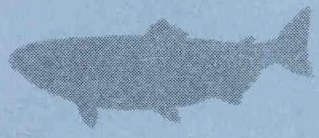
National Marine Fisheries Service
SOUTHWEST REGION
300 S. Ferry Street
Terminal Island, CA 90731



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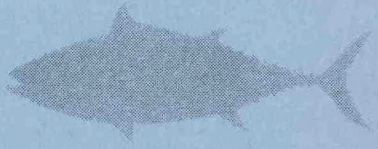
Sandra L. Diamond and Doyle A. Hanan



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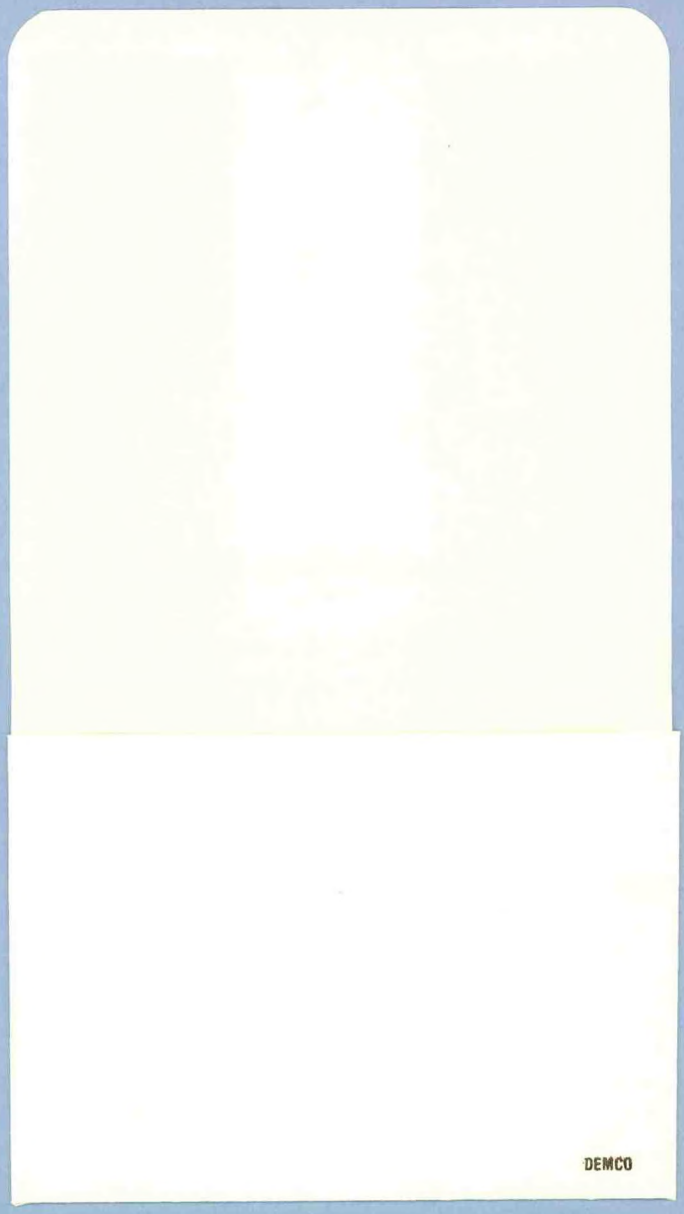

An Estimate of Harbor Porpoise Mortality in California Set Net Fisheries April 1, 1983 through March 31, 1984

by

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Southwest Region
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Terminal Island, California 90731

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Sandra L. Diamond and Doyle A. Hanan

ABSTRACT

Harbor porpoise were taken incidentally in the halibut set net fishery off central California during the 1983-84 fishing year. Total fishing effort was determined by geographic area based on skipper's logs, landing receipts, and fishery observation data. Fishing effort data applied to observations of porpoise taken incidentally to fishing gave estimates of the total number killed. Three separate methods of calculating mortality were used; each method yielded a mean of approximately 300 $\pm$190 porpoise killed during the 1983-84 fishing year.

INTRODUCTION

The Marine Mammal Protection Act (MMPA) of 1972 prohibits the take (harassing, injuring, or killing) of marine mammals. Exemptions to the MMPA are allowed under a permit system established by the National Marine Fisheries Service (NMFS) for commercial fisheries likely to take marine mammals incidentally to fishing operations. These permits, or "certificates of inclusion" allow an incidental take of designated species only when that take is determined by NMFS to have no adverse effects on the population in question.

Although the incidental take of harbor porpoise, Phocoena phocoena, is not currently permitted, some are caught in fishing nets off the California coast. This is of concern for three reasons: 1) little is known about harbor porpoise abundance, distribution, or reproductive capacity; 2) reliable estimates of porpoise mortality have not been available; and 3) during the past three years, there has been a sharp increase in the number of harbor porpoise stranded on the beaches of central California (David Ainley, Point Reyes Bird Observatory, pers. com.) and an increase in the number of nets being fished.

The objective of this study was to estimate the number of harbor porpoise that were taken incidentally in California set net fisheries during the April 1, 1983 to March 31, 1984 fishing year. In order to do this, it was necessary to determine the total fishing effort in the fisheries involved. Therefore, this paper consists of two parts: the determination of total fishing effort and the estimate of total kill.

BACKGROUND

The term "incidental take" legally includes the harassing, injuring, or killing of marine mammals, but in this report "take" refers specifically to accidental mortality caused by fishing gear. Animals caught in gear and released alive, and animals intentionally taken during fishing operations are not included in our definition of incidental take.

Observations made by California Department of Fish and Game (DFG) personnel indicated that harbor porpoise were taken only in nearshore set nets with stretched mesh eight inches (203 mm) or greater. Based on these criteria and on the knowledge that harbor porpoise occur only north of Point Conception (Dohl et al. 1983), the only fishery that could take harbor porpoise was the halibut/flounder set net fishery off central California. For sampling and analysis, this fishery was divided into three geographic areas (Figure 1): the San Francisco area (Sonoma-Mendocino county line to Pigeon Point), the Monterey Bay area (Pigeon Point to Point Sur), and the Morro Bay area (Point Sur to Point Arguello). Since each area has its own fishing fleet

characterized by specific fishing methods, three separate observation programs were developed and implemented by DFG. The data obtained from those programs were summarized by fishing area for this report.

The fisheries involved in this investigation utilize vertical walls of netting anchored to the ocean bottom at both ends. In this report, these nets are collectively called "set nets". Set nets are of three types:

1) Gill nets, constructed of one wall of approximately 8 inch (203 mm) webbing with very little vertical slack;

2) Trammel nets, consisting of two or three walls of webbing hung between the same lead and cork lines; the loosely hung inner panel is made of approximately 8 inch (203 mm) mesh and the tautly hung outer panels consist of 24 to 32 inch (610 to 812 mm) mesh; and

3) Suspendered gill nets, which are gill nets constructed with vertical lines (called suspenders) attached at 1 to 4 fathom (fm) intervals between the lead and cork lines. The suspenders cause the net to bow, increasing vertical slack in the net. Legally, any gill net with vertical slack is a trammel net (California Fish and Game Code, Section 8700), but for this report suspendered gill nets were analyzed separately.

DESCRIPTION OF THE FISHERIES

San Francisco Area

Halibut fishing was conducted primarily from April through October, with peak fleet effort in July and August (Figure 2). Fleet effort was concentrated in the Fish and Game fishing blocks (Appendix I) near Bodega Bay, San Francisco Bay, and Half Moon Bay (Figure 3), with most nets fished in shallow water of approximately 6 to 15 fm (Figure 4). Gill, trammel, and suspendered gill nets were used except that north of Point Reyes, only trammel or suspendered gill nets were legally permitted (Figure 5). Based on observations, most nets ranged from approximately 1 to 3 fm in width (leadline to corkline) and from 100 to 300 fm in length (Figure 6). The mean length of observed nets was approximately 175 fm. As many as six nets were fished simultaneously per boat with most nets fishing or "soaking" as long as 24 hours before being pulled (Figure 7).

The goal of the observation program in this area was to document the incidental take of seabirds, marine mammals, and non-target fish. All observations were made aboard the fishing vessel; observers were stationed in Bodega Bay, San Francisco, and Half Moon Bay, and rides were arranged from port for an entire fishing trip. A large incidental take of seabirds in the halibut nets resulted in DFG closures to halibut fishing for specific areas by depth during the period August 15 through October 16, 1983.

Monterey Bay Area

Halibut were fished primarily in the summer, with peak fleet effort in July and August 1983, and March 1984 (Figure 8). Because the area inside 10 fm was closed to halibut fishing, fleet effort was concentrated in the Fish and Game fishing blocks (Appendix I) near Santa Cruz, Moss Landing, and Monterey (Figure 9) in 11 to 15 fm of water (Figure 10). Although suspendered gill nets may have been used, only gill and trammel nets were observed (Figure 11). Based on observations, net lengths ranged from 150 to 350 fm, and averaged 200 fm (Figure 12). The mean soak time was approximately 24 hours; however, some nets soaked 48 hours or longer (Figure 13).

The goal of the observation program in this area was to document the incidental take of seabirds, marine mammals, and non-target fish. Observations were made from a skiff pulled alongside the fishing vessel.

Morro Bay Area

Halibut were fished primarily in the summer months, with peak fleet effort in July and August (Figure 14). Fleet effort

was concentrated in the Fish and Game fishing blocks (Appendix II) near Morro Bay and Avila (Figure 15), with most nets fished in shallow water, usually 6 to 15 fm (Figure 16). At the beginning of the year, primarily trammel nets were observed fishing, but as the year progressed the fishery changed to suspendered gill nets (Figure 17). Observed nets ranged in length from 100 to about 400 fm and averaged approximately 200 fm (Figure 18). As many as five nets were set simultaneously per boat and each soaked an average of 24 hours (Figure 19).

The goal of the observation program in this area was to document the incidental take of marine mammals (particularly sea otters). Observations were made from a skiff pulled alongside the fishing vessel, although the method became less practicable as cooperation from the fishing community decreased. Beginning in January 1984, alongside observations were supplemented by observations from shore using high-powered telescopes. Telescopic observations were fairly accurate because the fleet fished near shore, however data on net length and soak time became less accurate or unobtainable.

DATA USED IN ESTIMATING TOTAL EFFORT

A unit of effort (a set) was defined as one net deployed to fish and then retrieved, and total fishing effort as the number of sets obtained by the compilation of three sources:

1) Fishing logs completed daily by the set net permit holder and submitted to DFG (California Fish and Game Code, Section 8681). Required information includes: date and location of set, target species, water depth, net length, soak time, and number or pounds of fish caught by species (usually only marketable fish are reported).

2) Landing receipts or "pink tickets" completed at the loading docks and submitted to DFG (California Fish and Game Code, Section 8011). These are required fromany dealer or market that buys fish and from individuals who sell their catch directly to restaurants or the public. Pink ticket information includes date, port of landing, gear type, weight, and price per pound by species.

3) Direct observations by DFG personnel. The observation programs were conducted by three different DFG research projects with differing goals, and the intensity of sampling and methods of observation varied depending on funding, project goals, and fishery characteristics. Data collected include: date and location of the set, net length and type, water depth, number of each species caught, and soak time when possible.

ESTIMATES OF TOTAL EFFORT

Total fishing effort was calculated by area using fishing logs as the primary data base (Table 1). Although most of the fishing effort was reported on the fishing logs, a portion of the effort in each area was not reported and we attempted to estimate that portion from the pink tickets and observations. To do this, fishing effort was divided into two categories, "logged days" and "unlogged days". Logged days were simply those days reported on the fishing logs.

Unlogged days were estimated from two sources: 1) observed fishing days without corresponding logs and 2) pink tickets without corresponding logs. Observed fishing days without corresponding logs were tallied as unlogged days. Pink tickets without corresponding logs were first multiplied by the mean number of fishing days per pink ticket (determined from logged days with corresponding pink tickets) and then tallied with unlogged days.

The number of sets per boat per day was obtained for the San Francisco and Morro Bay areas from DFG observational data, and for the Monterey Bay area from a calculated mean of the total net length reported on fishing logs per boat per day divided by mean net length from observation data. Total effort (as total sets) was calculated by area as follows:

Total Sets = total days (logged + unlogged) X mean # nets/day

ESTIMATES OF HARBOR PORPOISE TAKE

Concentration or Clustering of Harbor Porpoise Take

Chi square tests (Zar 1974) were used to discover concentration or clustering of the observed take of harbor porpoise due to fishing parameters including time of year, location, water depth, net type, net length, and soak time (when available). The null hypothesis was: the number of harbor porpoise observed taken was proportional to the number of observed sets by fishing parameter. A significant Chi square value ($P<0.05$) indicated that the take of porpoise was significantly higher than expected for the fishing parameter being tested, and implied the need to stratify fleet effort by that parameter when estimating total mortality.

Calculations of Total Take

For comparison, three separate methods were used to estimate the harbor porpoise take. Each method calculated a subtotal by area and then the subtotals were combined to obtain the total 1983-84 take of harbor porpoise in California waters. The calculations are as follows:

METHOD 1) Straight ratio:

$$T_i = (t_i / n_i) S_i$$

where (for area i):

T = total take of harbor porpoise
t = number harbor porpoise observed taken
n = number of sets observed
S = estimated total number of sets

METHOD 2) Poisson distribution (Zar 1974):

$$P_1 = \bar{Y}/e^{\bar{Y}}, \quad P_2 = \bar{Y}^2/2e^{\bar{Y}}, \quad \ldots \; P_r = \bar{Y}^r/r!e^{\bar{Y}}$$

$$T_i = \text{sum}(P_r * S_i)$$

where (for area i):

P = probability of taking r porpoise in a set
r = number of animals in a set (0,1,2 or more)
Y = mean number of porpoise per set
T = total take of harbor porpoise
S = estimated total number of sets

METHOD 3) Bootstrap...a computer-intensive MonteCarlo resampling method (Efron 1979):

where:

a) sets of potential observations are drawn thousands of times with replacement from the DFG observer data to obtain a probability distribution of observed porpoise take for each area,

b) fleet effort is then applied to the probability distribution of observed take to obtain a probability distribution of actual take for each area, and

c) the take from each area is added with the others to obtain a probability distribution of harbor porpoise taken.

d) Finally, the mean and dispersion of the distribution are calculated as an estimate of the 1983-84 take of harbor porpoise in California waters.

RESULTS

San Francisco Area

The incidental take of harbor porpoise was not confined to a particular location, instead it was distributed along the coast from Bodega Bay to Half Moon Bay (Figure 20). Although Chi square tests showed no significant clustering of harbor porpoise take by any of the fishing parameters tested, harbor porpoise were only taken in the spring (April 1983 and March 1984) and summer (July and August 1983) (Figure 2). There was also a tendency (although not significant) for porpoise to be taken in depths of 11 to 15 fm (Figure 4).

Sampling effort was representative of fleet effort by month, location, water depth, and soak time (Figures 2, 3, 4, and 6). Approximately 2.8% of the fleet effort was observed by DFG (Table 2).

Fleet effort was estimated to be 5408 sets (Table 1). When applied to the harbor porpoise mortality rate for the San Francisco area, the estimates of porpoise take were 179, 175, and 173 respectively with 95% confidence levels ranging from 7 to 345 porpoise (Table 3).

Monterey Bay Area

The take of harbor porpoise appeared to be clustered in the northern inshore part of the Bay (Figure 20) during June and July (Figure 8). However, both sample size and porpoise take were too small for statistical analysis to be applicable.

Sampling effort was not representative of fleet effort by month (Figure 8) or Fish and Game fishing block (Appendix I, Figure 9). Approximately 4% of the fleet effort was sampled.

Fleet effort was estimated to be 517 sets (Table 1) and when applied to the harbor porpoise mortality rate for the Monterey Bay area, the estimates of porpoise take were 47, 45, and 47 respectively with 95% confidence levels ranging from 0 to 116 porpoise (Table 3).

Morro Bay Area

Harbor porpoise were observed taken from Morro Bay to Point Piedras Blancas (Figure 21). Chi square tests showed that water depth was the only significant fishing parameter in the take of harbor porpoise ($P<0.05$); more porpoise were taken in 16-20 fm than in 15 fm or less.

More than 9% of the fleet effort was observed (Table 2). Sampling effort was not representative of fleet effort by month

(Figure 14) or Fish and Game fishing block (Appendix II, Figure 15), but was representative of fleet effort by water depth (Figure 16).

Fleet effort was estimated to be 3195 sets (Table 1). Because the take of harbor porpoise in water less than or equal to 15 fm was significantly less than the take in deeper water, effort was stratified by the 15 fm contour; this gave estimates of 2,748 sets in water less than or equal to 15 fm and 447 sets in deeper water.

Both nonstratified and stratified estimates of take were calculated. The nonstratified estimates were 77, 76, and 78 porpoise respectively with 95% confidence levels ranging from 11 to 145 porpoise (Table 3). The stratified estimates were: 41, 41, and 49 porpoise respectively with 95% confidence levels ranging from 0 to 111 porpoise for water depth less than or equal to 15 fathoms, and 34, 32, and 34 respectively with 95% confidence levels ranging from 0 to 68 porpoise for water depth greater than 15 fathoms (Table 3).

California Total

Total effort during the fishing year was approximately 9,122 sets (Table 1) and the estimate of take was close to 300 harbor porpoise, regardless of calculation method used (Table 3).

DISCUSSION

Harbor porpoise mortality estimated in this study may be lower than the actual mortality for several reasons. First, an unknown amount of fishing effort was not reported on the fishing logs or pink tickets. The magnitude of the undocumented fishing effort is presently impossible to assess. Second, it is possible that some porpoise may have fallen out of the nets while they were being pulled; although, this is unlikely since porpoise observed in the nets were usually thoroughly entangled.

There were additional problems with the fishing logs and pink tickets that could bias the estimate of total effort and thus bias the harbor porpoise mortality estimate. Some problems with the fishing logs were:

1) Many logs were filled out incompletely or improperly. Part of this problem is attributable to confusion about the proper way to complete logs (e.g. some permit holders fished more than one net per day, but reported only one net with a length equivalent to the sum of all the nets).

2) It is suspected that some permit holders submitted false or misleading information for a variety of personal reasons.

3) Logs were not always completed immediately after fishing so recollection of fishing activities might have been different than actual fishing activities.

Problems with the pink tickets were:

1) Many pink tickets were filled out incompletely or improperly. Information on the type of gear fished and the location of fishing was often missing. In addition, several types of landing tickets were issued by DFG and fish dealers often used them interchangeably, leading to miscoding of gear type in the computer data base. Problems such as these would cause the estimated fishing effort by set nets in central California to be smaller than actual fishing effort.

2) Difficulties were encountered in correlating personal observations and pink ticket data because of inaccuracies in recording of fish species on pink tickets, differences in recording techniques (numbers of fish vs. pounds of fish), and the fact that some fish were not sold immediately, or were kept for personal consumption.

There were also potential problems with the observer programs, which could have biased the estimates of porpoise mortality. Although attempts were made to insure that sampling effort was representative of fleet effort, this was not always possible. In addition, onboard observations were only made with the permission of the fishing boat's skipper; thus, sampling effort was never a random sample of fleet effort by fishing vessel (i.e. most samples were obtained from a small portion of the fleet). It is possible that the vessels not observed were fishing somehow differently from those observed; this could cause bias in the mortality estimate.

Although the problems with the fishing logs and pink tickets are potentially misleading and there were some problems in the sampling program, we feel that using the three sources in combination provides a reasonably reliable estimate of effort ... certainly the best available estimate.

Population estimates indicate that there are seasonal fluctuations in harbor porpoise numbers, with a fall maximum of 2813 $\pm$ 872 (95% CI) harbor porpoise from Point Conception to the Oregon border (Dohl et. al., 1983). Since there is little demographic data available, we do not know if the harbor porpoise population can sustain the mortality that we have estimated. Additionally, we do not know if there are problems of localized depletion (i.e. assuming strong site fidelity and reducing or eliminating those porpoise that utilize a particular site or locale).

Approximately 66.5 per cent of the harbor porpoise in Dohl's

(1983) study were observed north of Point Arena, California; however, the halibut/flounder set net fishery is located exclusively south of Point Arena, in the southern portion of the porpoise range. Harbor porpoise may migrate northward along the coast or offshore/onshore during some seasons; such movement could put them beyond the range of the nets. Perhaps porpoise mortality caused by set nets could be reduced by limiting the fishing during periods when the porpoise are abundant. Fishing parameters which significantly concentrate the take could also provide a means to mitigate or reduce the mortality; these should be fully examined.

The 1983-84 fishing year was anomalous because of the El Nino event. Perhaps a return to cooler or more typical water conditions would reduce the porpoise take; but it is also possible that additional porpoise would then move south within range of the nets. At this time, we do not know the degree to which El Nino may have affected the behavior or the observed take of harbor porpoise.

CONCLUSIONS AND RECOMMENDATIONS

1) Since we do not have reliable population estimates, we do not know what impact the take of harbor porpoise might have; but if the population is small, the take we have described would be considerable.

2) Reliable population indices should be monitored on an annual basis to assess potential implications of the incidental take on a local scale and to the whole population.

3) Reproductive and migratory behavior of harbor porpoise should be studied.

4) Monitoring the set net fisheries should be continued to determine number, age, and sex of porpoise taken.

5) Research on the actual mechanism of entanglement in nets should be conducted to discover whether alternative fishing gear or techniques might mitigate or eliminate the take.

ACKNOWLEDGEMENTS

We sincerely thank Marija Vojkovich and Rhonda Reed (DFG) for valuable computer assistance; Paul Wild, Robert Hardy, Charles Haugen, and Fred Wendell (DFG) for use of their observational data and advice about the fisheries in their study areas; and Alec MacCall (NMFS) for advice and expertise in the calculations. There were a number of seasonal aids who donated their time to this study and we heartily thank them.

LITERATURE CITED

Dohl, T., R.C. Guess, M.L. Duman, and R.C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: status, abundance, and distribution. Center for coastal marine studies. UC Santa Cruz. Final Rpt. Minerals Mgt. Serv. No. MMS-84/0045. 274pp.

Efron, B. 1979. Bootstrap methods: another look at the jackknife, Ann. Statist., 7:1-26.

Zar, J.H. 1974. Biostatistical Analysis. Prentice-Hall, Inc. 620 pp.

TABLE 1. Estimates of total effort by area for central California, (SF = San Francisco, MntB = Monterey Bay, MB = Morro Bay) based on fishing logs, pink tickets without corresponding logs, and DFG observations without corresponding logs during 1983-84.

ESTIMATES OF TOTAL EFFORT

AREA	LOGGED DAYS	#LAND-INGS	#DAYS/ LANDING (±SE)	SETS OBSER-VED	TOTAL DAYS	#SETS/ DAY (±SE)	TOTAL EFFORT (±SE)
SF	1423	311	1.26 ±.02	31	1853	2.93 ±.38	5408 ±702
MntB	170	63	1.17 ±.09	7	251	2.07 ±.34	519 ±86
MB	829	131	1.47 ±.17	33	1055	3.03 ±.19	3195 ±212
MB stratified by water depth:							
						≤15 fm	2748
						>15 fm	447
CALIFORNIA TOTAL:							9122 ±738

TABLE 2. DFG sampling effort by area for central California, 1983-84.

	SAMPLING EFFORT		
AREA	#SAMPLES	#HARBOR PORPOISE	%EFFORT OBSERVED
San Francisco	151	5	2.79%
Monterey Bay	22	2	4.24%
Morro Bay	288	7	9.01%
Morro Bay stratified by water depth:			
≤15 fm	199	3	7.24%
>15 fm	53	4	1.19%
CALIFORNIA TOTAL:	461	14	5.05%

TABLE 3. Estimates of the number of harbor porpoise taken by set net fisheries off California for 1983-84.

	MEAN KILL ESTIMATE ±SE		
AREA METHOD:	RATIO	POISSON	BOOTSTRAP
San Francisco	178 ±84	175 ±84	173 ±77
95% CI Range	12-345	7-344	20-326
Monterey Bay	47 ±32	45 ±34	47 ±30
95% CI Range	0-113	0-116	0-108
Morro Bay	77 ±32	76 ±29	78 ±66
95% CI Range	12-141	17-134	11-145
Morro Bay Stratified by water depth:			
≤15 fm	41 ±30	41 ±25	49 ±62
95% CI Range	0-102	0-91	0-111
>15 fm	34 ±17	32 ±17	34 ±17
95% CI Range	0-67	0-66	0-68
ESTIMATED CALIFORNIA TOTALS			
UNSTRATIFIED	302 ±96	296 ±96	298 ±92
95% CI Range	110-495	104-488	114-482
STRATIFIED	300 ±94	294 ±96	303 ±93
95% CI RANGE	113-488	101-486	124-482

Figure 1. California set net fleets or areas. During 1983-84, harbor porpoise were taken incidentally to fishing in the San Francisco, Monterey Bay, and Morro Bay areas.

SAN FRANCISCO AREA

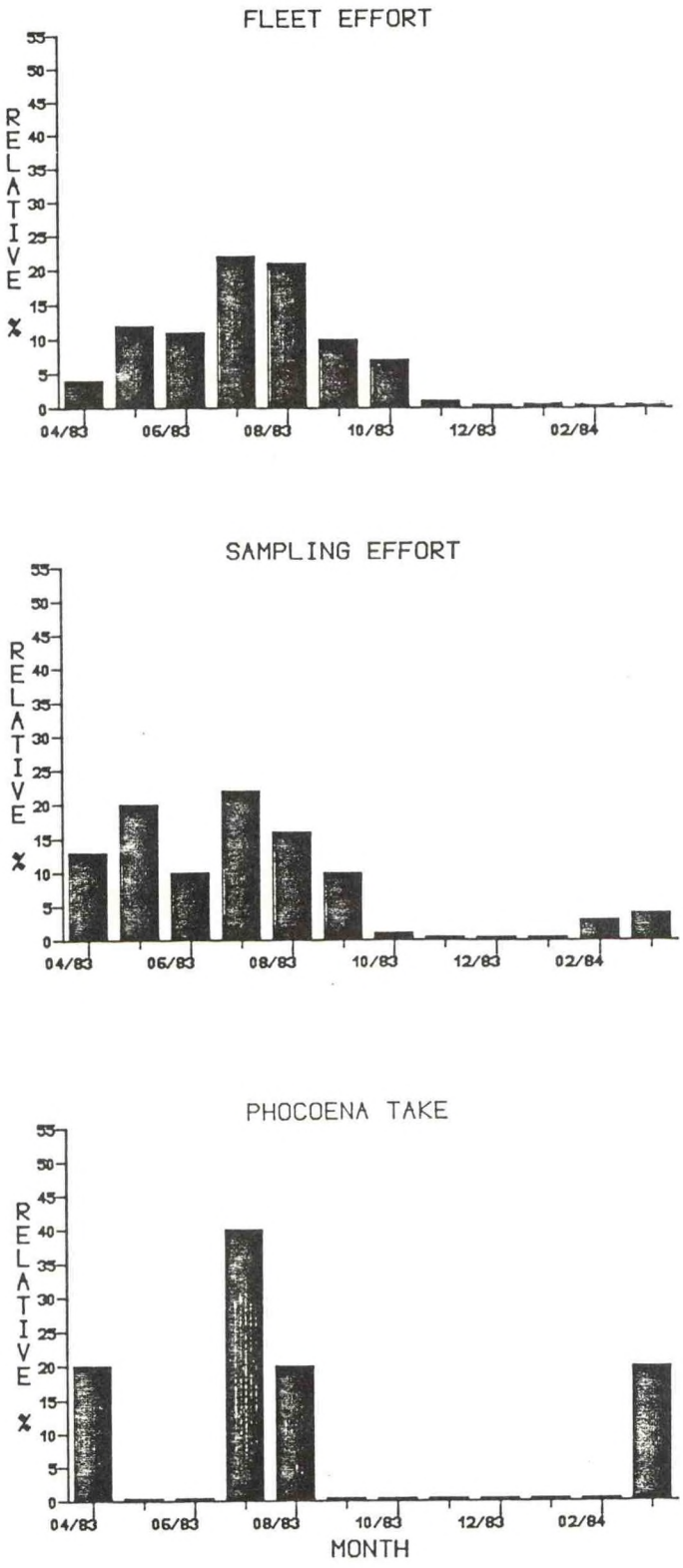


Figure 2. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by month in the San Francisco area, April 1983 to March 1984.

SAN FRANCISCO AREA

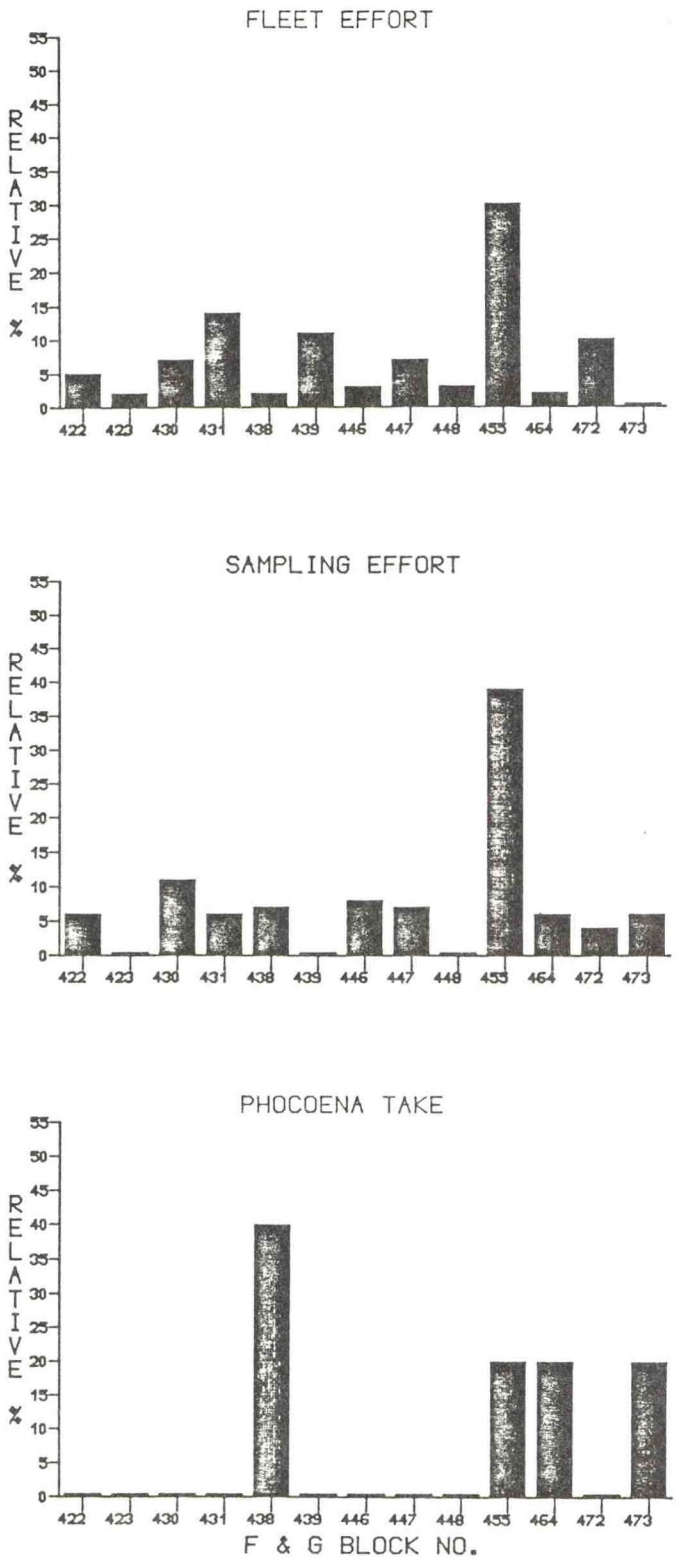


Figure 3. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by Fish and Game block number (block specified by longitude and latitude) in the San Francisco area, April 1983 to March 1984.

SAN FRANCISCO AREA

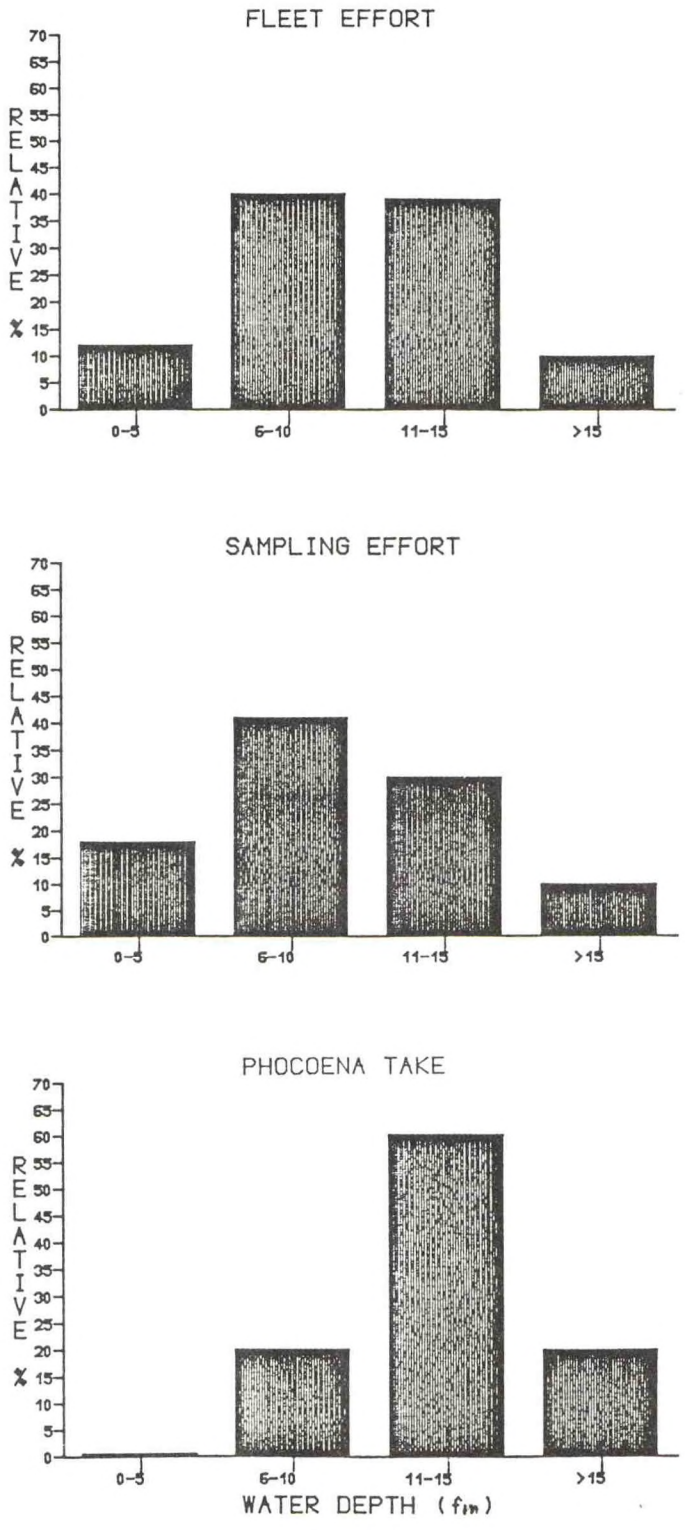


Figure 4. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by water depth in the San Francisco area, April 1983 to March 1984.

SAN FRANCISCO AREA

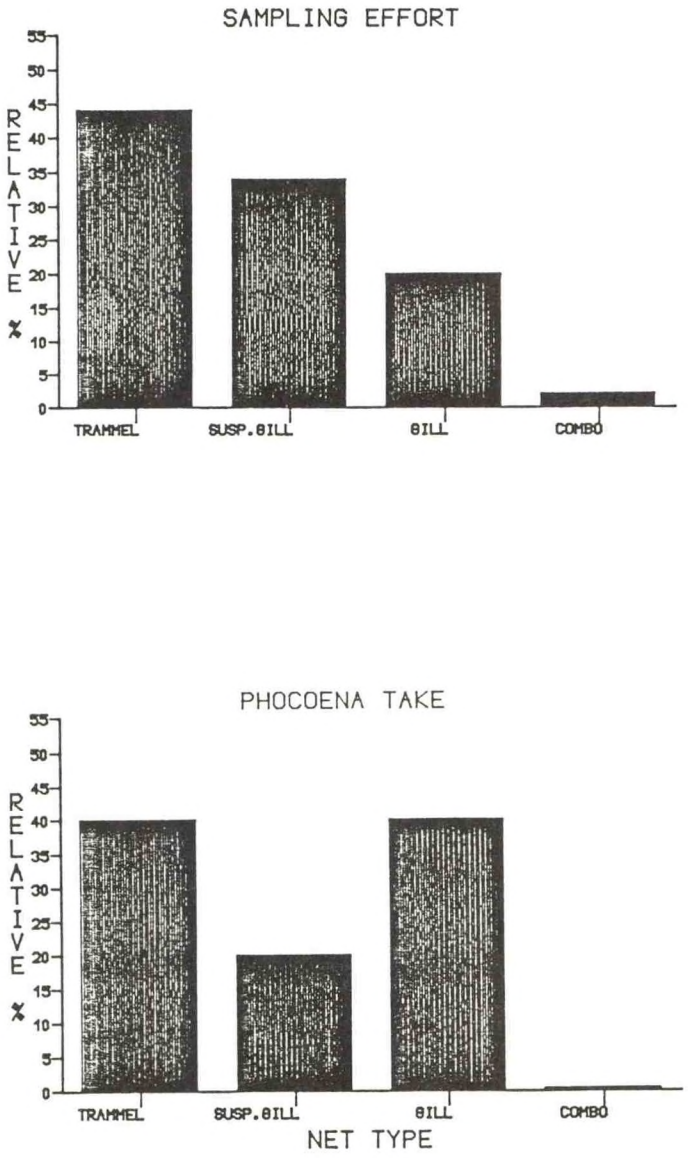


Figure 5. Relative percentages of sampling effort and harbor porpoise incidental take by net type in the San Francisco area, April 1983 to March 1984.

SAN FRANCISCO AREA

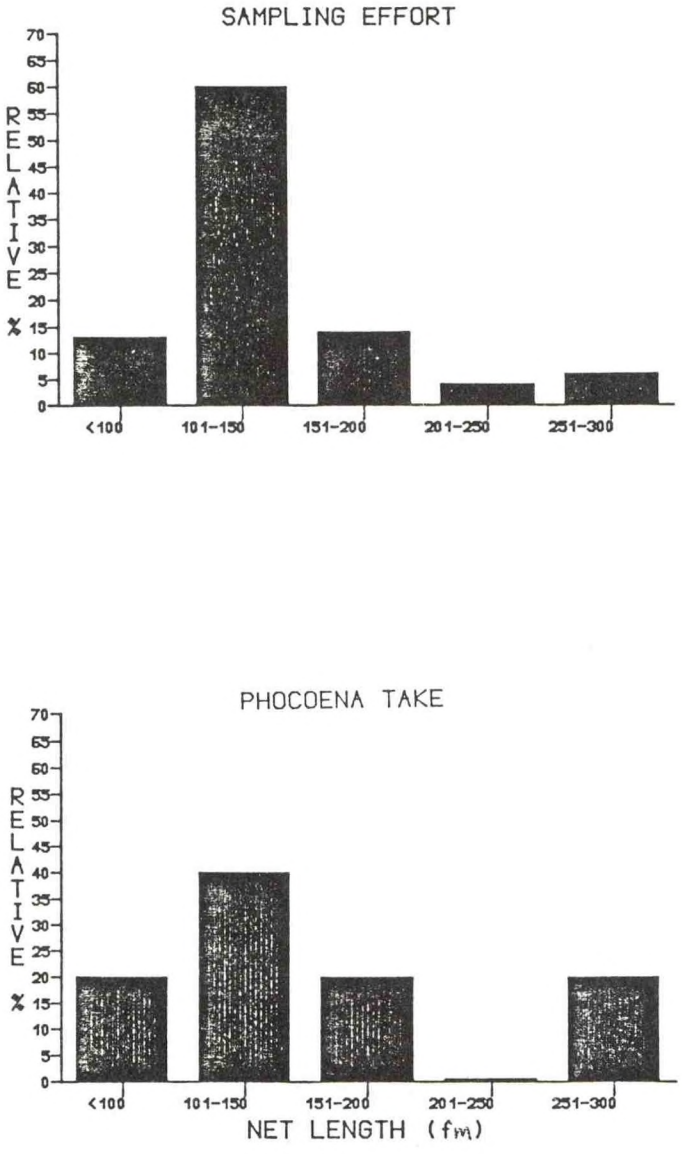


Figure 6. Relative percentages of sampling effort and harbor porpoise incidental take by net length in the San Francisco area, April 1983 to March 1984.

SAN FRANCISCO AREA

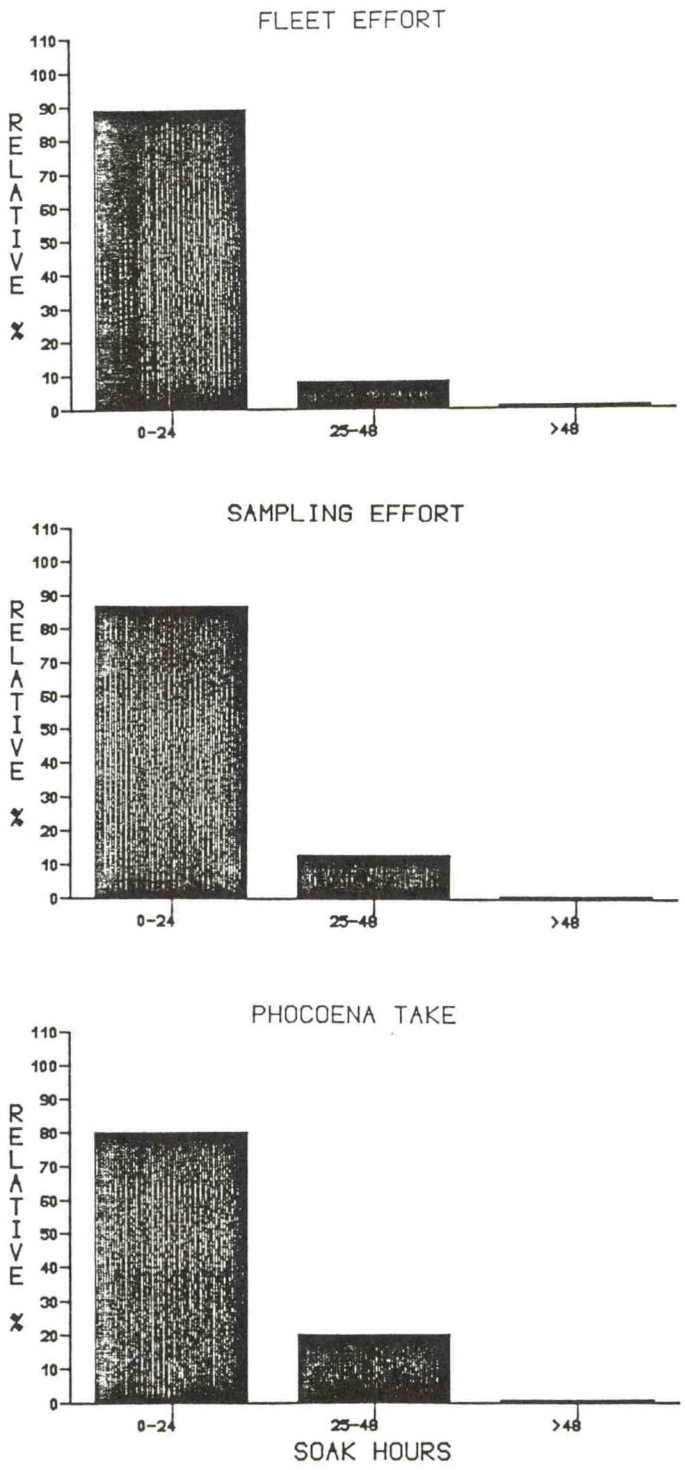


Figure 7. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by soak hours in the San Francisco area, April 1983 to March 1984.

MONTEREY BAY AREA

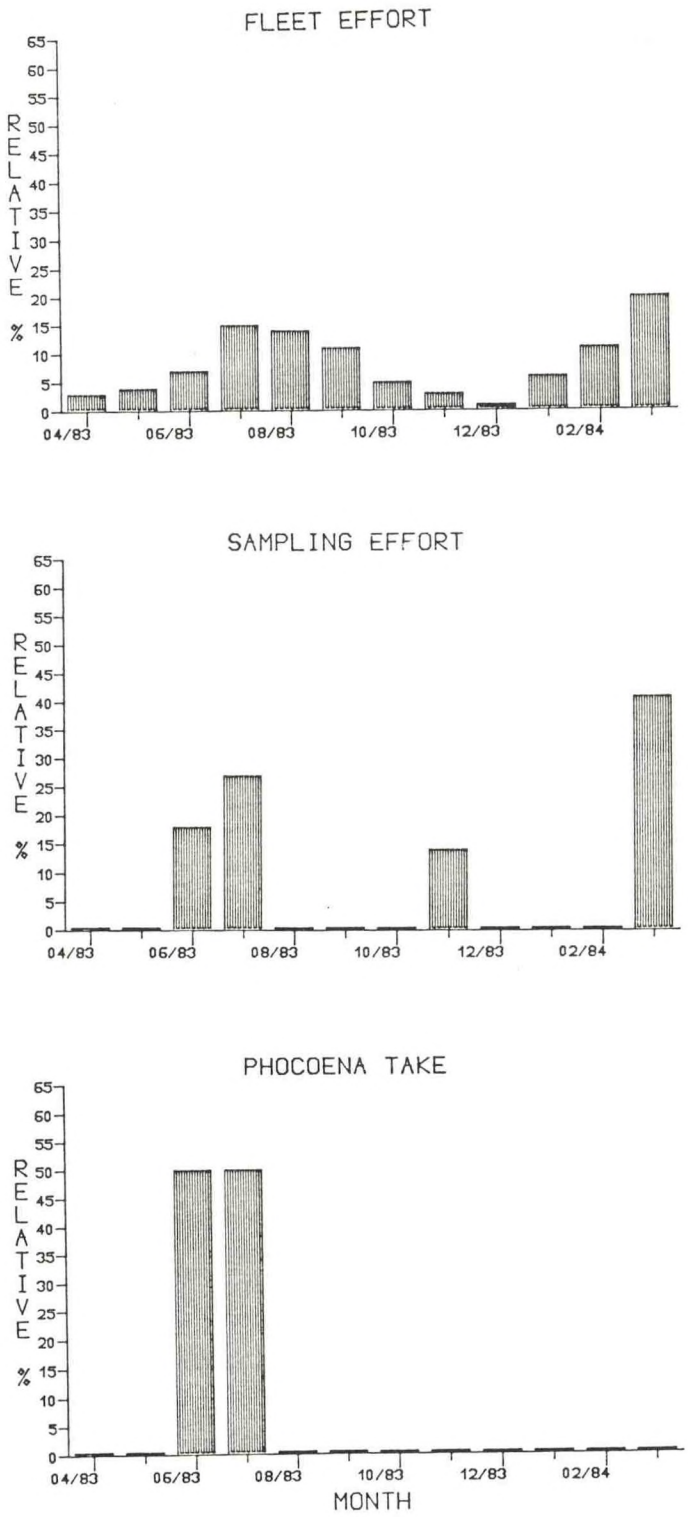


Figure 8. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by month in the Monterey Bay area, April 1983 to March 1984.

MONTEREY BAY AREA

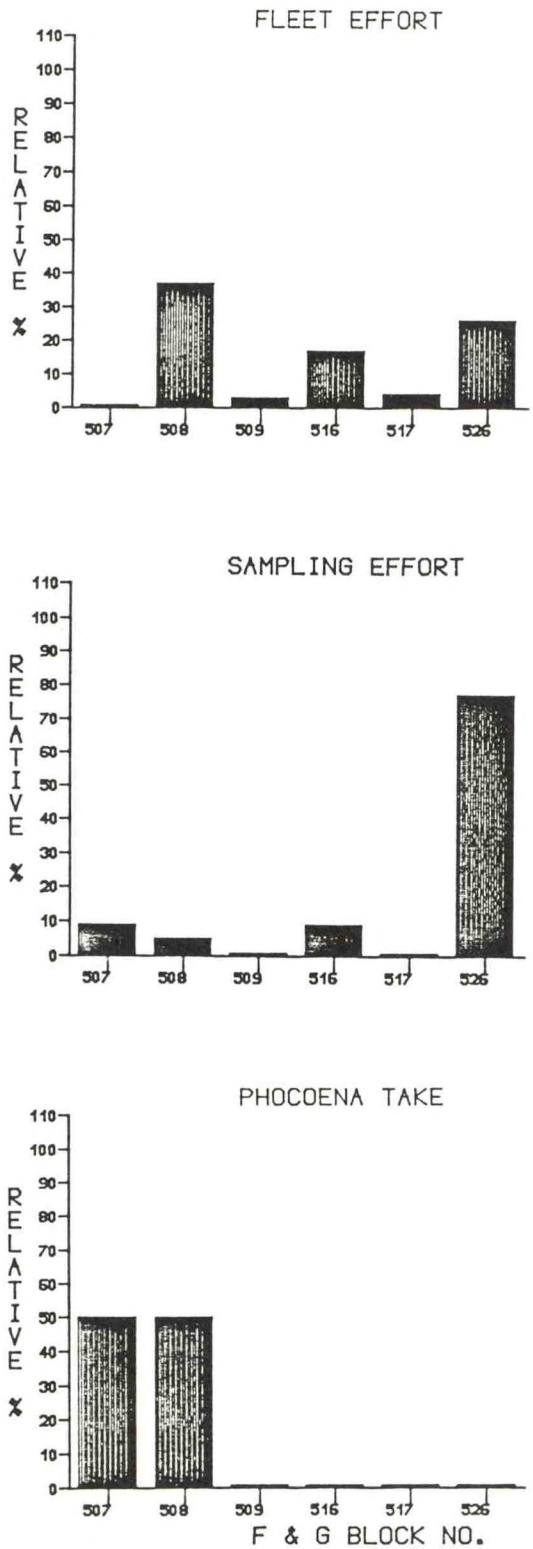


Figure 9. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by Fish and Game block number (block specified by longitude and latitude) in the Monterey Bay area, April 1983 to March 1984.

MONTEREY BAY AREA

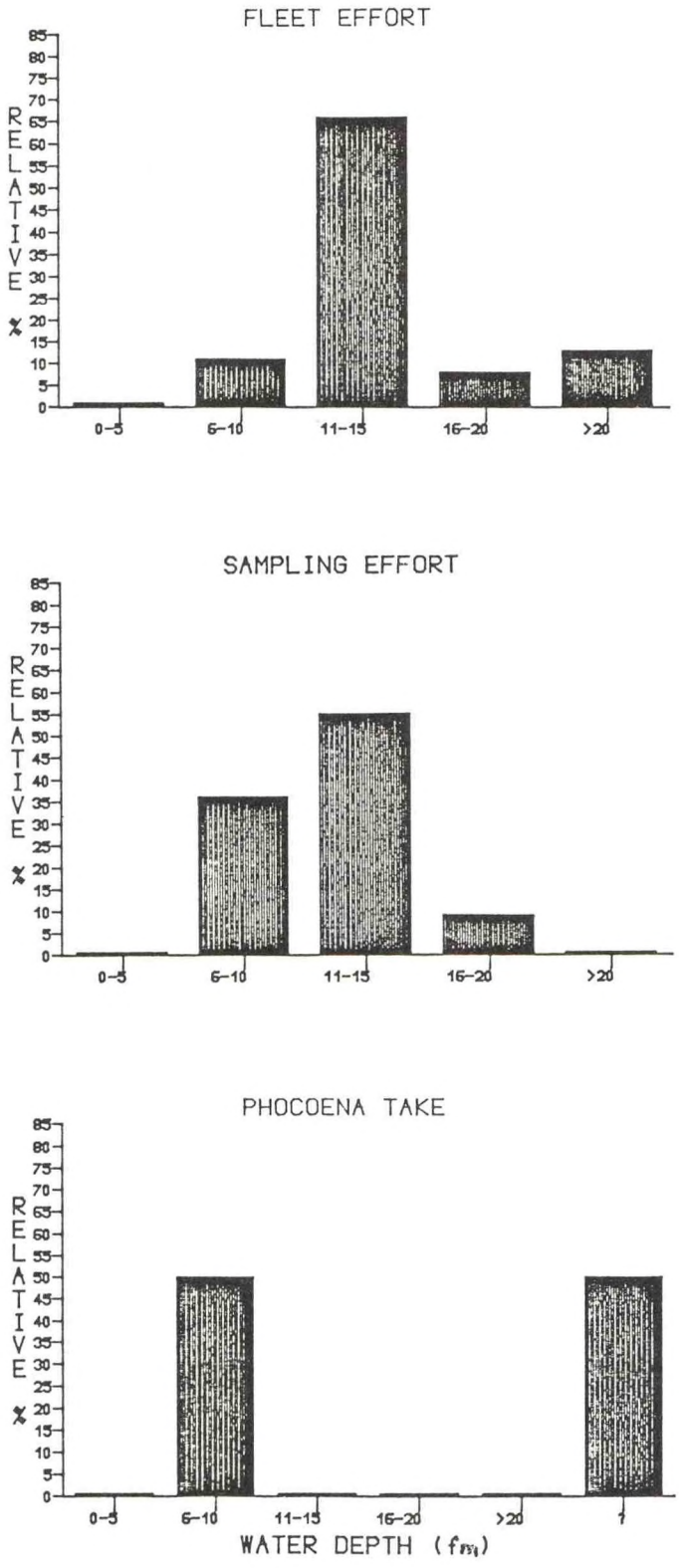


Figure 10. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by water depth in the Monterey Bay area, April 1983 to March 1984.

MONTEREY BAY AREA

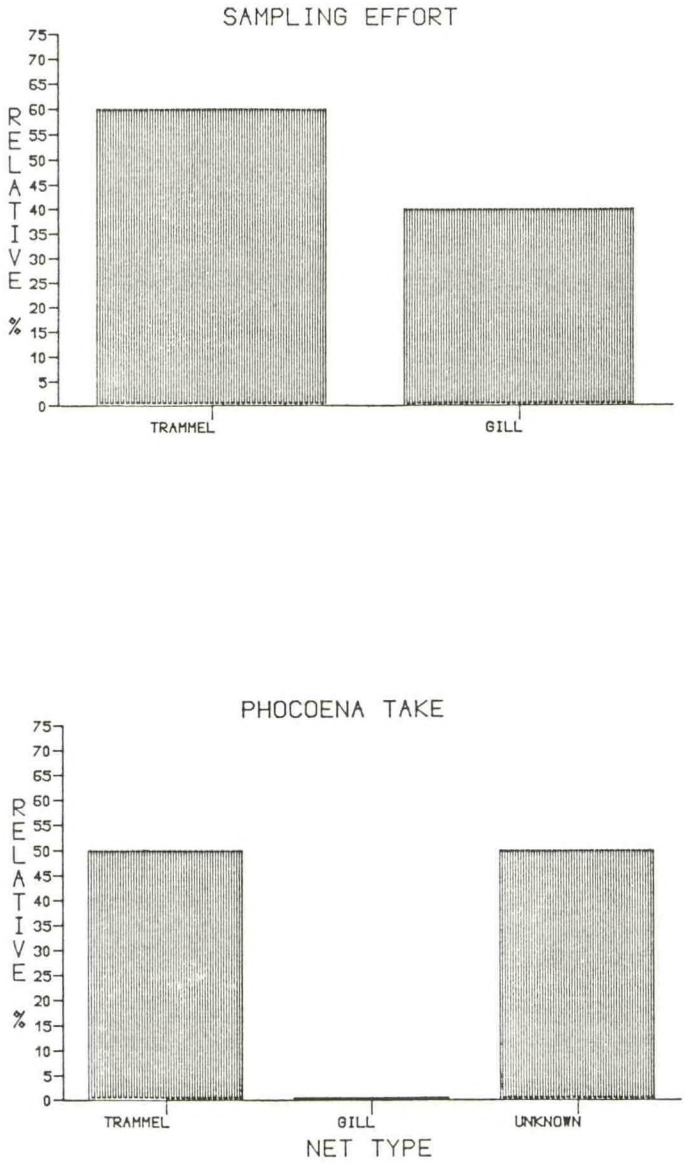


Figure 11. Relative percentages of sampling effort and harbor porpoise incidental take by net type in the Monterey Bay area, April 1983 to March 1984.

MONTEREY BAY AREA

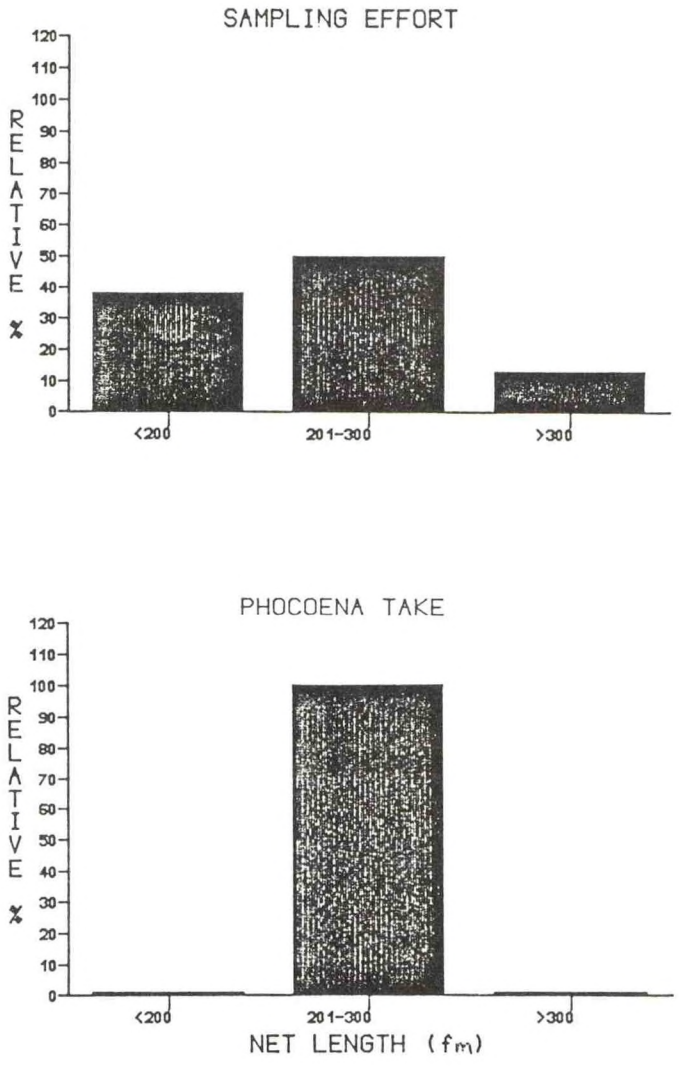


Figure 12. Relative percentages of sampling effort and harbor porpoise incidental take by net length in the Monterey Bay area, April 1983 to March 1984.

MONTEREY BAY AREA

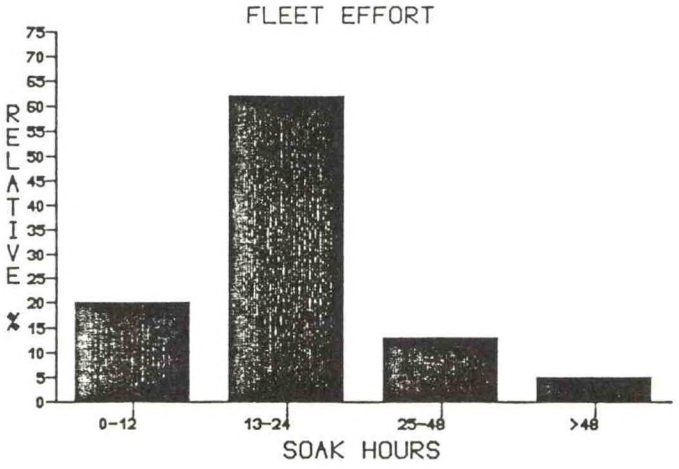


Figure 13. Relative percentage of fishing effort by soak hours in the Monterey Bay area, April 1983 to March 1984.

MORRO BAY AREA

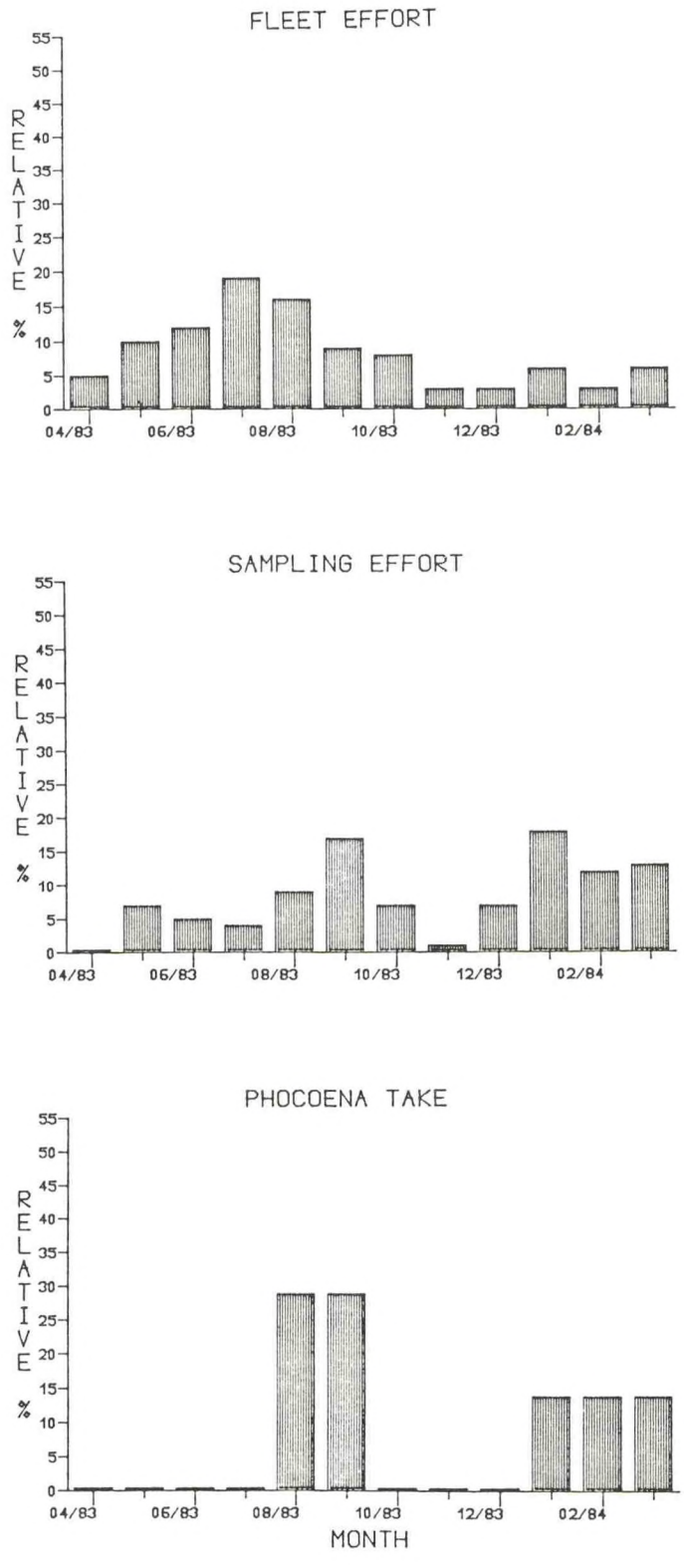


Figure 14. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by month in the Morro Bay area, April 1983 to March 1984.

MORRO BAY AREA

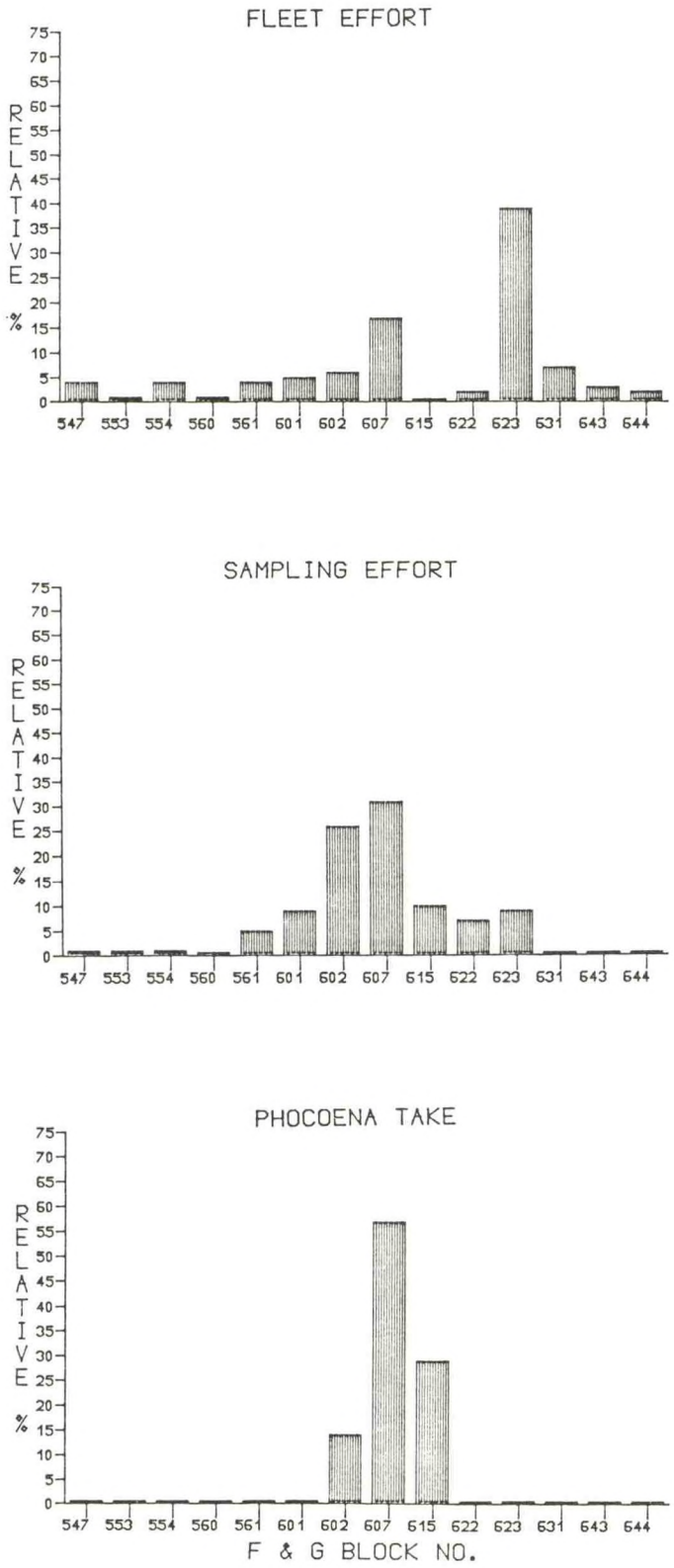


Figure 15. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by Fish and Game block number (block specified by longitude and latitude) in the Morro Bay area, April 1983 to March 1984.

MORRO BAY AREA

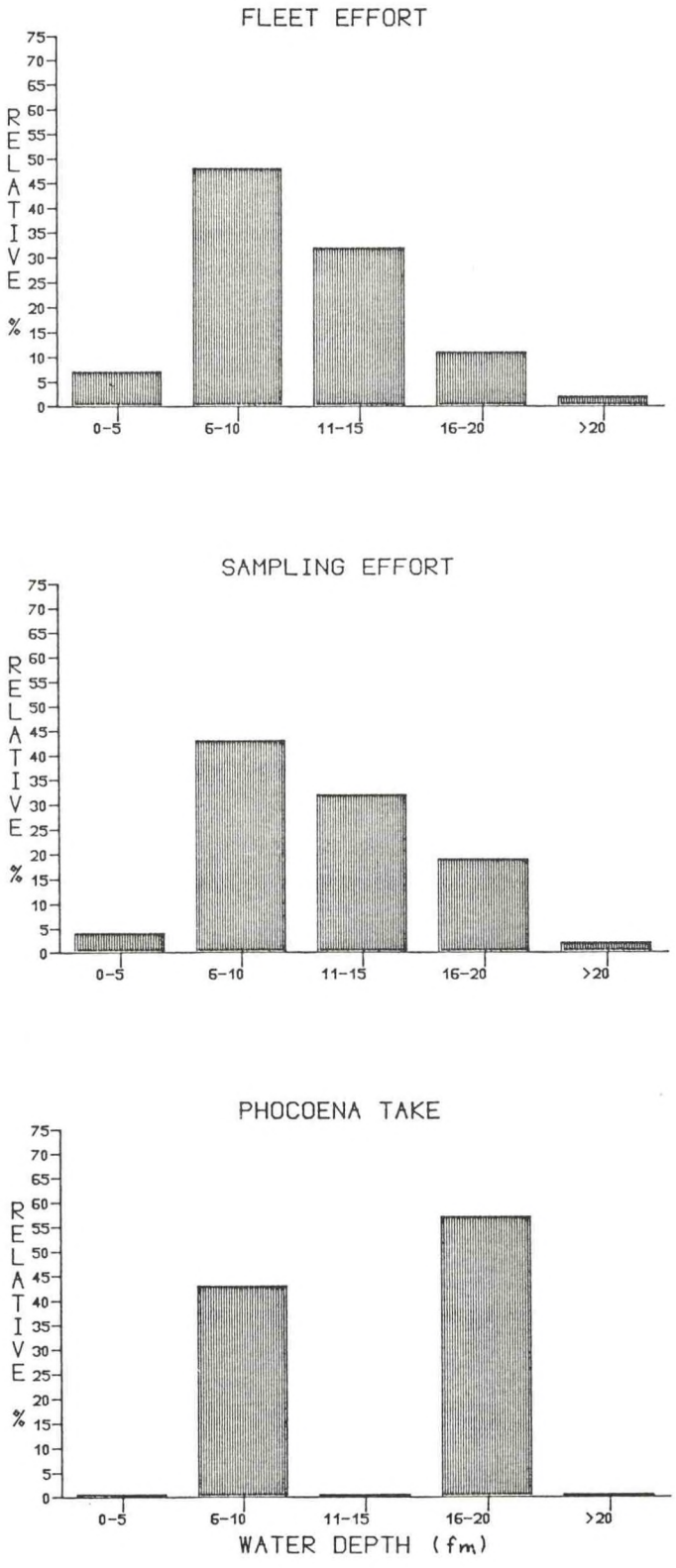


Figure 16. Relative percentages of fishing effort, sampling effort, and harbor porpoise incidental take by water depth in the Morro Bay area, April 1983 to March 1984.

MORRO BAY AREA

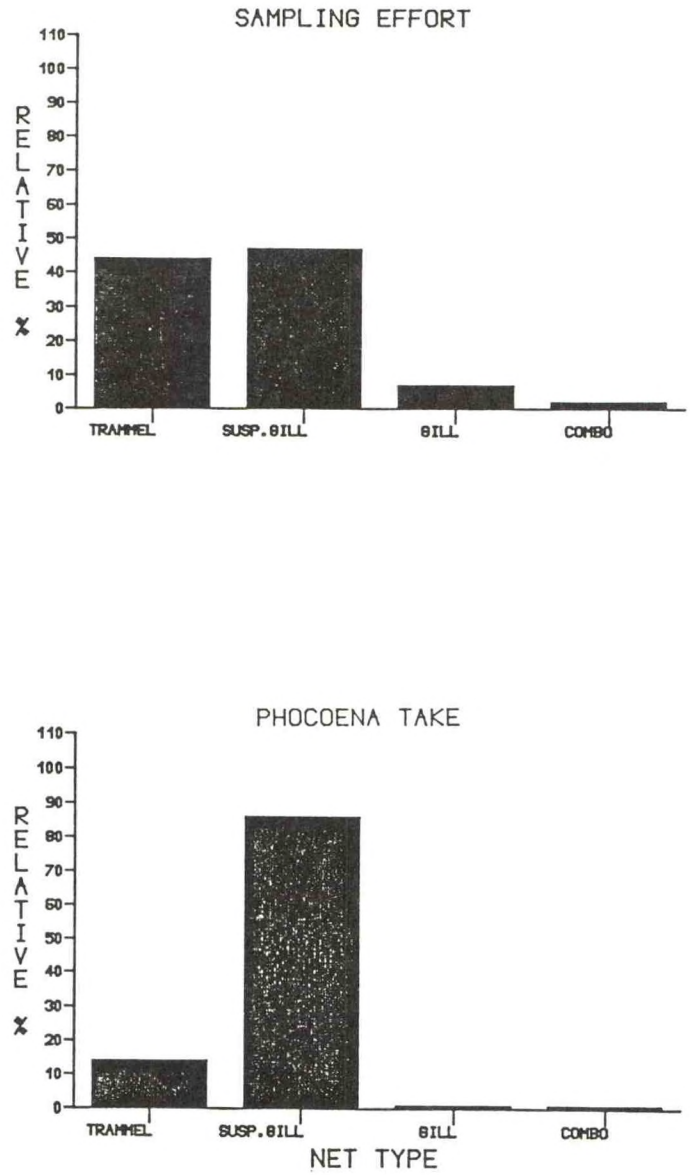


Figure 17. Relative percentages of sampling effort and harbor porpoise incidental take by net type in the San Francisco area, April 1983 to March 1984.

MORRO BAY AREA

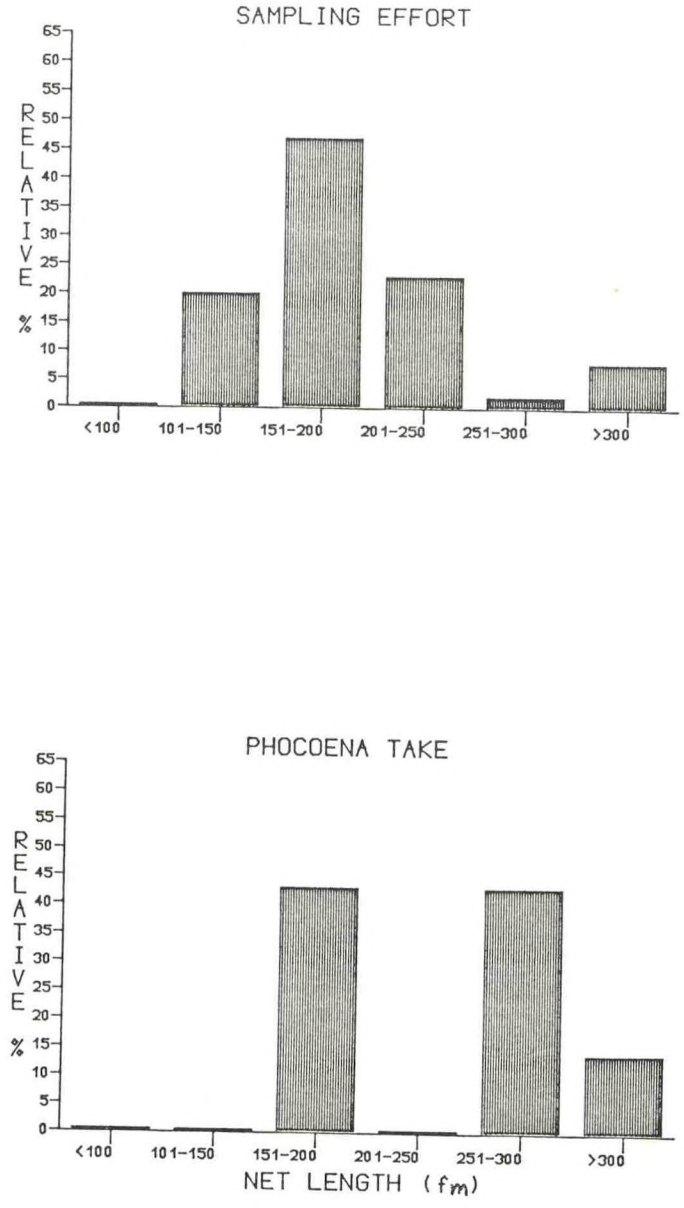


Figure 18. Relative percentages of sampling effort and harbor porpoise incidental take by net length in the Morro Bay area, April 1983 to March 1984.

MORRO BAY AREA

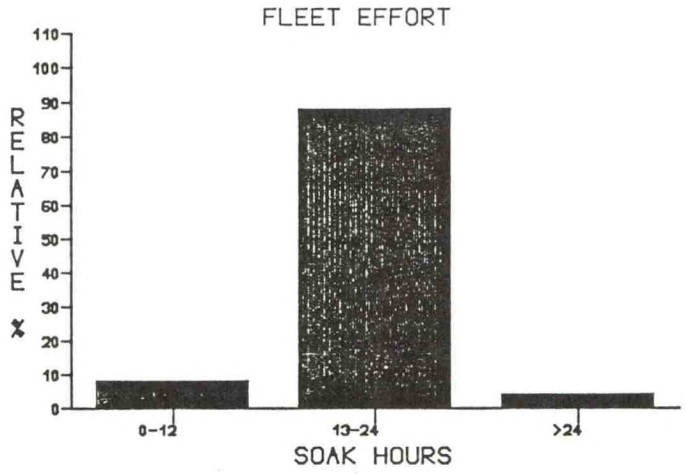


Figure 19. Relative percentage of fishing effort by soak hours in the Morro Bay area, April 1983 to March 1984.

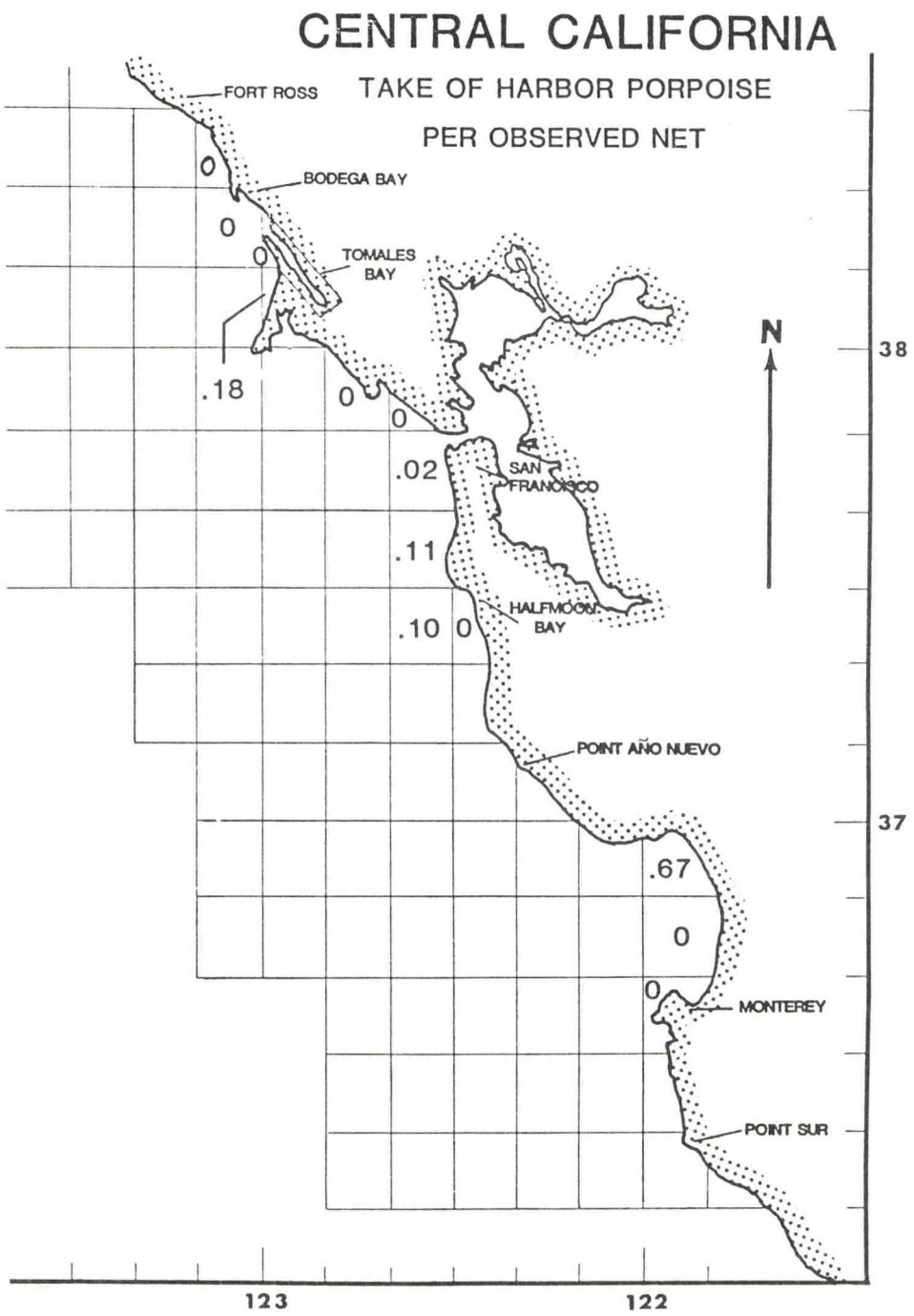


Figure 20 Observed take of harbor porpoise by location. Zero values indicate samples with no observed take.

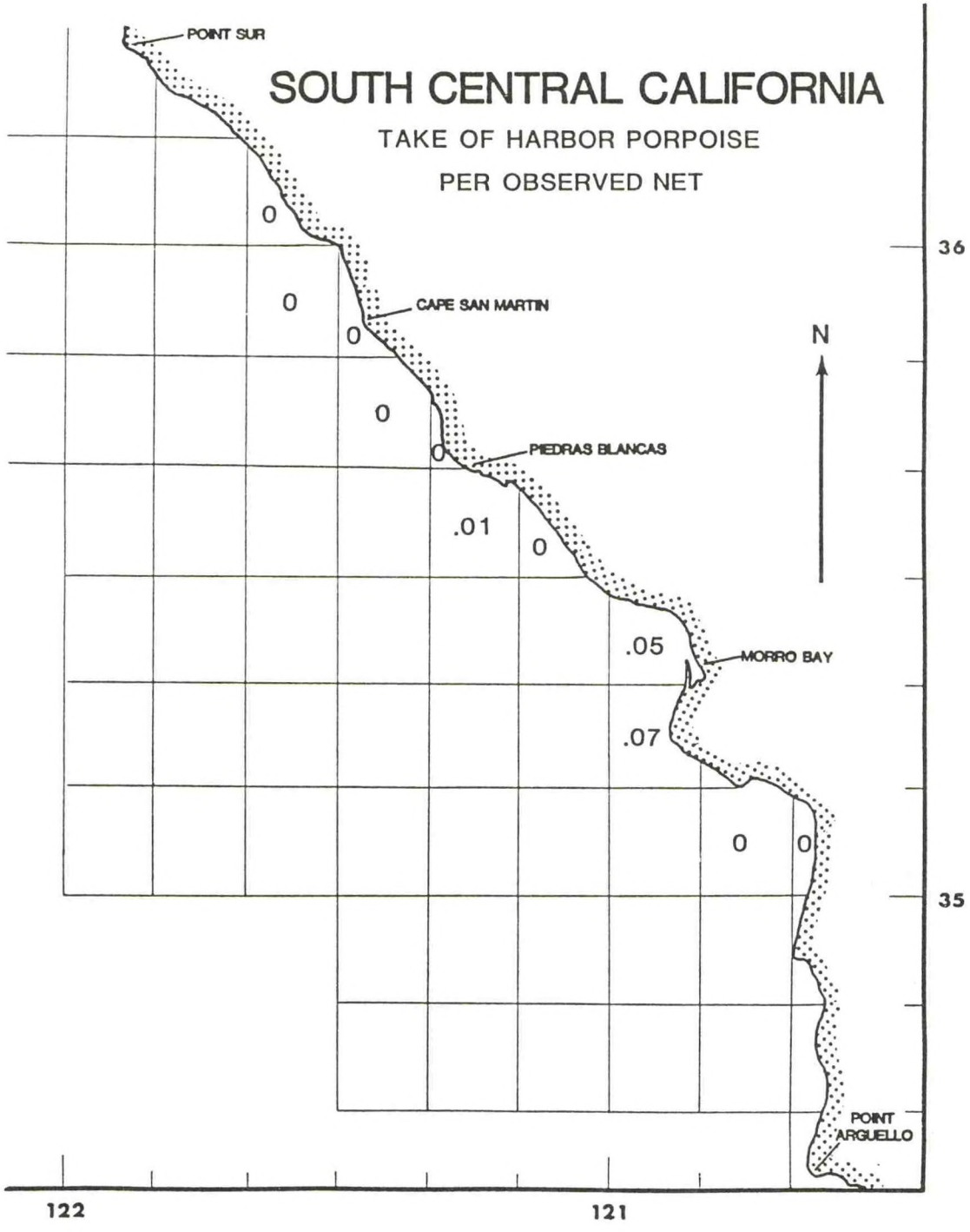
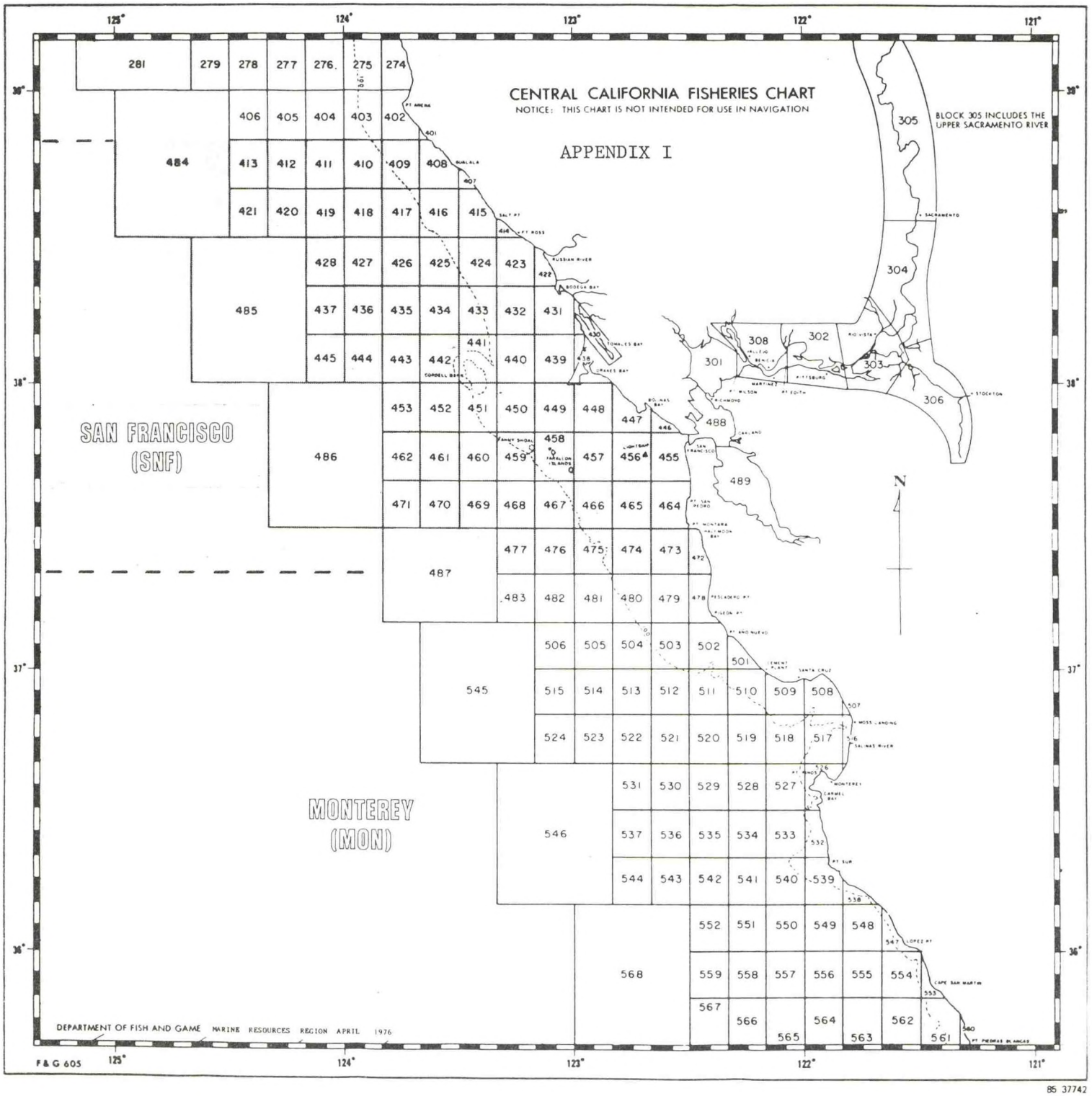
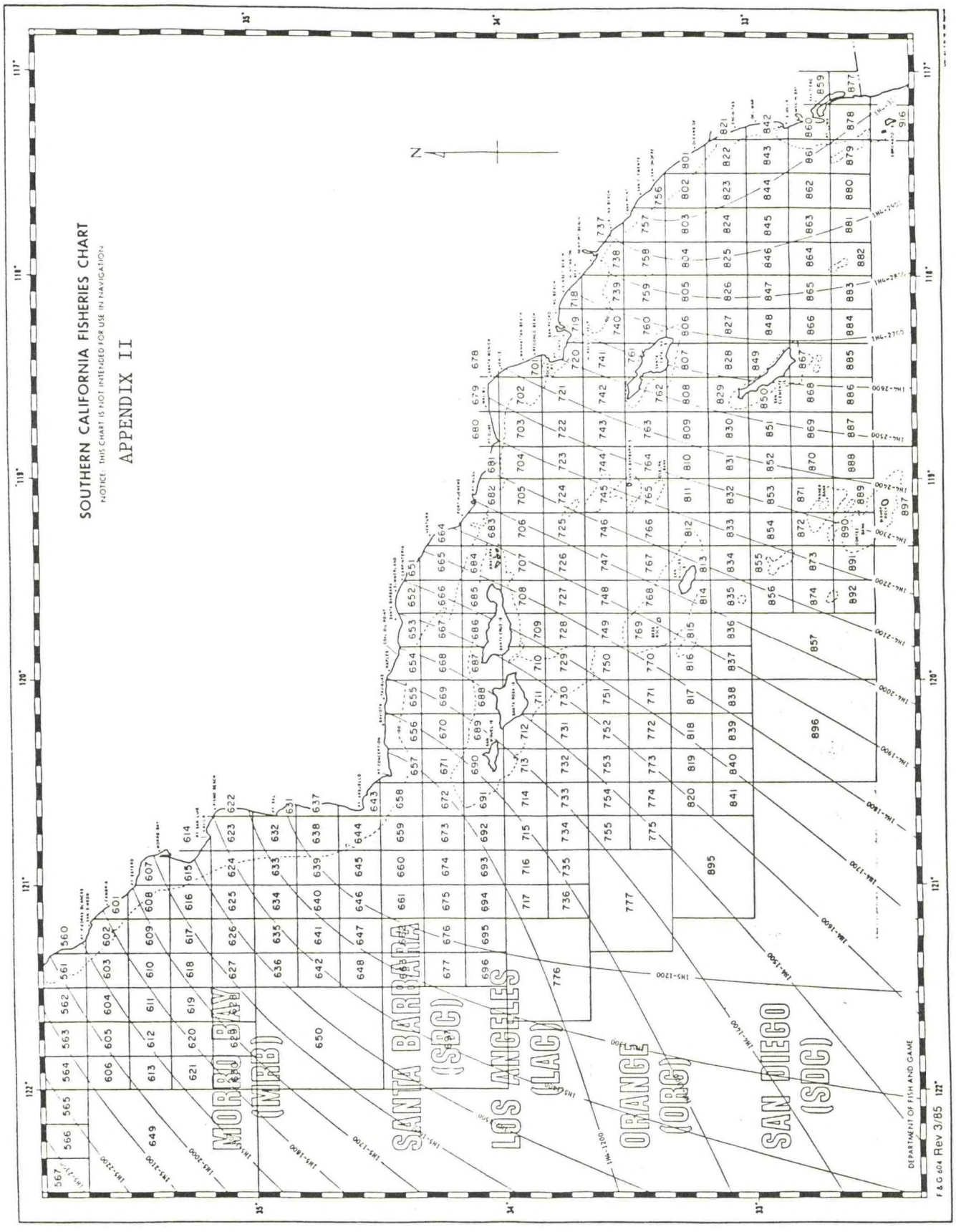


Figure 21 Observed take of harbor porpoise by location. Zero values indicate samples with no observed take.


CENTRAL CALIFORNIA FISHERIES CHART
NOTICE: THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION
APPENDIX I
BLOCK 305 INCLUDES THE UPPER SACRAMENTO RIVER
SAN FRANCISCO (SNF)
MONTEREY (MON)
DEPARTMENT OF FISH AND GAME MARINE RESOURCES REGION APRIL 1976
F&G 605
125°
124°
123°
122°
121°
39°
38°
37°
36°
N

85 37742


SOUTHERN CALIFORNIA FISHERIES CHART
NOTICE: THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION
APPENDIX II
MORRO BAY (MRB)
SANTA BARBARA (SBC)
LOS ANGELES (LAC)
ORANGE (ORC)
SAN DIEGO (SDC)
DEPARTMENT OF FISH AND GAME
F & G 604 Rev 3/85