

Figure 3.SSC. Numbers of recreationally caught rockfish and all fish by the CPFV fleets and CPFV effort from 1957-near present. Figure taken from Karpov et al. (1995).

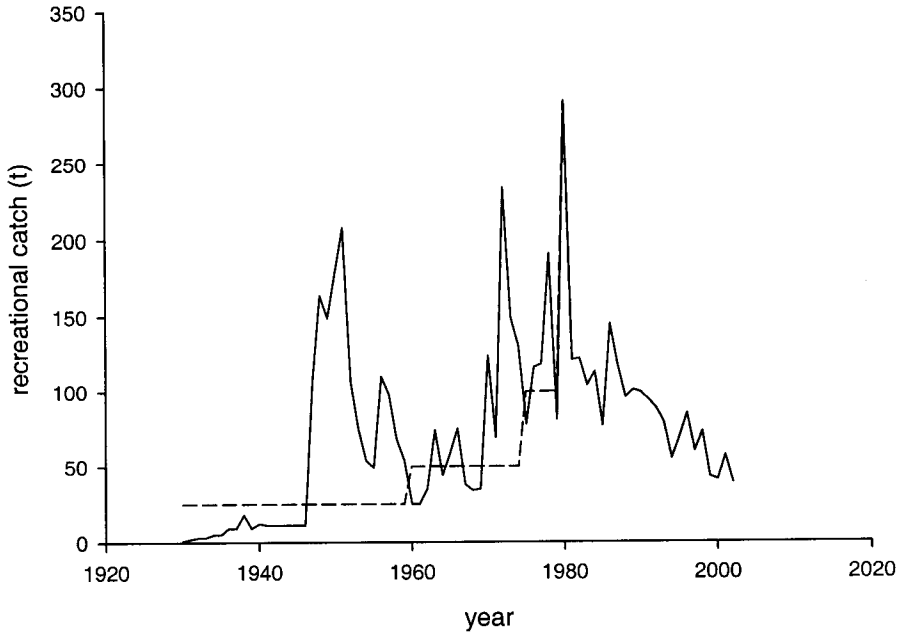
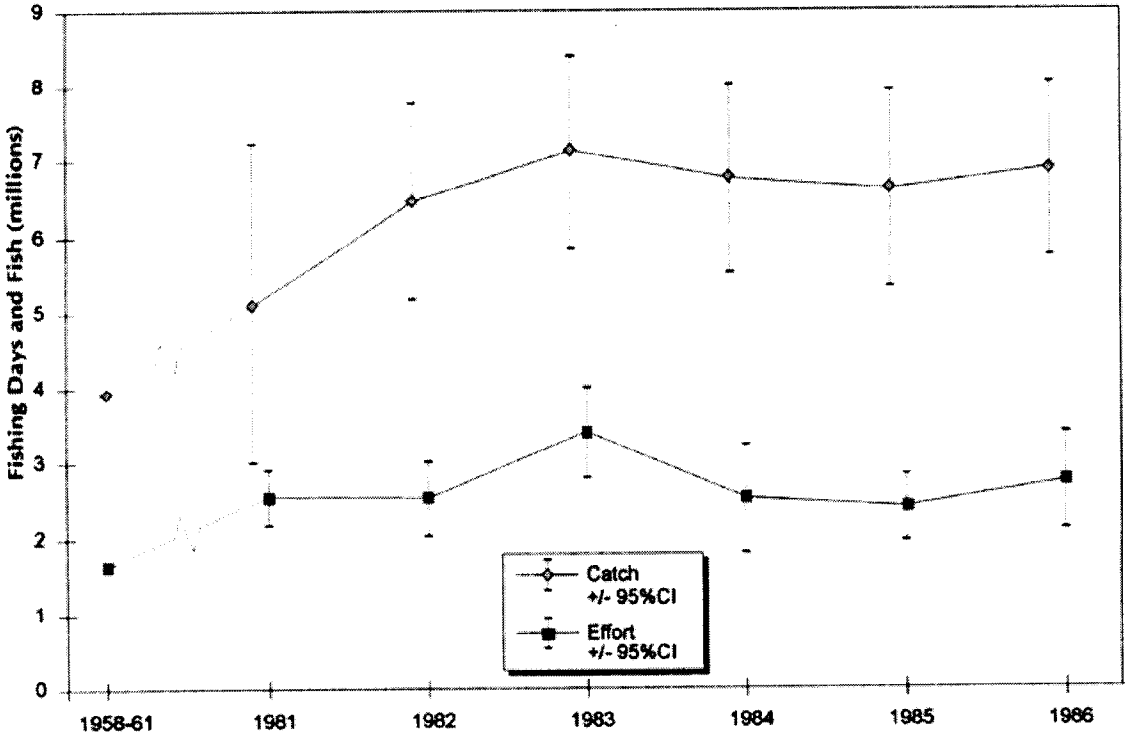


Figure 4.SSC. Estimated California recreational catch. Solid line depicts new estimates and dashed line the old estimates (Cope et al. 2003).



Average annual effort (millions of fishing days) and catch (millions of fish), with 95% confidence intervals in the marine recreational fishery in northern and central California.

Figure 5.SSC. A plot taken from Karpov et al (1995) depicting the increasing total recreational effort in California 1958-1986.