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CALIFORNIA DEPARTMENT OF FISH AND GAME COASTAL MARINE MAMMAL STUDY, ANNUAL REPORT FOR THE PERIOD JULY 1, 1983-JUNE 30, 1984

By

Doyle A. Hanan

ADMINISTRATIVE REPORT LJ-86-16

CALIFORNIA DEPARTMENT OF FISH AND GAME,
COASTAL MARINE MAMMAL STUDY,
ANNUAL REPORT FOR THE PERIOD
JULY 1, 1983 - JUNE 30, 1984

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INTRODUCTION

This report presents results of several ongoing research projects of California Fish and Game's coastal marine mammal study. These projects are part of a cooperative effort with National Marine Fisheries Service to identify sources of marine mammal/fisheries interactions and and monitor the interactions where possible. Once identified, we are searching for means to ameliorate or mitigate the interactions. Project personnel have also participated in efforts to determine the status of marine mammal stocks off California by investigating their numbers, distribution, and migratory patterns.

Presented in this report are the results of the harbor seal census, the shark/swordfish drift gill net observation program, and the acoustic harassment tests.

HARBOR SEAL, PHOCA VITULINA RICHARDSI, CENSUS IN CALIFORNIA, JUNE 25-30, 1984

by

Doyle Hanan, John Scholl, and Sandra Diamond

INTRODUCTION AND METHODS

California Department of Fish and Game (DFG) initiated a harbor seal, Phoca vitulina richardsi, census along the mainland California coast in 1981 as part of a cooperative marine mammal assessment program with National Marine Fisheries Service (NMFS). The data gathered from these censuses were to be used for development of an annual index of abundance, which could be used to detect trends in population abundance and distribution. The first census was incomplete but allowed refinement of techniques, which have been employed in the subsequent four censuses. Those techniques and the results of the 1982 and 1983 censuses are reported in previous annual reports (Miller et al. 1983 and Hanan et al. 1985).

This report presents results of the June 1984 census, which employed the previous survey techniques as closely as field work permitted. The survey was flown at 600 feet altitude in a Cessna 185 equipped with an optical glass photography port in the belly of the plane for vertical pictures. Vertical photography, which has less counting bias, was used rather than oblique photography. The flight path was south to north to take advantage of the northward progression by time and location of the low tide; thus, the sites were photographed sequentially from south to north (except for those sites which were obscured by fog and were photographed on the return flight as the airplane flew north to south). Some sites were photographed on consecutive days to assure adequate photographic coverage. The survey team consisted of a pilot, recorder, and photographer using a Hasselbald model 500-ELM camera with a 100 mm f3.5 lens and motordrive. Kodak 64 or 200 ASA Ektachrome film was used depending on lighting conditions determined by a Soligor II spotmeter. [1] A Nikon 35 mm camera, 100 mm lens,and motordrive were available in case of Hasselbald malfunctions.

Aerial counts of harbor seals were made by viewing rolls of developed film through dissecting microscopes and marking each counted seal on a thin plastic sheet placed over the frame. Counts were recorded by hauling site number and transferred later to a microcomputer database.

[1] Use of brand names does not imply endorsement by DFG or NMFS.

In addition to the aerial surveys, fourteen known hauling sites were surveyed by observers from vantage points on the shore (ground counts). These observers counted seals each half hour or in the case of large numbers as frequently as conditions permitted. They counted, using binoculars or spotting scopes, from one hour before low tide to an hour and a half after low tide. For each day censused, the maximum count at each site was entered into the database. If the ground count exceeded the aerial count for a site, the ground count was used in the mainland total (Appendix I).

The harbor seal census database includes both aerial and ground count information stored in a separate file for each census. The files were created using the database management program dBASE II.[2] The files are maintained as individual records for each hauling site along the California coast. The records contain a number of fields that identify and describe the site in addition to the counts for each site.

RESULTS

There were no camera malfunctions during the census, but fog restricted visibility at a number of sites and those sites were photographed later in the census.

Harbor seals occuppied 218 of 516 (42%) hauling sites (compared with 57% in 1982 and 39% in 1983; Miller et al. 1983, Hanan et al. 1985). Of the occupied sites, 35 were new sites. We counted 10,885 seals including 113 pups (Appendices I and II). Seals not easily identified as pups were counted as adults. As in the previous censuses, counties north of San Francisco Bay had the largest numbers of seals and accounted for 63% of the mainland total in 1984 (Table 1). This percentage was slightly higher than the 1982 and 1983 censuses (57% and 56%) possibly indicating a lingering effect of the 1982/83 El Nino event. As mentioned above, duplication of census technique should ensure the integrity of this census for comparison to the previous censuses.

The southern California islands were surveyed on June 4th using the same techniques as for the mainland. The total count for all eight islands was 3,199 seals, which is less than the 1983 estimate of 3,448 seals and much less than Stewart's (1982) census (3,707) for the southern California islands. This apparent decline might be explained by the El Nino event of 1982/83, which was manifested in 1984 by the more northward distribution of harbor seals along the mainland (Appendix II).

[2] A trademark of Ashton-Tate, 10150 West Jefferson Boulevard, Culver City, California 90230.

Combining the island and mainland counts (3,199 and 10,885 seals) and assuming little movement between counting areas yields a June 1984 count of 14,084 harbor seals in California. This total is quite close to the 1983 total (14,200 seals; Hanan et al. 1985) but lower than the 1982 total (16,733 seals; Miller et al. 1983). As mentioned above, the lower counts in 1983 and 1984 are probably because of the El Nino event.

ACKNOWLEDGEMENTS

We wish to thank the two DFG warden-pilots, Larry Heitz and Joe Santana, who flew this survey for us. We also thank the people who donated their time to do the ground counts: B. Stephens, R. Folk, L. Wing, M. Klope, J. Vanderweir, D. Seagers, B. Hatfield, E. Faurot, J. Hardwick, J. Ames, A. Baldridge, D. Miller, S. Allen, C. Dempkin, C. Kuizenga, K. Karpov, T. Weist, P. Collier, H. Huber, and C. Fellers. Finally we express appreciation to Doug DeMaster, Jim Lecky, and Chuck Oliver for their help in these studies.

LITERATURE CITED

Hanan, D., J. Scholl, M. Herder, and K. Waldron. 1985. Harbor seal, Phoca vitulina richardsi, censuses in California, April and June, 1983. In D. A. Hanan. California Department of Fish and Game coastal marine mammal study, annual report for the period July 1, 1982 - June 30, 1983. NMFC-SWFC Admin. Rpt.LJ-84-10C.

Miller, D., M. Herder, J. Scholl, and P. Law. 1983. Harbor seal Phoca vitulia, censuses in California, 1981 and 1982. In D. J. Miller. Coastal marine mammal study, annual report for the period of July 1, 1981-June 30, 1982. NMFS-SWFC Admin. Rpt. LJ-83-21C.

Stewart, B. S. 1982. Peak 1982 aerial censuses of harbor seal populations on the southern California Channel Islands. Hubbs Seaworld Research Inst. Tech. Rpt. 82-143, 26 July 1982. Final rpt. submitted to Southwest Fish. Center, La Jolla 7p.

TABLE 1. Harbor seal counts with the number of sites and occupied sites by county for the June 25-30, 1984 census (DN= Del Norte, H= Humbolt, MEN= Mendecino, SON= Sonoma, MAR= Marin, CC= Contra Costa, SF= San Francisco, ALA= Alameda, SM= San Mateo, FI= Faralon Islands, SC= Santa Cruz, SCL= Santa Clara, M= Monterey, SLO= San Luis Obisbo, SB= Santa Barbara, V= Ventura, SD= San Diego).

COUNTY	ADULTS	PUPS	COMBINED	%TOTAL	#SITES	#OCCUPIED	SEALS/SITE
DN	491	0	491	5	13	5	98
H	1366	2	1368	13	45	18	76
MEN	1767	4	1771	16	64	32	55
SON	994	0	994	9	85	40	25
MAR	2211	60	2271	21	51	22	103
CC	64	0	64	<1	1	1	64
SF	47	0	47	<1	1	1	47
ALA	311	0	311	3	3	1	311
SM	563	10	573	5	32	14	41
FI	39	2	41	<1	*	*	*
SC	299	6	305	3	11	6	51
SCL	1	0	1	<1	1	1	1
M	849	7	856	8	79	31	27
SLO	971	1	972	9	101	32	30
V	92	2	94	1	1	1	94
SB	691	19	710	7	24	10	71
SD	16	0	16	<1	4	2	8
TOTAL	10,772	113	10885	100	516	231	21

*MULTIPLE SITES INCLUDED AS ONE COUNT

DRIFT GILL NET OBSERVATIONS FOR THE 1983-84 FISHING SEASON

by

Sandra L. Diamond, Doyle A.Hanan, and John P. Scholl

INTRODUCTION

Marine mammals interact with many commercial and sport fisheries in California. In some fisheries, (e.g. the salmon troll fishery) depredation by marine mammals results in major revenue losses (Miller et al. 1983), while in other fisheries, marine mammal mortality is the primary concern.

In the shark/swordfish drift gill net (DGN) fishery, mortality of the California sea lion, (Zalophus californianus), due to net entanglement has been a major concern. An estimated 600 to 1200 sea lions were killed incidentally in this fishery during September 1980 - September 1981 (Miller et al. 1983), based on data from an observer program required by legislation (AB 2564) and conducted by the California Department of Fish and Game (DFG) from 1980-1982. The mortality estimate prompted DFG to continue monitoring the DGN fleet using a revised, voluntary observer program (DGN skippers were not required by law to allow observation). The objective of the revised program was to document the take of target and non-target species (particularly marine mammals) in the nets. Observations began in May 1983, the beginning of the 1983-84 DGN fishing season.

This paper presents results of the first year of the voluntary observer program, May 1983 through January 1984. An estimate of the number of California sea lions killed incidentally in the DGN fishery is presented and compared to the estimate made by Miller et al. for 1980-81. Preliminary results for May and June 1983 were presented by Hanan and Scholl (1985) and are incorporated into this report.

BACKGROUND - DGN FISHERY

The DGN fishery began in the Southern California Bight around 1977 with the development of new markets for pelagic sharks, predominantly common thresher, (Alopias vulpinus). The fishery started with a fleet of about 15 vessels and by 1983 had expanded to almost 200 vessels. Other target species are swordfish, (Xiphias gladius), bonito shark, (Isurus oxyrinchus), opah, (Lampris regius), and louvar, (Luvarus imperialis).

In September 1980, the Legislature enacted Assembly Bill 2564 (Kapiloff) which directed DFG to study the impact of drift gill nets on marine resources. To complete that study, DFG began an analysis of the thresher shark population and its ability to sustain harvest (Hanan 1984), instituted a permit system requiring permit holders to submit daily fishing logs, and established the mandatory DGN observation program. From 1980 through 1982, fishing vessels with permits for both harpooning and gill netting swordfish were required to allow observers onboard (Bedford 1982). These "dual permit" vessels stayed at sea for up to two weeks; consequently, only those dual permit vessels with adequate room to accommodate an additional person were observed. These restrictions led to an observation program with a large number of samples from a very small percentage of vessels in the fleet. During those three years, fishing operations were observed from 17 of the 190 boats in the fleet and of the 263 nets observed pulled (Figure 1), 207 observations (79%) were from 6 DGN boats.

In September 1982, Senate Bill 1573 (Beverly) was enacted to replace AB 2564. It directed DFG to continue monitoring of the DGN fishery, but removed the requirement for dual permit vessels to allow observers onboard (Bedford 1985). SB 1573 also placed restrictions on fishing gear, limited entry into the fishery, and established a fishing season with time/area closures for protection of non-target species such as the California sea lion (See Appendix III for regulations).

Fishing gear used in the DGN fishery consists of a large gill net which is up to 1000 fathoms (fm) in length and 10 to 30 fm in width (corkline to leadline). Buoys at the surface are attached by extensor lines to the corkline so that the net drifts 2 to 5 fm below the ocean surface. The net is constructed of #24-#30 nylon twine with with stretched mesh sizes ranging from 14 to 21 inches. A radar reflector is attached to the distal end of the net (Figure 2). Under SB 1573, nets can be set to fish no earlier than 2 hours before sunset and must be fully retrieved by 2 hours after sunrise each morning. While in the water or "soaking", one end of the net is attached to the fishing vessel as both net and vessel drift to fish overnight. Nets are pulled from the water using a large hydraulic spool on which the net is wound for storage.

METHODS

To allow random sampling of DGN vessels in the voluntary program, DGN vessels were contacted at sea immediately before the net pull. This sampling method minimized the chance of altered fishing behavior due to an observer's presence and allowed up to four vessels to be sampled per day. Once permission to board was obtained from the DGN skipper, an observer was transferred from the research vessel to the fishing vessel by a 17 ft. Boston whaler, except during rough weather when observations were made from the research vessel using 7 to 10 power binoculars. Observers stayed aboard fishing vessels only for the duration of the net pull. Refusals to board the fishing vessels were rare; however, in such instances, observations were made from the skiff positioned alongside the fishing vessel.

Ten observation days were scheduled each month, but occasionally were limited to fewer days because of poor weather. The DFG research vessel KELP BASS was used for all but one trip, which was aboard the NOAA vessel DAVID STARR JORDAN (Table 1). The research vessel was used primarily for transportation to the area chosen for observation, and to house three or four observers. Sampling areas were chosen based on reports obtained from DFG market samplers, pilot-wardens, and past experience with the fishery. If no boats were sighted at the chosen location, another area was selected. Search effort was generally limited to the areas around the Channel Islands, and Cortez and Tanner Banks.

Observers gathered information on the length and width of the net, the mesh size, the corkline depth, and the time the net was set and pulled. The date, area by Fish and Game block number (Appendix IV), and location by Loran C reading were also recorded. Net slack, measured by hanging length, and the number of meshes per hanging were also recorded.

Catch data collected were: 1) numbers by species; 2) shark sex, length, and reproductive condition; 3) swordfish fork and alternate lengths; and 4) marine mammal species, sex, and total length. Whenever the DGN skipper permitted, a numbered brown Temple tag was inserted into the hind flipper of incidentally killed pinnipeds before they were discarded overboard (Marine Mammal Protection Act Permit No. 380). The purpose of the tags was to determine drift patterns of dead animals which strand on beaches; however, none were recovered.

Our estimate of California sea lion mortality was based on total effort as indicated by skipper's daily fishing logs and the observed kill of sea lions from the observer program. Kill estimates were calculated in two ways: 1) using the Poisson distribution and 2) using a computer-intensive resampling technique called the Bootstrap (Efron 1979).

RESULTS

Seventy-one net pulls were observed from May 1983 through January 1984 (Figure 3). Observations were made in every fishing month except December, when the R/V KELP BASS was in port for repairs. The largest numbers of observations were made in October (17) and the least in May (7) and November (6). This sampling effort compares favorably to peaks of fishing activity in October and January as reported on skipper's logs (Figure 4), although less than 1% of the logged net pulls were observed during the entire fishing year. All of the observations were made in Southern California (Figure 5) with most vessels observed in the vicinity of Santa Cruz, Anacapa, and San Clemente Islands. Approximately 88 per cent of the logged fishing activity was reported in Southern California, with fishing reported as far north as San Francisco (Figure 5).

Net characteristics varied a great deal among the fishing vessels (Table 3). Average net length was 829 fm, with a range of 330-1000 fm (Figure 6). Over 38 per cent of nets observed were 900 to 1000 fm in length. Net width averaged about 14 fm, with a range from 6 to 25 fm. Soak time, the time from the start of the set to the start of the pull, averaged 11 hours, and ranged from 6.25 to 13.25 hours (Figure 7). Mesh sizes (stretched measurement) were obtained by averaging all mesh sizes on a single net and found to range from 10 to 19 inches with a 16 inch average for all nets (Figure 8). Corkline depth averaged 3.6 fm, and ranged from 2 to 9 fm.

When the catch observed during this sampling program was compared to that observed during the mandatory program (1980-82), changes in catch composition were seen and species new to the catch such as skipjack and pelagic thresher sharks were noted (Table 4). The catch per observed net pull (catch rate) of common thresher sharks decreased from almost three sharks per net pull in the mandatory program to less than 0.5 sharks per net pull during the voluntary observation program.

Six California sea lions and two elephant seals (*Mirounga angustirostris*) were observed caught in the nets (Table 2). In this fishery, pinnipeds caught in the nets are usually dead by the time the net is pulled. All pinnipeds were taken in the vicinity of the northern Channel Islands, but outside the closure areas (Figure 3). Two of the sea lions and two elephant seals were taken in the same net. No other species of marine mammals were observed caught during the fishing season.

Although there were fewer California sea lions taken per observed net pull in 1983 (0.085 sea lions per pull) than during 1980-1982 combined (0.364 sea lions per pull), the difference was not significant (Mann-Whitney U test, $P>.05$). Based on logged effort and observed kills, approximately 900 sea lions were estimated incidentally killed in the 1983-84 DGN fishery; the Poisson calculation estimated 888 $\pm$ 380 (S.E.) sea lions killed and the Bootstrap estimated 925 $\pm$ 469 (S.E.) sea lions killed.

DISCUSSION

The estimated total kill of approximately 900 sea lions during the 1983-84 fishing season is comparable to the estimate of 600-1200 killed during 1980-81. The catch rate of sea lions in 1983-84 was only about 33 per cent of the 1980-82 catch rate of sea lions and estimated total kill is about the same level as reported by Miller et al. (1983) for the 1980-81 season. Total kill is at the same level because effort increased nearly fourfold between the two sampling periods. The decrease in the catch rate could be the result of several factors, or combinations thereof, including: 1) the effectiveness of the time/area closures in SB 1573 which was designed to reduce the take of sea lions, 2) the shift in primary target species from thresher shark to swordfish, with the subsequent movement of the fishery farther offshore and north of Point Conception, or 3) the trend towards larger mesh sizes, which may have different catch rates for sea lions.

It is premature to conclude that there is a definite long term decline in the catch rate of sea lions because of differences between the 1980-82 and 1983-84 data including: 1) the change in sampling method, 2) the lack of samples at the offshore seamounts and north of Point Conception, and 3) the El Nino conditions in 1983-84. More sampling, including at least one year following the El Nino should be conducted to separate the effects of these three complicating factors on incidental take. A larger sample size, and the sampling of vessels fishing north of Pt. Conception are also needed to avoid biases in the sampling program and to refine the estimates of incidental take.

LITERATURE CITED

Bedford, D. 1982. Pelagic shark/swordfish drift gill net fishery. State of California, Department of Fish and Game, Management Information Document. Presented to the California Legislature, January 1983.

Bedford, D. 1985. Pelagic shark/swordfish drift gill net fishery. State of California, Dept. Fish and Game, Management Information Document. Presented to the California Legislature, January 1985.

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

Hanan, D. A. 1984. Analysis of the common thresher shark, Alopias vulpinus, in the California bight. NMFS-SWFC Admin. Rept. No. LJ-84-10C, 34 p.

Hanan, D. A. and J. P. Scholl. 1985. Shark drift gill net fishery observation program (May - June, 1983). In Doyle A. Hanan, California Department of Fish and Game, coastal marine mammal study, annual report for the period July 1, 1982 - June 30, 1983. NMFS-SWFC Admin. Rept. No. LJ-85-10C, 75 p.

Miller, D. J., M. J. Herder, and J. P. Scholl. 1983. California marine mammal-fishery interaction study, 1979-1981. NMFS-SWFC Admin. Report No. LJ-83-13C, 233 p.

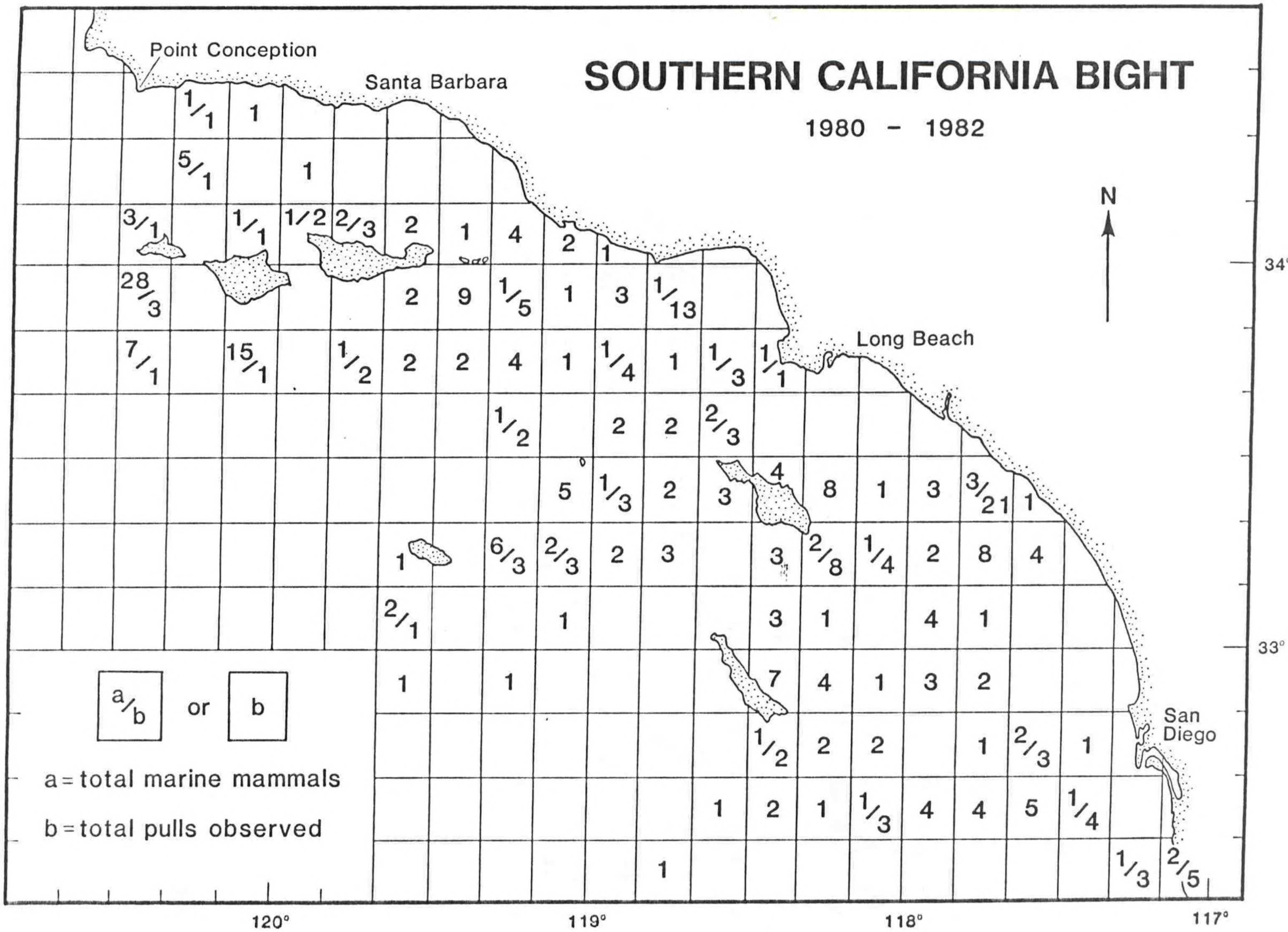


FIGURE 1: Location of marine mammals taken per observed net pull, 1980-1982

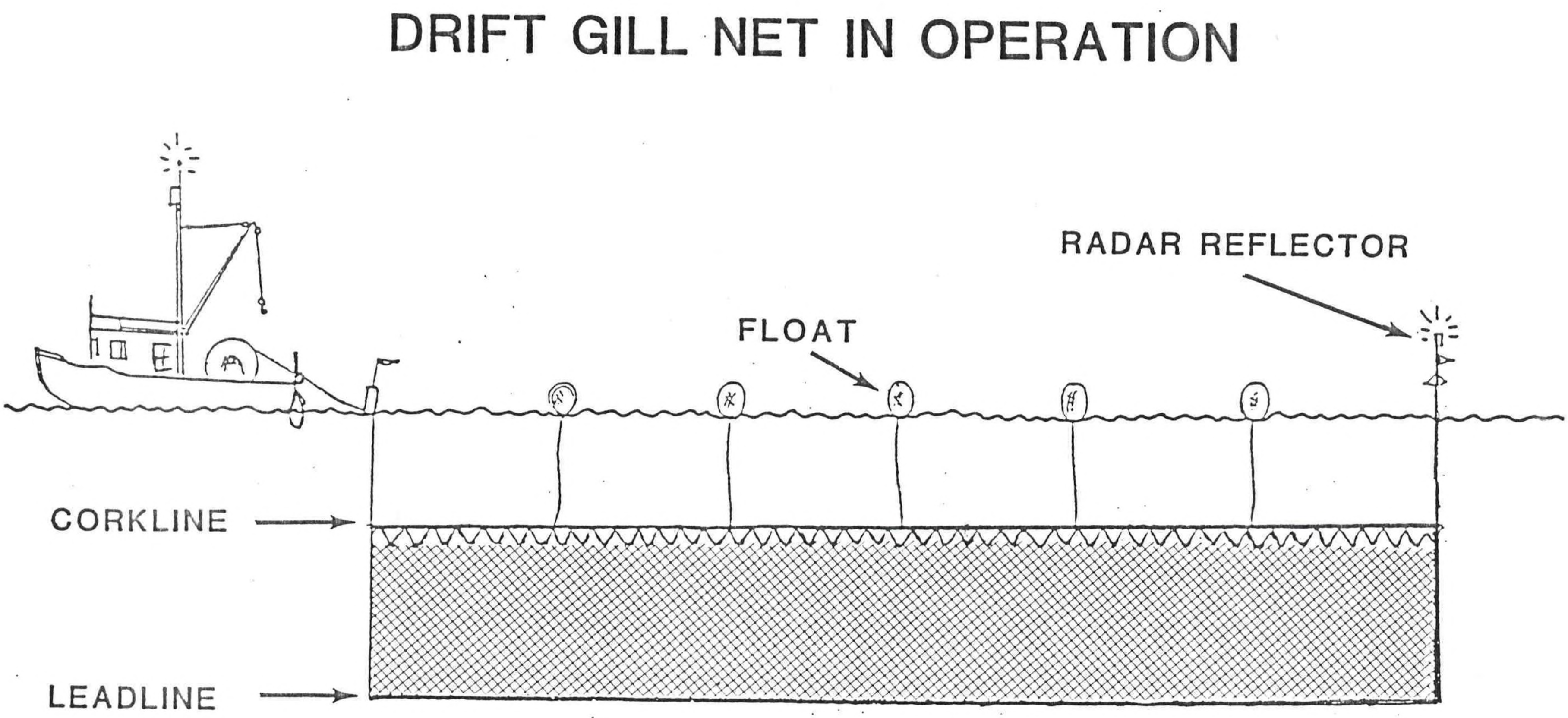


FIGURE 2: DGN Vessel in Operation

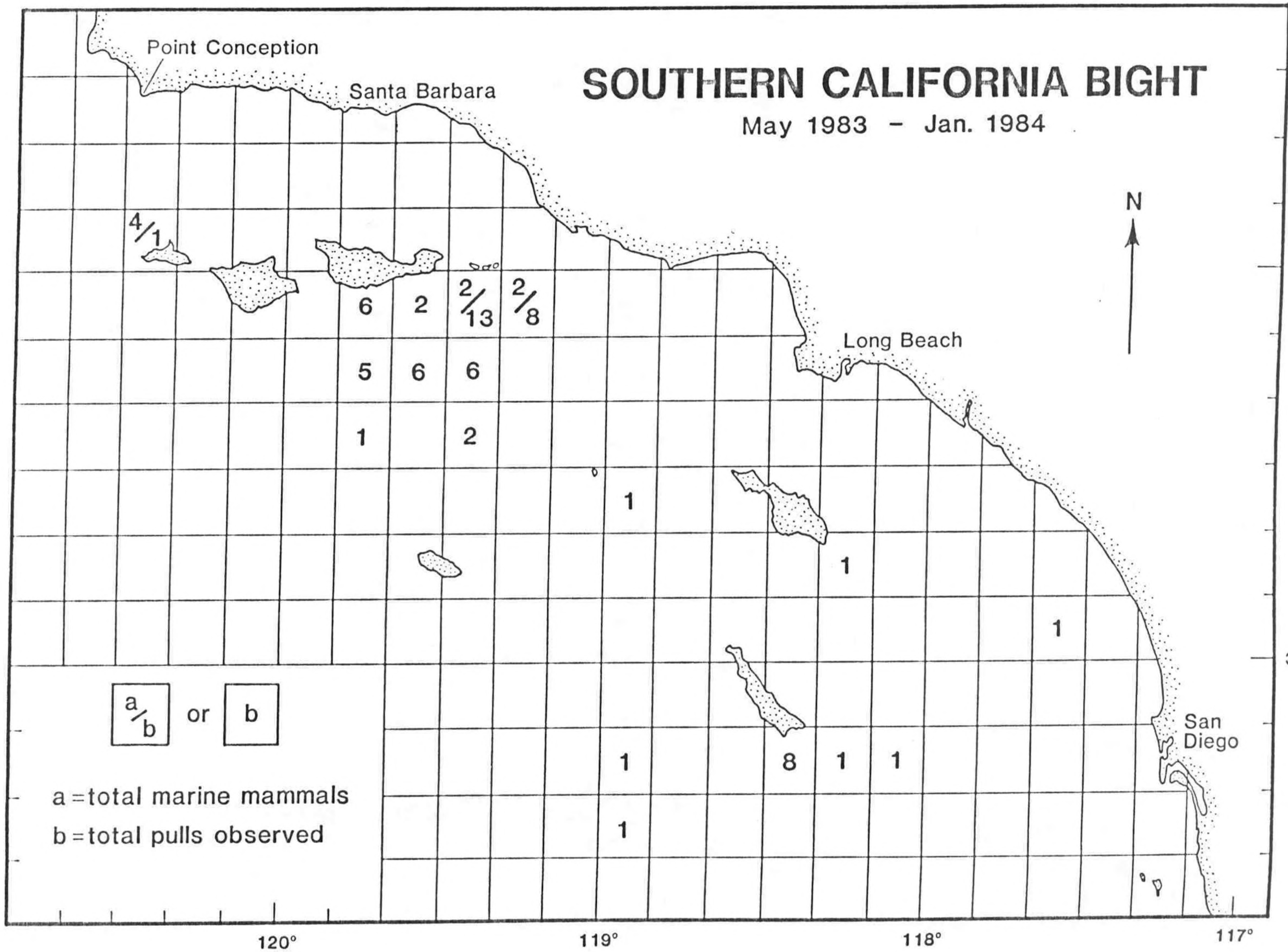


FIGURE 3: Location of marine mammals taken per observed net pull, 1983 Season

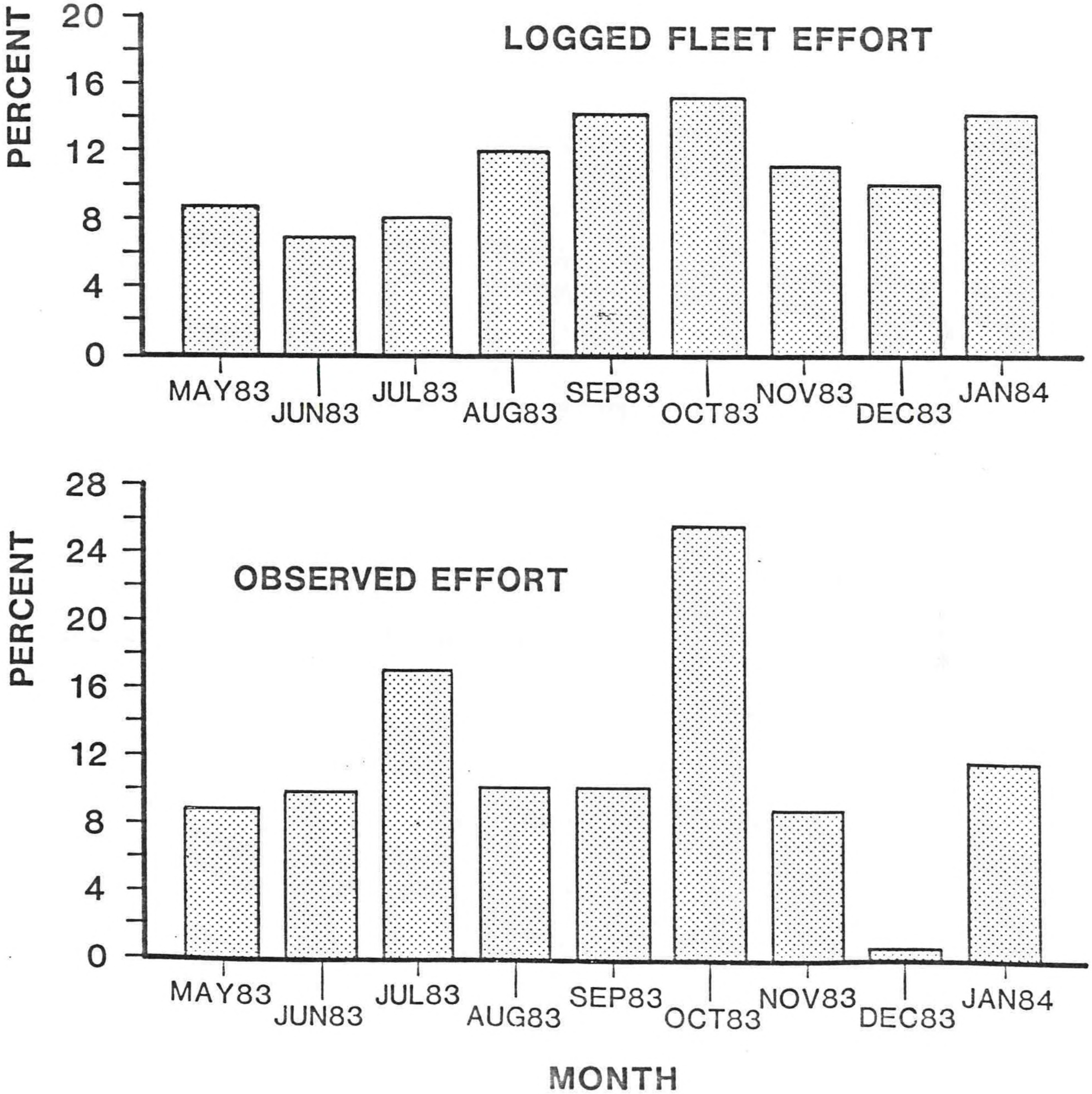


FIGURE 4: Percent of Logged Fleet Effort and Observed Effort by Month

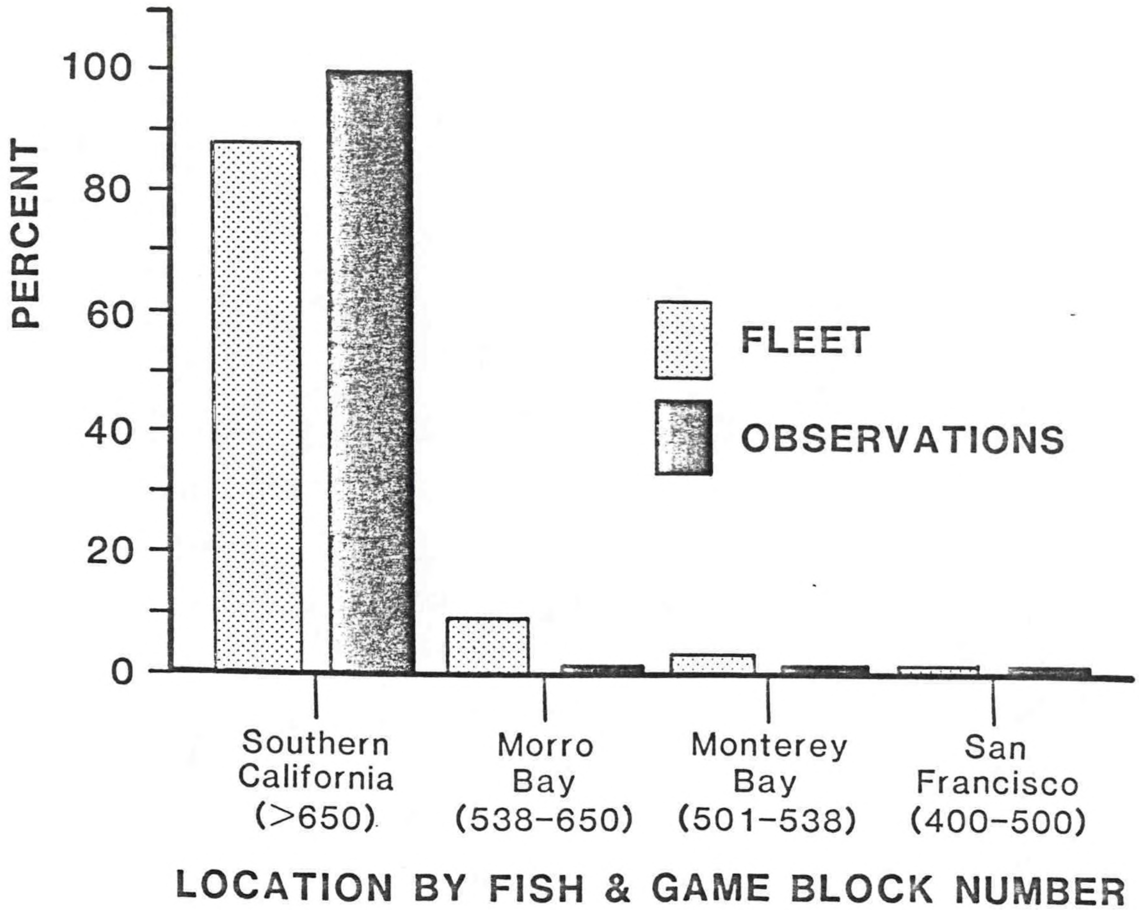


Figure 5. Percent of Logged Fleet Effort and Observed Effort by Month

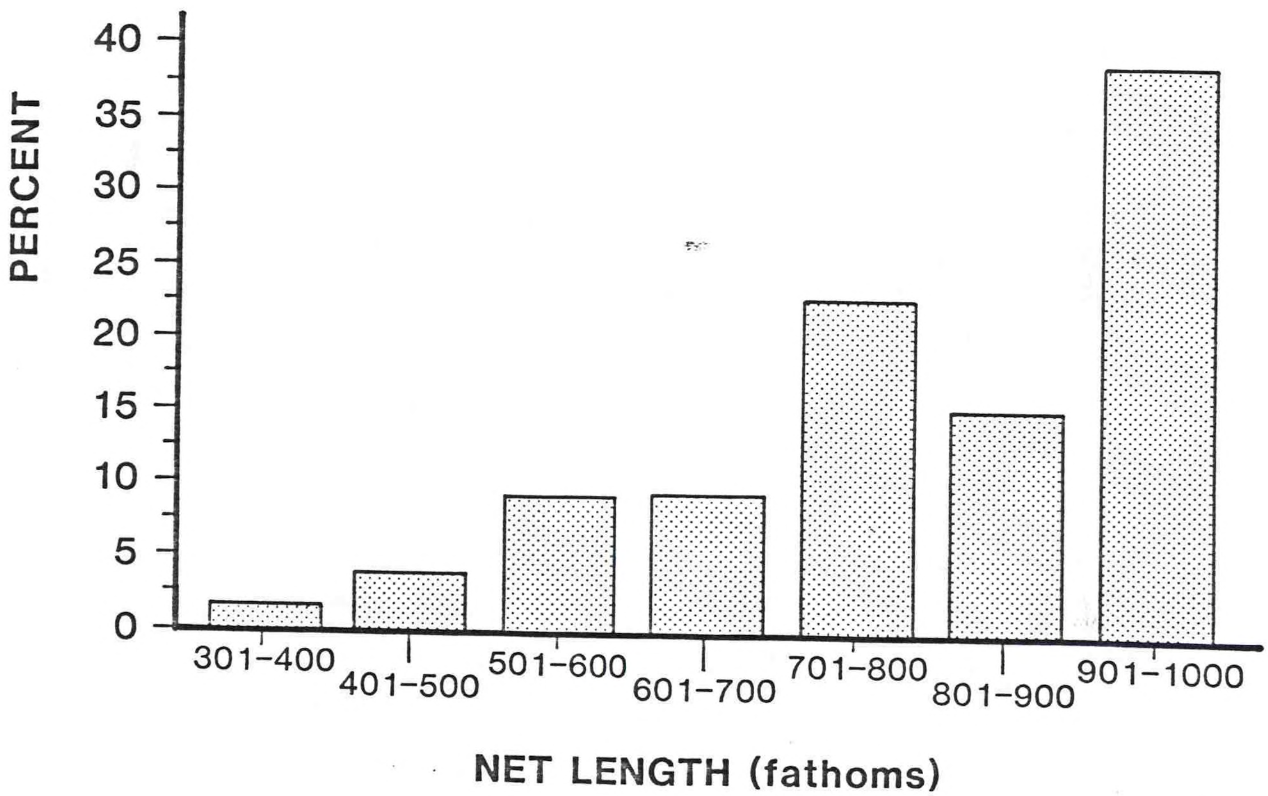


Figure 6. Percent of Observed Nte Length.

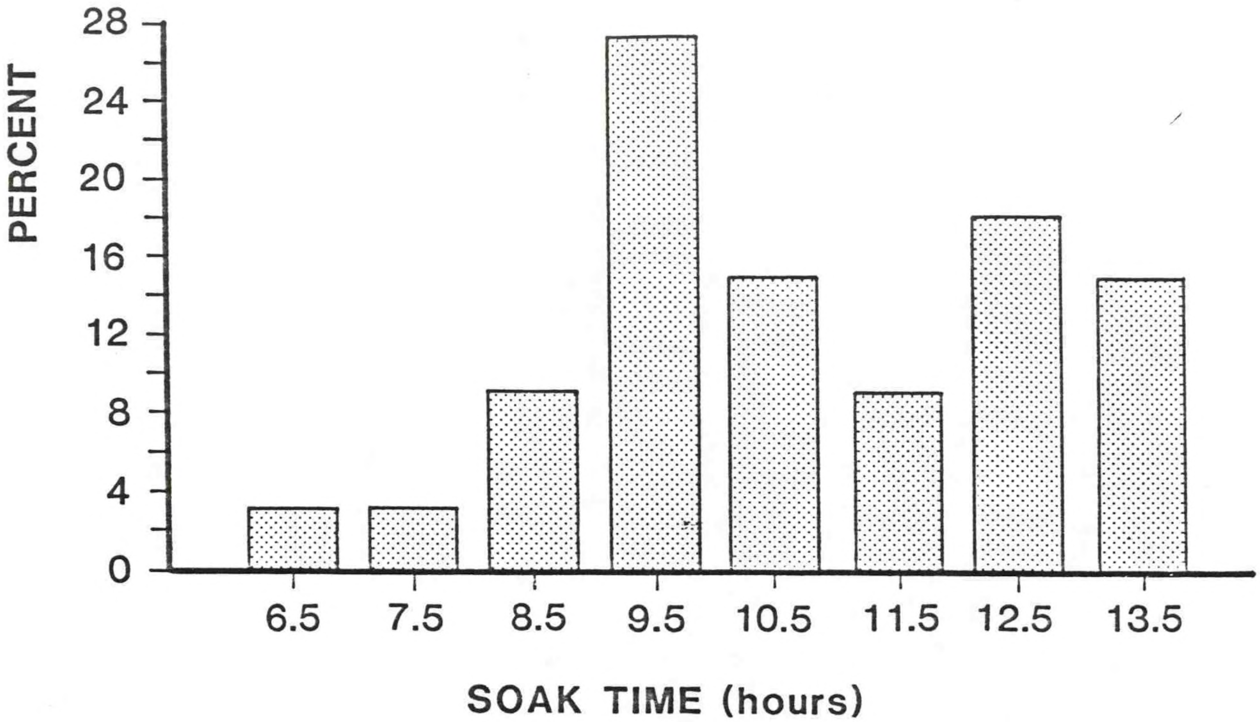


Figure 7. Percent of Observed Soak times.

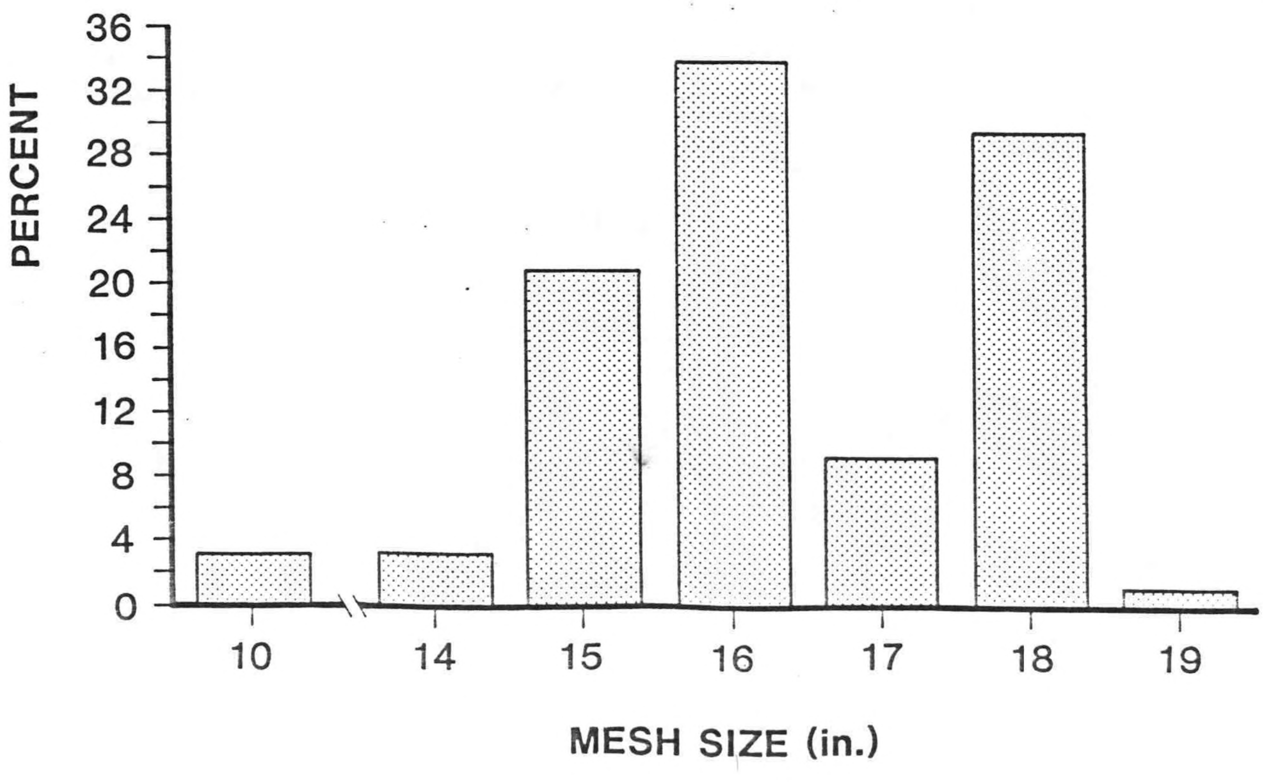


Figure 8. Percent of Observed Mesh Sizes.

TABLE 1: DATES and LOCATIONS of 1983-84 OBSERVATION CRUISES

CRUISE DATES	RESEARCH VESSEL	APPROXIMATE SEARCH LOCATION
May 2-4	KELP BASS	43 Fathom Spot, Santa Catalina Is.,San Clemente Is.
May 16-20	"	San Clemente Is., Tanner Bank, Santa Catalina Is., Santa Barbara Is., Anacapa Is.
June 6-15	"	Santa Cruz Is., Morro Bay, San Miguel Is.,Santa Barbara Is., Santa Catalina Is.
June 27-30	"	43 Fathom Spot, San Clemente Is., Lausen Knoll
July 19-22	DAVID STARR JORDAN	Anacapa Is., Santa Cruz Is., Santa Barbara Is., Santa Catalina Is.
July 25-29	KELP BASS	Anacapa Is., San Miguel Is.
August 2-5	"	Anacapa Is., Santa Cruz Is.
August 22-24	"	Santa Barbara Is., Anacapa Is.
September 12-16	"	Santa Barbara Is., San Clemente Is., Lausen Knoll
September 26-30	"	Santa Barbara Is., San Nicolas Is., Santa Cruz Is.
October 3-7	"	Santa Cruz Is.
October 18-21	"	Santa Cruz Is.
October 31-November 4	"	Anacapa Is.
January 10-13	"	Santa Catalina Is., Santa Barbara Is., San Clemente Is.
January 23-27	"	San Clemente Is.

TABLE2:MARINE MAMMALS OBSERVED CAUGHT IN DRIFT GILL NETS

DATE	FISHING BLOCK	COMMON NAME	NUMBER TAKEN
10/80	746	Ca. sea lion	1
11/80	757	Pilot whale	2
4/81	757	Ca. sea lion	1
	806	"	2
	862	"	2
	912	"	1
	916	"	1
5/81	721	"	1
	912	"	1
6/81	656	"	1
	670	"	5
	688	"	1
	706	"	1
	805	Finback whale	1
	812	Ca. sea lion	2
7/81	687	"	1
	730	"	15
	812	"	4
	835	"	2
8/81	703	"	1
	764	"	1
9/81	811	"	2
	883	"	1
10/81	723	"	1
	742	"	2
	867	"	1
	879	Whitesided dolphin	1
3/82	897	Whale (No ID)	1
4/82	686	Ca. sea lion	1
	686	Harbor seal	1
	720	Ca. sea lion	1
5/82	691	"	2
	691	Whale (No ID)	1
	714	Ca. sea lion	28
	728	"	1
	733	"	7
5/83	706	Ca. sea lion	1
6/83	656	"	2
	656	Elephant seal	2
	707	Ca. sea lion	1
10/83	706	"	1
	707	"	1

TABLE 3: CHARACTERISTICS OF OBSERVED GILL NETS

ITEM	MEAN	RANGE	# ITEM NETS OBSERVED
Net length	829 fathoms	330-1000 fathoms	66
Net width	14.9 fathoms	6.0-25.0 fathoms	61
Soak time	11.0 hours	6.3-13.3 hours	33
Mesh size	16 inches	10-19 inches	68
Corkline depth	3.6 fathoms	2.0-9.0 fathoms	60
TOTAL OBSERVATIONS			71

TABLE 4: MAY-JANUARY AVERAGE CATCHES PER OBSERVED NET PULL IN 1983 vs 1980-1982

COMMON NAME	1983	1980-1982 (combined)
MARINE MAMMALS		
California sea lion	.085	.364
Pacific harbor seal	0	.004
Finback whale	0	.004
Pilot whale	0	.004
White-sided dolphin	0	.009
Elephant seal	.028	0
Sharks		
Basking shark	0	.004
Blue shark	3.296	3.737
Bonito shark	1.197	2.539
Bull shark	0	.009
Hammerhead (No ID)	0	.022
Hammerhead (Smooth)	.493	.009
Soupfin shark	0	.048
Big-eye thresher shark	.070	.026
Common thresher shark	.423	2.785
Pelagic thresher shark	.056	0
BILLFISH		
Swordfish	1.070	1.496
Marlin	.085	.048
RAYS		
Bat ray	0	.022
Manta ray	.014	.004
Mobula	.028	.057
Sting ray	.014	.035
MISCELLANEOUS FISH		
Bonito	5.535	.684
Hake	.042	.088
Mola	1.254	1.452
Opah	.282	.066
Pacific blue mackerel	.817	1.211
Pipefish	0	.053
Remora	.014	.048
White sea bass	0	.004
Yellowfin tuna	.300	.075
Bluefin tuna	0	.004
Kelp bass	.014	0
Ocean whitefish	.028	0
Skipjack	1.606	0
TURTLES		
Redley's	.014	0
Loggerhead	.014	0

ACOUSTIC HARASSMENT DEVICES TESTED IN COMBINATION WITH CRACKERSHELLS ON PINNIPEDS INTERACTING WITH THE SOUTHERN CALIFORNIA PARTYBOAT FISHERY

by

John Scholl and Doyle Hanan

INTRODUCTION

Miller et al. (1983) documented that California sea lions, Zalophus californianus, and Pacific harbor seals, Phoca vitulina richardsi, interact with southern California commercial passenger fishing vessels (partyboats) by removing fish from fishing lines. Because of increasing complaints about fish losses and pinniped injuries, a study was initiated to seek solutions to the conflict. The study was conducted by the California Department of Fish and Game (CDFG) and the National Marine Fisheries Service (NMFS). The emphasis of the program was to produce an effective nonlethal means of keeping marine mammals from interacting with fishing operations.

Cracker shells (CS), which are exploding projectiles fired from shotguns, were initially tested during 1982-1983 and found to be marginally successful at driving sea lions away from boats which were fishing (Scholl and Hanan 1985, Scholl 1985). Acoustic harassment devices (AHD), which transmit noise under water to drive marine mammals away from fishing operations, were also tested in California fisheries with moderate success (Mate and Miller 1983, Scholl 1985). To test the effectiveness of combining CS with AHD to drive pinnipeds away from fishing vessels in the partyboat fishery, a study was conducted from March through September of 1984. The results of that study are presented in this paper.

MATERIALS and METHODS

AHD used for this study were originally developed by Dr. Bruce Mate and Mr. Charles Greenlaw of Oregon State University to keep harbor seals away from salmon spawning areas. Each AHD is composed of an underwater transducer which transmits sound generated by a signal production box using 110 AC power. Following is a list of AHD's used in this study; they were interchanged frequently during the tests, since each unit broke down at least once.

AHD Device Name	Sound Level Emitted
12k	12 Kilohertz (kHz)
17k	17 kHz
12wb	12-17 kHz
212r	12 kHz

The tests were conducted aboard partyboats as they went about their daily fishing operations. Trips were prearranged by the observers to focus on fishing areas reported to have high sea lion depredation rates. Test equipment including AHD, shotgun, CS, and tape recorder was taken aboard by the observer. Skippers were asked to announce to the passengers at the beginning of the trip that DFG personnel were aboard and going to be testing AHD and CS. The skippers were also asked to fire the CS with the shotgun during sea lion interactions.

The AHD signal production box was placed in an easily accessible location on the boat. At each fishing site the transducer, with lead weights attached for stability, was lowered into the water to a level well below the vessel's draft (5-7 m), thus allowing the sound waves to emit in all directions. Catch rates by fish species and incidents of catch depredation by sea lions were recorded on the tape recorder.

When a sea lion was sighted within 100 m of the vessel, the observer recorded the time, species, age class, and distance from the fishing vessel. When the target animal was within range of the shotgun (<50 m), the skipper was asked to shoot the shotgun with the intention of landing the CS as close as possible to the animal without hitting it. The AHD was turned on immediately following the CS explosion and the animal's reaction and movements, especially inside the 100 m perimeter, were recorded.

Time from firing the CS (or activating the AHD when it was used alone) until return of the same pinniped species (of the same age class) within the 100m perimeter of observation was recorded by the observer. Animals observed beyond 100 m of the vessel were not considered interactive and were not recorded. Each firing of the CS followed by use of AHD was considered a paired test. Since the vessel changed location depending on the skipper's view of fishing success, not all tests lasted the same amount of time and of the 418 tests, there were 33 times that the skipper changed fishing location before twenty minutes had elapsed during a test. Since sea lions were kept away from the boat at least until the boat departed, those data were included in the analysis.

At the end of each test trip, the observer conducted a passenger opinion survey regarding their observations and the use of AHD and CS.

RESULTS

Data were gathered primarily to explore the effectiveness of CS paired with AHD, but occasionally only AHD or only CS were used to drive the sea lions away from the partyboat. There were 418 total interactions during which either AHD or CS was used. Of those interactions, there were 209 interactions with AHD and CS used in combination; 66 with CS used alone; and 143 with AHD used alone.

Observers conducted tests on 105 of the 121 partyboat trips taken. Trips originated from Long Beach, Dana Point, Oceanside, and San Diego during the period March through September of 1984. The percentage of trips with tests (87.5%) is an indication of sea lion interaction rates, since tests were made only when sea lions were within 50m of the fishing vessel. The highest number of tests per trip (5.1) was in April. During May, the number of tests declined to 2.8 per trip and stayed at low levels until August.

For all tests using AHD, the mean time until pinniped return was 13.74 minutes (SD=23.08, n=352) and the median time was 4.0 minutes (Table 1). Because the data were not normally distributed (g1=3.3; g2=16.5), the median time away (MTA) was considered a less biased measurement of central tendency than the mean and was used to compare effectiveness in these tests.

CS was tested alone when an AHD malfunctioned or an AHD was not available for testing. The MTA for those tests was 5.0 minutes (n=66, Table 1).

Combining the results of all four AHDs used with no CS gives an MTA of only 2.0 minutes (n=143); however, when the AHDs were paired with CS, an MTA of 6.0 minutes (n=209) was achieved with an MTA range of 3.0 minutes to 9.0 minutes for each of the four AHDs (Table 1).

Paired CS-AHD Tests

Two aspects of effects of pairing CS and AHD are the nearness of the CS explosion to the target animal and the nearness of the target animal to the AHD transducer (Table 2). When the MTA ratings were evaluated by nearness of CS explosion to the target animal, the data show that the closer the explosion was to the animal the more effective the test. CS exploding within one meter of the animal gave an MTA of 12.0 minutes (n=59). The most frequent CS exploding distance was 2 m to 5 m from the target animal with an MTA of 7.0 minutes (n=83). Tests were most often initiated with target animals between 31 m and 40 m from the vessel with an MTA of 12.0 minutes (n=74) and if the animal was nearer than 31 m the MTA was much shorter (6.0 minutes or less, Table 2).

During months when adult male sea lions interacted more frequently than other age classes, depredation of catch was also at the highest level. The paired AHD-CS tests on adult males showed this age class to be the least affected (MTA = 4.0 minutes, n=45, Table 3). When females or subadult males were tested with AHD-CS, an MTA of 6.0 minutes (n=150) was obtained. Juvenile sea lions were the most responsive to acoustic harassment with an MTA of 15 minutes, although sample size was small (n=14).

Fishing block 860 (Appendix IV), in the vicinity of the the Point Loma kelp beds, was the area with highest interaction rates and the only block having interactions each month during this study. The MTA for all tests in this block was 7.0 minutes (n=101, Table 4). Of the blocks with 16 or more tests, the shortest MTA was in block 720 (MTA= 2.0 minutes, n=16) and the longest MTA was in block 877 (MTA= 15.0 minutes, n=22). Other areas, such as block 761, had seasonally high interaction rates with some problems lasting a week or less. For example, an interaction occurred June 1 about 5 miles south of San Mateo point (block 802) in 5 fm of water. A male adult sea lion appeared to follow a fishing vessel to four different locations during a trip. This trip had the highest fishing success (3.28 fish per angler hour) and the shortest MTA (3.0 minutes, n=35). On June 12th the same area was fished again with a similar catch of fish, but no pinniped sightings.

During the month of July, the lowest number of paired tests per trip and the longest MTA for any one month (28.0 minutes, n=15) was recorded (Table 5). The shortest MTA (3.0 minutes, n=35) during this study was obtained during the month of March.

There was little difference in the MTAs depending on the fish species being caught (Table 6); although, there was more success at keeping the sea lions away when barracuda was the most abundant component of the catch (MTA =10, n=16).

Two hundred and one opinion surveys were taken by the observers following acoustic harassment testing. The results (Table 7) indicate acceptance of the harassment methods used; although, there probably would have been acceptance of most non-lethal methods as long as something was tried. These results are similar to result of the opinion survey taken during the 1982-83 tests of CS.

DISCUSSION

The MTA for the 1982-83 CS tests was four minutes (n=72) (Scholl and Hanan 1985), which is quite close to the results obtained during this study for CS used alone (MTA=5 min, n=66). Use of CS paired with AHD improved the MTA to only six minutes (n=209). Four to six minutes of sea lion-free fishing is not a very long time for fishing, especially when one considers the amount of time it may take to chum or lure the desired fish to the fishing boat. Although some of the observers felt personally that they could effectively keep sea lions away from the fishing operations, the data do not show that to be true. Another factor needing consideration is the extinction rate of the AHD-CS effectiveness with time. It is possible that the sea lions would learn not to fear or be driven away by the AHD-CS. We did not address that factor in this study but expect it to be of considerable importance for evaluation of these devices.

Our paired tests were effective with harbor seals (MTA=14, n=6); although, sample size was small. Other studies (Hanan and

Scholl 1985) suggest that harbor seals are responsive to AHD harassment. Since the AHD's used in this study were originally developed for use with harbor seals (Charles Greenlaw, Pers. Com.) and these AHD's were effective with harbor seals, it is possible that modification of the AHD's to improve their effectiveness with sea lions would be a worthwhile extension of this study.

LITERATURE CITED

Hanan, D. and J. Scholl. 1985. Acoustic harassment testing with the Klamath River salmon fishery. In Doyle A. Hanan, California Department of Fish and Game, coastal marine mammal study, annual report for the period July 1, 1982 - June 30, 1983. NMFS-SWFC Admin. Rept. No. LJ.-85-10C, 75 p.

Mate, B. and D. Miller. 1983. Acoustic harassment on harbor seals in the Klamath River. In Daniel J. Miller. Coastal marine mammal study, annual report for the period of July 1, 1981-June 30, 1982. NMFS-SWFC Admin. Rpt. LJ-83-21C, 130 p.

Miller, D. J., M. J. Herder, and J. P. Scholl. 1983. California marine mammal-fishery interaction study, 1979-1981. NMFS-SWFC Admin. Report No. LJ-83-13C, 233 p.

Scholl, J. P. 1985. Acoustic harassment and crackershell tests in the southern California partyboat fishery. In Doyle A. Hanan, California Department of Fish and Game, coastal marine mammal study, annual report for the period July 1, 1982 - June 30, 1983. NMFS-SWFC Admin. Rept. No. LJ.-85-10C, 75 p.

Scholl, J. and D. Hanan. 1985. Effects of crackershells on California sea lions, *Zalophus californianus*, interacting with the southern California partyboat fishery. In Doyle A. Hanan, California Department of Fish and Game, coastal marine mammal study, annual report for the period July 1, 1982 - June 30, 1983. NMFS-SWFC Admin. Rept. No. LJ.-85-10C, 75 p.

Table 1. Summary of harassment test results in the southern California partyboat fishery. Tests employed electronic acoustic harassment devices (AHD) and explosive cracker shell harassment (CS). Results are presented as time (in minutes) from beginning of sea lion harassment to return of a similar sea lion.

DEVICE	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
CS 1983	72	8.8	8.8	100%	4.0
CS 1984	66	7.6	12.0	158%	5.0
AHD no CS					
12k	2	29.0	38.2	132%	NA
17k	32	7.7	14.8	192%	2.0
12wb	9	2.6	0.7	27%	2.0
212r	100	8.3	15.4	186%	2.0
AHD with CS					
12k	50	17.1	22.7	133%	9.0
17k	91	19.4	29.1	150%	7.0
12wb	39	15.0	13.4	89%	5.0
212r	29	16.7	33.6	201%	3.0
ALL AHD'S COMBINED					
No CS	143	8.1	15.2	188%	2.0
With CS	209	17.6	26.5	151%	6.0
Total	352	13.7	23.1	168%	4.0

Table 2. Results of paired AHD-CS tests on California sea lions based on: 1) nearness of CS explosion distance to the sea lion and 2) the distance of the sea lion to the AHD transducer.

DISTANCE	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
1) CS DISTANCE					
0-1m	57	16.3	17.4	107%	12.0
2-5m	83	20.8	30.4	147%	7.0
6-10m	38	13.7	24.3	177%	4.0
11+m	31	16.5	31.8	193%	4.0
2) SEA LION DISTANCE					
0-10m	9	11.7	12.3	106%	3.0
11-20m	46	11.2	13.8	123%	6.0
21-30m	60	19.2	31.3	164%	5.0
31-40	74	19.6	23.1	118%	12.0
41-50	14	28.0	51.9	185%	6.0
51+	6	NA	NA	NA	NA

Table 3. Results of paired AHD-CS tests on California sea lions based on ageclass (AM = adult male, NAM = female or subadult male, Juv = juvenile).

AGECLASS	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
AM	45	15.9	30.3	191%	4.0
NAM	150	17.1	22.4	131%	6.0
JUV	14	29.2	47.3	162%	15.0

Table 4. Results of paired AHD-CS tests on California sea lions based on California Fish and Game fishing blocks (see Appendix IV).

BLOCK #	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
701	1	170.0	-	-	-
720	16	4.8	7.7	160%	2.0
740	1	21.0	-	-	-
756	5	18.4	-	-	-
760	4	1.5	-	-	-
761	7	18.4	-	-	-
801	8	21.6	-	-	-
802	8	5.1	-	-	-
821	10	17.8	-	-	-
842	20	30.6	47.3	155%	7.0
860	101	16.0	18.4	115%	7.0
877	22	22.5	24.3	111%	15.0
878	6	13.0	-	-	-

Table 5. Results of paired AHD-CS tests on California sea lions based on month.

MONTH	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
March	35	11.3	16.8	149%	3.0
April	26	20.1	30.0	149%	6.0
May	50	17.3	28.2	163%	7.0
June	18	11.8	18.5	157%	6.0
July	15	44.0	52.3	118%	28.0
August	29	19.2	19.6	102%	11.0
September	36	13.0	14.2	109%	6.0

Table 6. Results of paired AHD-CS tests on California sea lions with a sample of size 16 or more based on 1) the fish most abundant in the catch during a test and 2) a fish being one of the three most abundant in the catch during a test.

	FISH	NUMBER TESTS	MEAN TIME AWAY	STANDARD DEVIATION	COEFFICIENT VARIATION	MEDIAN TIME AWAY
1)	Barrracuda	16	46.0	62.6	136%	10.0
	Bonito	48	16.9	17.3	102%	7.0
	Kelp Bass	70	14.6	21.2	145%	6.0
	P. Mackerel	51	15.7	21.4	137%	6.0
2)	Barrracuda	33	22.5	37.7	154%	7.0
	Bonito	93	21.6	33.2	113%	6.0
	Kelp Bass	134	17.7	27.0	152%	6.0
	P. Mackerel	79	18.0	25.6	142%	6.0
	Yellowtail	33	22.5	37.7	168%	7.0

Table 7. Public opinion survey (1982-83 results and 1983-84) results from acoustic (AHD) and cracker shell (CS) harassment in the southern California partyboat fishery.

	CS 1982-83	CS and AHD 1983-84	Combined 1982-84
Tests Bothersome?			
YES	5%	3%	4%
NO	95%	97%	96%
Controls Needed?			
YES	76%	89%	84%
NO	24%	11%	16%
Controls Regularly?			
YES	76%	94%	88%
NO	24%	6%	12%
Total Surveyed	113	201	314

APPENDIX I. Census results for the June 1984 harbor seal survey along the California coast. (Date= date of count; Site= site number; Prob: C= camera, D= disturbance, F= fog; Time= time of photograph (zero indicates no seals observed from plane); Tide= tide height in meters; FA= count of adult seals from photograph; FP= count of pups from photograph; FT= total seals from photograph; GA= ground count of adult seals; GP= ground count of pups; GT= total seals from ground count; ET= higher total from FT or GT; Max= maximum count to date for a site.

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/19/84	0.1			0.00	7	0	7	0	0	0	7	7
	1.0		0	0.00	0	0	0	0	0	0	0	0
	2.0		0	0.00	0	0	0	0	0	0	0	25
6/25/84	3.0		1330	0.57	0	0	0	9	0	9	9	24
6/26/84	4.0		1417	0.67	81	0	81	92	2	94	94	96
6/25/84	5.0		1150	0.79	5	0	5	0	0	0	5	116
6/25/84	6.0		1150	0.79	21	1	22	0	0	0	22	26
	7.0		0	0.00	0	0	0	0	0	0	0	53
	8.0		0	0.00	0	0	0	0	0	0	0	10
	9.0		0	0.00	0	0	0	0	0	0	0	70
6/25/84	10.0		1204	0.71	29	0	29	0	0	0	29	205
6/26/84	11.0	C	1515	0.72	167	1	168	359	16	375	375	554
6/25/84	12.0		1222	0.69	18	0	18	0	0	0	18	38
	13.0		0	0.00	0	0	0	0	0	0	0	19
	13.1		0	0.00	0	0	0	0	0	0	0	2
	14.0		0	0.00	0	0	0	0	0	0	0	13
	14.1		0	0.00	0	0	0	0	0	0	0	31
	15.0		0	0.00	0	0	0	0	0	0	0	247
6/25/84	16.0		1231	0.66	71	0	71	0	0	0	71	71
	17.0		0	0.00	0	0	0	0	0	0	0	57
	18.0		0	0.00	0	0	0	0	0	0	0	127
6/25/84	19.0		1239	0.66	100	0	100	0	0	0	100	100
	20.0		0	0.00	0	0	0	0	0	0	0	38
	21.0		0	0.00	0	0	0	0	0	0	0	4
	21.1		0	0.00	0	0	0	0	0	0	0	10
6/25/84	21.2		1240	0.66	25	1	26	0	0	0	26	26
6/25/84	21.3		1247	0.66	2	0	2	0	0	0	2	2
6/25/84	22.0		1250	0.66	61	1	62	0	0	0	62	62
	23.0		0	0.00	0	0	0	0	0	0	0	1
	23.1		0	0.00	0	0	0	0	0	0	0	2
	24.0		0	0.00	0	0	0	0	0	0	0	58
6/25/84	25.0	C	1248	0.66	0	0	0	0	0	0	30	138
	26.0		0	0.00	0	0	0	0	0	0	0	51
	26.1		0	0.00	0	0	0	0	0	0	0	22
	27.0		0	0.00	0	0	0	0	0	0	0	29
	28.0		0	0.00	0	0	0	0	0	0	0	20
	29.0		0	0.00	0	0	0	0	0	0	0	2
	30.0		0	0.00	0	0	0	0	0	0	0	2

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
	31.0		0	0.00	0	0	0	0	0	0	0	67
	32.0		0	0.00	0	0	0	0	0	0	0	4
	33.0		0	0.00	0	0	0	0	0	0	0	14
	33.1		0	0.00	0	0	0	0	0	0	0	16
6/30/84	34.0		1602	0.78	20	0	20	0	0	0	20	20
6/30/84	34.1		1602	0.78	38	0	38	0	0	0	38	38
6/30/84	35.0		1602	0.78	2	0	2	0	0	0	2	58
	35.1		0	0.00	0	0	0	0	0	0	0	3
6/30/84	36.0		1602	0.78	15	0	15	0	0	0	15	22
6/30/84	37.0		1603	0.78	60	1	61	0	0	0	61	61
	38.0		0	0.00	0	0	0	0	0	0	0	9
6/30/84	39.0		1604	0.78	124	0	124	0	0	0	124	132
	40.0		0	0.00	0	0	0	0	0	0	0	126
6/30/84	41.0		1605	0.78	21	0	21	0	0	0	21	57
6/30/84	41.1		1608	0.78	49	0	49	0	0	0	49	49
	42.0	F	0	0.00	0	0	0	0	0	0	0	36
	42.1	F	0	0.00	0	0	0	0	0	0	0	12
	43.0	F	0	0.00	0	0	0	0	0	0	0	21
	43.1	F	0	0.00	0	0	0	0	0	0	0	1
	44.0	F	0	0.00	0	0	0	0	0	0	0	24
	45.0	F	0	0.00	0	0	0	0	0	0	0	22
6/25/84	46.0	F	1358	0.60	0	0	0	33	0	33	33	41
	46.1	F	0	0.00	0	0	0	0	0	0	0	1
	47.0		0	0.00	0	0	0	0	0	0	0	13
	48.0		0	0.00	0	0	0	0	0	0	0	22
	49.0		0	0.00	0	0	0	0	0	0	0	15
	50.0		0	0.00	0	0	0	0	0	0	0	86
	51.0		0	0.00	0	0	0	0	0	0	0	15
	52.0		0	0.00	0	0	0	0	0	0	0	24
6/30/84	53.0		1622	0.75	13	0	13	0	0	0	13	197
	54.0		0	0.00	0	0	0	0	0	0	0	65
	55.0		0	0.00	0	0	0	0	0	0	0	101
6/30/84	55.1	F	1623	0.76	30	0	30	0	0	0	30	30
	56.0		0	0.00	0	0	0	0	0	0	0	50
	56.1		0	0.00	0	0	0	0	0	0	0	12
	56.2		0	0.00	0	0	0	0	0	0	0	7
	57.0		0	0.00	0	0	0	0	0	0	0	46
6/30/84	58.0	F	1624	0.76	0	0	0	0	0	0	15	67
	58.1		0	0.00	0	0	0	0	0	0	0	51
	59.0		0	0.00	0	0	0	0	0	0	0	3
	60.0		0	0.00	0	0	0	0	0	0	0	11
6/30/84	61.0	F	1625	0.76	0	0	0	0	0	0	12	12
	62.0		0	0.00	0	0	0	0	0	0	0	17
	63.0		0	0.00	0	0	0	0	0	0	0	19
	64.0		0	0.00	0	0	0	0	0	0	0	27
	65.0		0	0.00	0	0	0	0	0	0	0	43
	65.1		0	0.00	0	0	0	0	0	0	0	1
6/30/84	65.2		1627	0.75	28	0	28	0	0	0	28	28
6/30/84	66.0		1628	0.75	15	0	15	0	0	0	15	51
	66.1		0	0.00	0	0	0	0	0	0	0	10

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
	67.0		0	0.00	0	0	0	0	0	0	0	26
6/30/84	68.0		1630	0.75	14	0	14	0	0	0	14	15
	69.0		0	0.00	0	0	0	0	0	0	0	15
6/30/84	69.1		1633	0.75	15	0	15	0	0	0	15	15
	70.0		0	0.00	0	0	0	0	0	0	0	18
	70.1		0	0.00	0	0	0	0	0	0	0	8
6/30/84	71.0		1636	0.77	28	0	28	0	0	0	28	87
6/30/84	71.1	C	1636	0.77	0	0	0	0	0	0	2	2
	72.0		0	0.00	0	0	0	0	0	0	0	68
	73.0		0	0.00	0	0	0	0	0	0	0	13
	73.1		0	0.00	0	0	0	0	0	0	0	22
6/25/84	74.0		1334	0.62	33	0	33	0	0	0	33	68
6/25/84	75.0		1335	0.62	20	0	20	0	0	0	20	23
6/25/84	76.0		1336	0.62	25	0	25	0	0	0	25	90
6/25/84	76.1		1338	0.62	40	0	40	0	0	0	40	40
	77.0		0	0.00	0	0	0	0	0	0	0	17
	77.1		0	0.00	0	0	0	0	0	0	0	1
	78.0		0	0.00	0	0	0	0	0	0	0	104
6/25/84	79.0		1338	0.62	30	0	30	0	0	0	30	64
	80.0		0	0.00	0	0	0	0	0	0	0	33
	81.0		0	0.00	0	0	0	0	0	0	0	18
6/30/84	82.0		1642	0.74	13	0	13	0	0	0	13	70
	83.0		0	0.00	0	0	0	0	0	0	0	58
	84.0		0	0.00	0	0	0	0	0	0	0	10
6/30/84	85.0		1644	0.74	77	0	77	0	0	0	77	122
	86.0		0	0.00	0	0	0	0	0	0	0	68
6/30/84	87.0	C	1647	0.74	121	0	121	0	0	0	121	138
	87.1		0	0.00	0	0	0	0	0	0	0	0
	88.0		0	0.00	0	0	0	0	0	0	0	5
	89.0		0	0.00	0	0	0	0	0	0	0	20
	90.0		0	0.00	0	0	0	0	0	0	0	15
	91.0		0	0.00	0	0	0	0	0	0	0	1
	91.1		0	0.00	0	0	0	0	0	0	0	21
	92.0		0	0.00	0	0	0	0	0	0	0	12
	93.0		0	0.00	0	0	0	0	0	0	0	1
6/30/84	93.1		1652	0.74	9	0	9	0	0	0	9	9
	94.0		0	0.00	0	0	0	0	0	0	0	2
6/30/84	95.0	C	1655	0.74	0	0	0	0	0	0	15	15
	96.0		0	0.00	0	0	0	0	0	0	0	1
6/30/84	96.1		1656	0.74	14	0	14	0	0	0	14	14
6/30/84	97.0	C	1656	0.74	10	0	10	0	0	0	10	22
	98.0		0	0.00	0	0	0	0	0	0	0	59
	99.0		0	0.00	0	0	0	0	0	0	0	5
	100.0		0	0.00	0	0	0	0	0	0	0	9
	101.0		0	0.00	0	0	0	0	0	0	0	14
	102.0		0	0.00	0	0	0	0	0	0	0	44
	103.0		0	0.00	0	0	0	0	0	0	0	1
	104.0		0	0.00	0	0	0	0	0	0	0	7
	105.0		0	0.00	0	0	0	0	0	0	0	6
	106.0		0	0.00	0	0	0	0	0	0	0	1

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
	107.0		0	0.00	0	0	0	0	0	0	0	34
	108.0		0	0.00	0	0	0	0	0	0	0	15
	109.0		0	0.00	0	0	0	0	0	0	0	4
6/30/84	110.0		1711	0.71	82	0	82	0	0	0	82	201
6/30/84	111.0	C	1711	0.71	0	0	0	0	0	0	15	15
	112.0		0	0.00	0	0	0	0	0	0	0	13
	113.0		0	0.00	0	0	0	0	0	0	0	12
	114.0		0	0.00	0	0	0	0	0	0	0	71
6/30/84	114.1	C	1712	0.71	1	0	1	0	0	0	1	3
	114.2		0	0.00	0	0	0	0	0	0	0	8
	115.0		0	0.00	0	0	0	0	0	0	0	46
	116.0		0	0.00	0	0	0	0	0	0	0	0
6/30/84	117.0	C	1712	0.71	4	0	4	0	0	0	4	29
	118.0		0	0.00	0	0	0	0	0	0	0	13
	119.0		0	0.00	0	0	0	0	0	0	0	3
	120.0		0	0.00	0	0	0	0	0	0	0	2
	121.0		0	0.00	0	0	0	0	0	0	0	3
	122.0		0	0.00	0	0	0	0	0	0	0	18
	123.0		0	0.00	0	0	0	0	0	0	0	1
	124.0		0	0.00	0	0	0	0	0	0	0	1
	125.0		0	0.00	0	0	0	0	0	0	0	13
	126.0		0	0.00	0	0	0	0	0	0	0	11
6/25/84	127.0		1402	0.62	87	0	87	0	0	0	87	97
	128.0		0	0.00	0	0	0	0	0	0	0	1
6/25/84	129.0		1405	0.62	20	0	20	0	0	0	20	42
6/25/84	130.0		1409	0.62	64	0	64	0	0	0	64	266
	131.0		0	0.00	0	0	0	0	0	0	0	29
	131.1		0	0.00	0	0	0	0	0	0	0	56
	131.2		0	0.00	0	0	0	0	0	0	0	3
6/30/84	131.3		1724-1725	0.71	64	0	64	0	0	0	64	64
	132.0		0	0.00	0	0	0	0	0	0	0	32
6/30/84	133.0		1725	0.71	19	0	19	0	0	0	19	158
	134.0		0	0.00	0	0	0	0	0	0	0	6
	135.0		0	0.00	0	0	0	0	0	0	0	38
	136.0		0	0.00	0	0	0	0	0	0	0	10
	137.0		0	0.00	0	0	0	0	0	0	0	5
	137.1		0	0.00	0	0	0	0	0	0	0	2
6/27/84	138.0		1706	0.89	20	0	20	0	0	0	20	26
	139.0		0	0.00	0	0	0	0	0	0	0	14
	140.0		0	0.00	0	0	0	0	0	0	0	19
	140.1		0	0.00	0	0	0	0	0	0	0	1
6/27/84	141.0		1708	0.89	23	0	23	0	0	0	23	71
	141.1		0	0.00	0	0	0	0	0	0	0	3
6/27/84	142.0		1710	0.89	3	0	3	0	0	0	3	31
	143.0		0	0.00	0	0	0	0	0	0	0	2
6/26/84	144.0		1505	0.64	1	0	1	11	0	11	11	28
	145.0		0	0.00	0	0	0	0	0	0	0	25
6/27/84	146.0		1711-1712	0.92	18	0	18	0	0	0	18	18
	147.0		0	0.00	0	0	0	0	0	0	0	48
6/27/84	148.0		1715	0.92	12	0	12	0	0	0	12	36

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/27/84	149.0		1715	0.92	1	0	1	0	0	0	1	71
6/27/84	150.0		1715	0.92	64	0	64	0	0	0	64	96
6/27/84	151.0		1716	0.92	23	0	23	0	0	0	23	53
6/30/84	152.0		1740	0.70	39	0	39	36	0	36	39	42
6/29/84	153.0		1840	0.95	5	0	5	0	0	0	5	93
6/30/84	154.0		1742	0.70	19	0	19	0	0	0	19	58
6/30/84	154.1		1742	0.70	2	0	2	0	0	0	2	2
6/30/84	155.0		1742	0.70	1	0	1	0	0	0	1	45
6/30/84	156.0	C	1743	0.70	9	0	9	0	0	0	9	63
	156.1		0	0.00	0	0	0	0	0	0	0	54
6/27/84	157.0	C	1545	0.67	64	0	64	97	1	98	98	155
6/30/84	158.0		1745	0.70	1	0	1	0	0	0	1	2
	159.0		0	0.00	0	0	0	0	0	0	0	6
6/26/84	160.0		1310	0.98	8	0	8	0	0	0	8	43
6/26/84	160.1	C	1310	0.98	0	0	0	0	0	0	1	2
6/26/84	161.0		1310	0.98	22	0	22	0	0	0	22	49
6/27/84	162.0		1430	0.98	25	0	25	79	6	85	85	149
	162.1		0	0.00	0	0	0	0	0	0	0	1
	163.0		0	0.00	0	0	0	0	0	0	0	7
6/25/84	164.0		1437	0.73	35	0	35	0	0	0	35	35
6/27/84	165.0		1445	0.94	0	0	0	8	0	8	8	52
6/25/84	166.0		1451	0.76	49	0	49	0	0	0	49	138
6/25/84	167.0		1453	0.76	131	5	136	0	0	0	136	136
	168.0		0	0.00	0	0	0	0	0	0	0	29
6/26/84	169.0		1333	0.88	31	0	31	0	0	0	31	40
	170.0		0	0.00	0	0	0	0	0	0	0	1
	171.0		0	0.00	0	0	0	0	0	0	0	33
6/25/84	172.0		1502	0.76	62	1	63	0	0	0	63	120
	173.0		0	0.00	0	0	0	0	0	0	0	53
6/25/84	174.0		1503	0.76	18	0	18	0	0	0	18	86
	175.0		0	0.00	0	0	0	0	0	0	0	81
6/26/84	176.0		1348	0.85	15	5	20	0	0	0	20	31
6/26/84	177.0		1343-1347	0.85	90	0	90	0	0	0	90	90
6/26/84	178.0		1349	0.85	10	0	10	0	0	0	10	83
	179.0		0	0.00	0	0	0	0	0	0	0	36
	180.0		0	0.00	0	0	0	0	0	0	0	44
	181.0		0	0.00	0	0	0	0	0	0	0	17
	182.0		0	0.00	0	0	0	0	0	0	0	3
	183.0		0	0.00	0	0	0	0	0	0	0	4
	184.0		0	0.00	0	0	0	0	0	0	0	1
6/29/84	185.0		1817	1.04	19	0	19	0	0	0	19	19
	186.0		0	0.00	0	0	0	0	0	0	0	12
6/29/84	187.0	C	1816	1.04	0	0	0	0	0	0	1	4
6/29/84	188.0		1816	1.04	107	2	109	0	0	0	109	109
	189.0		0	0.00	0	0	0	0	0	0	0	11
6/29/84	190.0	C	1815	1.04	71	0	71	0	0	0	71	71
	191.0		0	0.00	0	0	0	0	0	0	0	21
	192.0		0	0.00	0	0	0	0	0	0	0	34
	193.0		0	0.00	0	0	0	0	0	0	0	24
6/29/84	194.0		1814	1.02	6	0	6	0	0	0	6	45

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/29/84	195.0		1809	1.01	12	0	12	0	0	0	12	40
	195.1		0	0.00	0	0	0	0	0	0	0	20
6/29/84	196.0		1809	1.01	20	1	21	0	0	0	21	21
6/29/84	197.0	C	1804	1.01	38	0	38	0	0	0	38	115
	197.1		0	0.00	0	0	0	0	0	0	0	80
6/29/84	198.0	C	1804	1.01	123	2	125	0	0	0	125	125
	199.0		0	0.00	0	0	0	0	0	0	0	45
	200.0		0	0.00	0	0	0	0	0	0	0	58
	201.0		0	0.00	0	0	0	0	0	0	0	34
6/29/84	202.0	C	1758	1.01	11	0	11	0	0	0	11	35
	202.1		0	0.00	0	0	0	0	0	0	0	4
6/27/84	203.0		1225	2.19	0	0	0	0	0	0	1	1
	204.0		0	0.00	0	0	0	0	0	0	0	14
6/27/84	205.0		1213-1220	1.98	311	0	311	0	0	0	311	327
	206.0		0	0.00	0	0	0	0	0	0	0	7
6/27/84	207.0		1232	1.80	40	0	40	0	0	0	40	65
	208.0		0	0.00	0	0	0	0	0	0	0	17
6/26/84	209.0		1701	0.00	47	0	47	0	0	0	47	58
	210.0		0	0.00	0	0	0	0	0	0	0	1
	211.0		0	0.00	0	0	0	0	0	0	0	30
	212.0		0	0.00	0	0	0	0	0	0	0	97
6/26/84	213.0		1707	0.00	64	0	64	0	0	0	64	85
	214.0		0	0.00	0	0	0	0	0	0	0	8
6/26/84	215.0		1422	0.98	20	0	20	0	0	0	20	34
6/26/84	215.1	C	1422	0.98	0	0	0	0	0	0	1	1
6/26/84	216.0		1424	0.98	5	0	5	0	0	0	5	5
6/26/84	217.0		1428-1429	0.84	141	2	143	0	0	0	143	143
6/26/84	217.1	C	1430	0.84	0	0	0	0	0	0	2	2
6/26/84	218.0		1431	0.91	7	0	7	0	0	0	7	164
	218.1		0	0.00	0	0	0	0	0	0	0	24
6/26/84	219.0		1433	0.91	7	1	8	0	0	0	8	19
6/26/84	220.0		1437	0.88	47	0	47	0	0	0	47	93
6/27/84	221.0	C	1600	0.91	669	0	669	789	42	831	831	831
	222.0		0	0.00	0	0	0	0	0	0	0	11
	223.0		0	0.00	0	0	0	0	0	0	0	1
6/29/84	224.0		1740-1742	0.98	501	7	508	0	0	0	508	509
6/29/84	225.0		1739	0.98	164	8	172	0	0	0	172	726
	226.0		0	0.00	0	0	0	0	0	0	0	66
	226.1		0	0.00	0	0	0	0	0	0	0	21
	226.2		0	0.00	0	0	0	0	0	0	0	72
	226.3		0	0.00	0	0	0	0	0	0	0	12
	227.0		0	0.00	0	0	0	0	0	0	0	34
	228.0		0	0.00	0	0	0	0	0	0	0	29
	229.0		0	0.00	0	0	0	0	0	0	0	0
	230.0		0	0.00	0	0	0	0	0	0	0	7
	231.0		0	0.00	0	0	0	0	0	0	0	101
6/30/84	232.0		2000	1.10	66	0	66	0	0	0	66	66
6/30/84	232.1	C	2000	1.10	11	0	11	0	0	0	11	11
6/30/84	232.2	C	2000	1.10	0	0	0	0	0	0	3	3
6/30/84	233.0	C	2000	1.10	3	0	3	0	0	0	3	31

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
	234.0		0	0.00	0	0	0	0	0	0	0	13
	235.0		0	0.00	0	0	0	0	0	0	0	17
	236.0		0	0.00	0	0	0	0	0	0	0	19
	237.0		0	0.00	0	0	0	0	0	0	0	1
	238.0		0	0.00	0	0	0	0	0	0	0	12
	239.0		0	0.00	0	0	0	0	0	0	0	1
	240.0		0	0.00	0	0	0	0	0	0	0	0
	240.1		0	0.00	0	0	0	0	0	0	0	3
6/29/84	241.0	C	1726	0.89	135	0	135	0	0	0	135	135
	242.0		0	0.00	0	0	0	0	0	0	0	2
	242.1		0	0.00	0	0	0	0	0	0	0	1
	243.0		0	0.00	0	0	0	0	0	0	0	53
6/29/84	244.0	C	1725	0.89	39	0	39	0	0	0	39	86
6/29/84	244.1	C	1725	0.89	0	0	0	0	0	0	1	1
6/29/84	245.0	C	1724	0.89	142	0	142	0	0	0	142	419
6/29/84	246.0		1724	0.89	8	0	8	0	0	0	8	12
	247.0		0	0.00	0	0	0	0	0	0	0	5
	248.0		0	0.00	0	0	0	0	0	0	0	338
6/29/84	248.1		1721	0.50	72	0	72	0	0	0	72	72
6/29/84	249.0	C	1719	0.50	47	0	47	0	0	0	47	236
	250.0		0	0.00	0	0	0	0	0	0	0	3
6/29/84	251.0	C	1713	1.01	99	0	99	0	0	0	99	115
	252.0		0	0.00	0	0	0	0	0	0	0	11
	253.0		0	0.00	0	0	0	0	0	0	0	11
	254.0		0	0.00	0	0	0	0	0	0	0	9
	255.0		0	0.00	0	0	0	0	0	0	0	8
6/29/84	255.1		1707	1.01	16	0	16	0	0	0	16	16
	256.0		0	0.00	0	0	0	0	0	0	0	8
6/29/84	257.0		1705	1.01	38	0	38	0	0	0	38	47
	258.0		0	0.00	0	0	0	0	0	0	0	2
	259.0		0	0.00	0	0	0	0	0	0	0	1
	260.0		0	0.00	0	0	0	0	0	0	0	2
	261.0		0	0.00	0	0	0	0	0	0	0	3
	261.1		0	0.00	0	0	0	0	0	0	0	10
	261.2		0	0.00	0	0	0	0	0	0	0	8
6/26/84	262.0		1509	0.85	93	0	93	0	0	0	93	190
	263.0		0	0.00	0	0	0	0	0	0	0	31
6/26/84	264.0		1515	0.85	26	0	26	0	0	0	26	26
6/26/84	265.0	D	1516	0.85	0	0	0	0	0	0	1	10
	266.0		0	0.00	0	0	0	0	0	0	0	13
6/26/84	267.0		1517	0.85	3	0	3	0	0	0	3	5
6/26/84	268.0		1517	0.85	5	0	5	0	0	0	5	16
	268.1		0	0.00	0	0	0	0	0	0	0	2
	269.0		0	0.00	0	0	0	0	0	0	0	13
	270.0		0	0.00	0	0	0	0	0	0	0	9
	270.1		0	0.00	0	0	0	0	0	0	0	3
	270.2		0	0.00	0	0	0	0	0	0	0	1
6/26/84	271.0		1520	0.85	10	0	10	0	0	0	10	28
6/26/84	272.0		1520	0.85	14	0	14	0	0	0	14	14
6/26/84	272.1		1520	0.85	1	0	1	0	0	0	1	1

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/26/84	273.0	C	1520	0.85	6	0	6	0	0	0	6	70
6/26/84	274.0		1521	0.85	3	0	3	0	0	0	3	22
6/26/84	274.1		1523	0.85	3	0	3	0	0	0	3	3
6/26/84	275.0		1523	0.85	10	0	10	0	0	0	10	20
	276.0		0	0.00	0	0	0	0	0	0	0	3
6/26/84	277.0		1523	0.85	15	0	15	0	0	0	15	51
	277.1		0	0.00	0	0	0	0	0	0	0	3
	278.0		0	0.00	0	0	0	0	0	0	0	0
	279.0		0	0.00	0	0	0	0	0	0	0	1
	280.0		0	0.00	0	0	0	0	0	0	0	9
6/26/84	281.0		1524	0.85	15	0	15	0	0	0	15	21
6/26/84	282.0		1524-1526	0.85	48	0	48	0	0	0	48	50
	283.0		0	0.00	0	0	0	0	0	0	0	10
6/26/84	283.1		1527	0.85	1	0	1	0	0	0	1	1
	284.0		0	0.00	0	0	0	0	0	0	0	29
	284.1		0	0.00	0	0	0	0	0	0	0	5
6/26/84	284.2		1529	0.85	3	0	3	0	0	0	3	3
6/26/84	284.3		1529	0.85	1	0	1	0	0	0	1	1
	285.0		0	0.00	0	0	0	0	0	0	0	57
6/26/84	285.1		1529	0.85	16	0	16	0	0	0	16	16
6/26/84	285.2		1532	0.85	10	0	10	0	0	0	10	10
	286.0		0	0.00	0	0	0	0	0	0	0	0
6/26/84	287.0		1532	0.85	67	0	67	0	0	0	67	67
	287.1		0	0.00	0	0	0	0	0	0	0	3
	288.0		0	0.00	0	0	0	0	0	0	0	2
	289.0		0	0.00	0	0	0	0	0	0	0	10
	290.0		0	0.00	0	0	0	0	0	0	0	34
6/26/84	291.0		1536	0.85	9	0	9	0	0	0	9	9
6/26/84	291.1		1537	0.85	1	0	1	0	0	0	1	1
	292.0		0	0.00	0	0	0	0	0	0	0	1
	293.0		0	0.00	0	0	0	0	0	0	0	18
6/26/84	294.0		1538	0.85	8	0	8	0	0	0	8	21
6/26/84	294.1		1539	0.85	5	0	5	0	0	0	5	5
	295.0		0	0.00	0	0	0	0	0	0	0	40
6/26/84	296.0		1539	0.85	79	0	79	0	0	0	79	79
	297.0		0	0.00	0	0	0	0	0	0	0	2
6/26/84	297.1		1541	0.85	35	0	35	0	0	0	35	35
	298.0		0	0.00	0	0	0	0	0	0	0	26
	298.1		0	0.00	0	0	0	0	0	0	0	23
6/26/84	299.0		1542	0.85	36	0	36	0	0	0	36	36
6/26/84	299.1		1544	0.85	29	0	29	0	0	0	29	29
	300.0		0	0.00	0	0	0	0	0	0	0	1
	301.0		0	0.00	0	0	0	0	0	0	0	1
6/26/84	302.0		1544	0.85	67	0	67	0	0	0	67	125
6/26/84	303.0		1545	0.85	13	0	13	0	0	0	13	17
	304.0		0	0.00	0	0	0	0	0	0	0	39
	305.0		0	0.00	0	0	0	0	0	0	0	45
	306.0		0	0.00	0	0	0	0	0	0	0	1
6/26/84	307.0		1546	0.85	51	0	51	0	0	0	51	131
6/26/84	308.0		1547	0.85	72	0	72	0	0	0	72	72

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/26/84	309.0		1547	0.85	45	0	45	0	0	0	45	45
	310.0		0	0.00	0	0	0	0	0	0	0	3
6/26/84	311.0		1549-1550	0.85	6	0	6	0	0	0	6	10
6/26/84	312.0	C	1551	0.85	7	0	7	0	0	0	7	7
6/26/84	312.1		1552	0.85	27	0	27	0	0	0	27	27
	313.0		0	0.00	0	0	0	0	0	0	0	27
	314.0		0	0.00	0	0	0	0	0	0	0	4
6/26/84	315.0		1555	0.85	33	0	33	0	0	0	33	39
	316.0		0	0.00	0	0	0	0	0	0	0	27
	316.1		0	0.00	0	0	0	0	0	0	0	1
	317.0		0	0.00	0	0	0	0	0	0	0	13
6/26/84	318.0	C	1559	0.87	19	0	19	0	0	0	19	19
	319.0		0	0.00	0	0	0	0	0	0	0	5
6/26/84	320.0		1602	0.88	69	0	69	0	0	0	69	69
	321.0		0	0.00	0	0	0	0	0	0	0	4
	322.0		0	0.00	0	0	0	0	0	0	0	0
	323.0		0	0.00	0	0	0	0	0	0	0	25
6/28/84	324.0		1532	1.07	14	0	14	0	0	0	14	53
6/26/84	324.1	C	0	0.00	0	0	0	0	0	0	2	2
6/28/84	325.0	C	1534	1.07	2	0	2	0	0	0	2	27
6/28/84	326.0		1539	1.04	86	0	86	0	0	0	86	86
	327.0		0	0.00	0	0	0	0	0	0	0	48
6/28/84	328.0		1543	1.04	49	0	49	0	0	0	49	49
6/28/84	329.0		1543	1.04	1	0	1	0	0	0	1	2
	330.0		0	0.00	0	0	0	0	0	0	0	32
6/28/84	331.0		1546	1.01	1	0	1	0	0	0	1	1
6/28/84	332.0	C	1548	1.01	76	0	76	0	0	0	76	176
6/28/84	333.0		1550	1.01	60	0	60	0	0	0	60	60
6/28/84	334.0		1550	1.01	36	0	36	0	0	0	36	45
	335.0		0	0.00	0	0	0	0	0	0	0	36
6/28/84	336.0		1552	1.01	19	0	19	0	0	0	19	19
	336.1		0	0.00	0	0	0	0	0	0	0	10
6/28/84	337.0		1554-1555	1.01	24	0	24	0	0	0	24	33
	337.1		0	0.00	0	0	0	0	0	0	0	0
6/28/84	338.0		1556	1.01	48	0	48	0	0	0	48	52
6/28/84	339.0		1557	1.01	7	0	7	0	0	0	7	38
6/28/84	340.0		1557	1.01	18	0	18	0	0	0	18	18
6/28/84	340.1		1558	1.01	14	0	14	0	0	0	14	14
6/28/84	341.0		1559	1.01	69	0	69	0	0	0	69	69
	342.0		0	0.00	0	0	0	0	0	0	0	32
	342.1		0	0.00	0	0	0	0	0	0	0	7
6/28/84	343.0		1601	1.01	2	0	2	0	0	0	2	31
6/28/84	344.0	C	1602	1.01	0	0	0	0	0	0	20	20
	345.0		0	0.00	0	0	0	0	0	0	0	31
6/28/84	346.0	C	1603	0.98	18	0	18	0	0	0	18	41
	347.0		0	0.00	0	0	0	0	0	0	0	21
6/28/84	348.0	C	1606	0.98	28	0	28	0	0	0	28	31
6/28/84	349.0		1607	0.98	24	0	24	0	0	0	24	51
6/28/84	350.0		1608	0.98	9	0	9	0	0	0	9	27
	351.0		0	0.00	0	0	0	0	0	0	0	2

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/28/84	352.0		1609-1610	0.98	107	0	107	92	4	96	107	183
	352.1		0	0.00	0	0	0	0	0	0	0	1
	353.0		0	0.00	0	0	0	0	0	0	0	55
6/29/84	354.0		1627	1.07	29	0	29	0	0	0	29	44
6/29/84	355.0		1626	1.07	2	0	2	0	0	0	2	9
	356.0		0	0.00	0	0	0	0	0	0	0	67
6/29/84	356.1		1622	1.07	100	0	100	0	0	0	100	100
	357.0		0	0.00	0	0	0	0	0	0	0	0
	358.0		0	0.00	0	0	0	0	0	0	0	25
	359.0		0	0.00	0	0	0	0	0	0	0	5
	360.0		0	0.00	0	0	0	0	0	0	0	58
	361.0		0	0.00	0	0	0	0	0	0	0	186
	362.0		0	0.00	0	0	0	0	0	0	0	78
6/29/84	363.0		1616	1.11	784	0	784	0	0	0	784	839
6/29/84	364.0	C	1616	1.11	0	0	0	0	0	0	1	13
	365.0		0	0.00	0	0	0	0	0	0	0	52
	366.0		0	0.00	0	0	0	0	0	0	0	240
	366.1		0	0.00	0	0	0	0	0	0	0	86
	367.0		0	0.00	0	0	0	0	0	0	0	10
	368.0		0	0.00	0	0	0	0	0	0	0	43
6/28/84	369.0	C	1644	0.98	0	0	0	0	0	0	1	11
	370.0		0	0.00	0	0	0	0	0	0	0	0
	371.0		0	0.00	0	0	0	0	0	0	0	25
	372.0		0	0.00	0	0	0	0	0	0	0	3
6/28/84	373.0		1657	0.96	138	0	138	0	0	0	138	172
	373.1		0	0.00	0	0	0	0	0	0	0	34
	374.0		0	0.00	0	0	0	0	0	0	0	76
	375.0		0	0.00	0	0	0	0	0	0	0	10
	376.0		0	0.00	0	0	0	0	0	0	0	1
	377.0		0	0.00	0	0	0	0	0	0	0	4
	378.0		0	0.00	0	0	0	0	0	0	0	5
	378.1		0	0.00	0	0	0	0	0	0	0	2
6/28/84	379.0		1704	0.94	3	0	3	0	0	0	3	3
	380.0		0	0.00	0	0	0	0	0	0	0	15
6/28/84	381.0	C	1707	0.94	16	0	16	0	0	0	16	46
6/28/84	381.1		1712	0.91	410	0	410	0	0	0	410	410
6/28/84	381.2		1714	0.91	81	0	81	0	0	0	81	81
	382.0		0	0.00	0	0	0	0	0	0	0	483
6/28/84	383.0	C	1719-1720	-.06	464	0	464	0	0	0	464	492
6/28/84	384.0		1726	0.12	12	0	12	0	0	0	12	518
6/28/84	385.0		1728	0.09	54	1	55	0	0	0	55	170
6/28/84	386.0		1738	0.91	9	0	9	0	0	0	9	9
	387.0		0	0.00	0	0	0	0	0	0	0	17
	388.0		0	0.00	0	0	0	0	0	0	0	39
	389.0		0	0.00	0	0	0	0	0	0	0	31
6/28/84	390.0		1739	0.91	57	0	57	0	0	0	57	79
	391.0		0	0.00	0	0	0	0	0	0	0	43
	392.0		0	0.00	0	0	0	0	0	0	0	19
	393.0		0	0.00	0	0	0	0	0	0	0	93
	394.0		0	0.00	0	0	0	0	0	0	0	22

DATE	SITE	PROB	TIME	TIDE (M)	FA	FP	FT	GA	GP	GT	ET	MAX
6/26/84	395.0		1455	0.91	9	0	9	20	1	21	21	32
6/28/84	396.0		1742	0.91	4	0	4	0	0	0	4	23
6/28/84	397.0		1743	0.91	8	0	8	0	0	0	8	12
	398.0		0	0.00	0	0	0	0	0	0	0	15
6/28/84	399.0		1744	0.91	49	0	49	0	0	0	49	69
	400.0		0	0.00	0	0	0	0	0	0	0	62
6/28/84	401.0	C	1745	0.91	0	0	0	0	0	0	3	24
	402.0		0	0.00	0	0	0	0	0	0	0	15
	403.0		0	0.00	0	0	0	0	0	0	0	27
6/26/84	404.0		1600	0.85	0	0	0	28	0	28	28	79
6/28/84	405.0		1745	0.91	9	0	9	0	0	0	9	56
	406.0		0	0.00	0	0	0	0	0	0	0	55
	407.0		0	0.00	0	0	0	0	0	0	0	9
	408.0		0	0.00	0	0	0	0	0	0	0	10
	409.0		0	0.00	0	0	0	0	0	0	0	341
6/28/84	410.0		1802	0.91	10	0	10	0	0	0	10	48
	411.0		0	0.00	0	0	0	0	0	0	0	20
	412.0		0	0.00	0	0	0	0	0	0	0	56
6/28/84	413.0		1803	0.91	5	0	5	0	0	0	5	66
	413.1		0	0.00	0	0	0	0	0	0	0	1
6/28/84	414.0	C	1807	0.94	328	0	328	0	0	0	328	363
	415.0		0	0.00	0	0	0	0	0	0	0	100
	416.0		0	0.00	0	0	0	0	0	0	0	61
	417.0		0	0.00	0	0	0	0	0	0	0	3
6/28/84	418.0	C	1813	0.94	139	0	139	0	0	0	139	542
	419.0		0	0.00	0	0	0	0	0	0	0	3
6/28/84	420.0		1821	0.98	9	0	9	0	0	0	9	9
	421.0		0	0.00	0	0	0	0	0	0	0	9
6/28/84	422.0		1615	0.98	0	0	0	39	2	41	41	84

APPENDIX II. Total harbor seal counts by site and census. (A82= April 1982, A83= April 1983, M/J82= May-June 1982, J83= June 1983, J84= June 1984). Rookery sites are underlined.

Site	A82	A83	M/J82	J83	J84
0.1					7
1.0	0	0	0	0	0
2.0	0	0	0	0	0
3.0	19	24	6	13	9
4.0	43	67	85	95	94
5.0	0	93	0	0	5
6.0	8	13	0	0	22
7.0	14	23	53	0	0
8.0	0	0	0	0	0
9.0	0	0	0	0	0
10.0	12	0	0	205	29
11.0	242	223	387	554	375
12.0	3	4	38	0	18
13.0	19	0	9	0	0
13.1		2		0	0
14.0	0	0	0	13	0
14.1				31	0
15.0	0	143	24	247	0
16.0	0	0	0	49	71
17.0	0	23	41	0	0
18.0	17	0	18	0	0
19.0	70	21	0	94	100
20.0	2	0	18	0	0
21.0	0	0	0	4	0
21.1				10	0
21.2					26
21.3					2
22.0	60	18	46	51	62
23.0	0	0	0	0	0
23.1				2	0
24.0	19	0	0	58	0
25.0	81	39	138	0	30
26.0	51	0	0	0	0
26.1	0	22	0	0	0
27.0	22	0	29	0	0
28.0	0	0	0	0	0
29.0	0	2	0	0	0
30.0	0	0	0	0	0
31.0	40	0	67	0	0
32.0	0	0	1	0	0
33.0	13	14	0	0	0
33.1		16		0	0
34.0	11	3	0	0	20
34.1					38
35.0	20	14	58	20	2
35.1		3		0	0
36.0	0	0	22	13	15
37.0	16	0	60	0	61

Site	A82	A83	M/J82	J83	J84
38.0	9	0	0	0	0
39.0	29	0	132	66	124
40.0	0	0	0	0	0
41.0	23	5	57	25	21
41.1					49
42.0	17	12	9	36	0
42.1				12	0
43.0	0	0	21	0	0
43.1		1		0	0
44.0	24	12	0	0	0
45.0	1	22	0	0	0
46.0	41	37	29	41	33
46.1		1		0	0
47.0	1	0	0	0	0
48.0	19	0	0	0	0
49.0	15	0	0	10	0
50.0	86	0	53	0	0
51.0	15	0	0	0	0
52.0	23	0	24	0	0
53.0	90	80	197	27	13
54.0	0	0	49	43	0
55.0	0	29	35	101	0
55.1					30
56.0	30	50	0	0	0
56.1		39		12	0
56.2		7		0	0
57.0	46	0	0	2	0
58.0	0	0	0	18	15
58.1				51	0
59.0	3	0	0	0	0
60.0	10	11	0	0	0
61.0	0	0	4	0	12
62.0	0	0	17	0	0
63.0	8	0	19	0	0
64.0	27	11	0	9	0
65.0	32	8	42	43	0
65.1		1		0	0
65.2					28
66.0	17	14	0	51	15
66.1		10		8	0
66.2		1			0
67.0	8	0	0	0	0
68.0	0	0	0	0	14
69.0	9	0	15	0	0
69.1					15
70.0	18	10	11	0	0
70.1				8	0
71.0	23	0	8	87	28

Site	A82	A83	M/J8	J83	J84
71.1					2
72.0	68	0	23	0	0
73.0	8	13	0	0	0
73.1	0	5	0	0	0
74.0	33	33	50	48	33
75.0	17	7	0	23	20
76.0	71	48	0	90	25
76.1					40
77.0	5	0	0	17	0
77.1				1	0
78.0	54	13	41	0	0
79.0	45	0	48	34	30
80.0	12	0	33	0	0
81.0	0	0	0	0	0
82.0	0	0	0	0	13
83.0	0	0	0	3	0
84.0	0	0	0	0	0
85.0	67	14	122	64	77
86.0	25	26	18	4	0
87.0	80	0	138	101	121
87.1	0	0	0	0	0
88.0	0	0	0	0	0
89.0	0	0	0	0	0
90.0	0	0	0	0	0
91.0	0	0	0	0	0
91.1	0			21	0
92.0	0	0	0	0	0
93.0	0	0	1	0	0
93.1					9
94.0	0	0	2	0	0
95.0	1	0	7	0	15
96.0	0	0	1	0	0
96.1					14
97.0	22	0	1	0	10
98.0	24	0	59	10	0
99.0	0	0	0	0	0
100.0	0	0	9	0	0
101.0	14	0	9	9	0
102.0	20	0	44	4	0
103.0	0	0	1	0	0
104.0	0	0	7	0	0
105.0	0	0	6	0	0
106.0	0	0	1	0	0
107.0	29	0	34	18	0
108.0	0	0	15	0	0
109.0	4	0	0	0	0
110.0	128	150	125	79	82
111.0	0	0	13	10	15
112.0	13	0	7	0	0
113.0	0	0	0	0	0
114.0	0	0	27	0	0
114.1		3		0	1
114.2		8		0	0

Site	A82	A83	M/J8	J83	J84
115.0	0	0	0	0	0
116.0	0	0	0	0	0
117.0	0	0	29	13	4
118.0	7	0	10	0	0
119.0	0	0	0	0	0
120.0	2	0	0	0	0
121.0	2	0	3	0	0
122.0	0	2	18	0	0
123.0	0	0	1	0	0
124.0	0	0	1	0	0
125.0	13	0	7	5	0
126.0	0	0	11	0	0
127.0	71	17	97	43	87
128.0	0	0	0	0	0
129.0	4	0	39	0	20
130.0	266	106	190	159	64
131.0	29	18	0	0	0
131.1		56		0	0
131.2		3		0	0
131.3					64
132.0	32	0	0	15	0
133.0	61	0	158	0	19
134.0	6	0	0	0	0
135.0	38	0	12	0	0
136.0	5	0	10	0	0
137.0	5	0	0	0	0
137.1				2	0
138.0	0	0	26	14	20
139.0	0	0	14	12	0
140.0	0	0	12	0	0
140.1		1		0	0
141.0	22	0	71	24	23
141.1		3		0	0
142.0	11	0	22	0	3
143.0	0	0	2	0	0
144.0	28	0	19	0	11
145.0	25	0	24	7	0
146.0	0	0	0	17	18
147.0	0	0	32	0	0
148.0	10	0	25	0	12
149.0	36	51	71	24	1
150.0	51	56	96	58	64
151.0	36	14	53	8	23
152.0	29	20	41	0	39
153.0	28	13	6	13	5
154.0	0	0	18	0	19
154.1					2
155.0	0	7	29	27	1
156.0	14	31	47	0	9
156.1	0	14	0	54	0
157.0	145	129	145	120	98
158.0	2	0	0	0	1
159.0	6	0	0	0	0

Site	A8	A83	M/J8	J83	J84
160.0	30	21	23	43	8
160.1		2		0	1
161.0	7	21	49	0	22
162.0	100	76	133	108	85
162.1		1		0	0
163.0	0	0	0	7	0
164.0	0	5	17	34	35
165.0	33	0	28	34	8
166.0	41	36	138	0	49
167.0	0	58	28	45	136
168.0	0	0	1	0	0
169.0	39	31	37	40	31
170.0	0	0	1	0	0
171.0	0	33	8	3	0
172.0	0	19	120	83	63
173.0	23	53	12	0	0
174.0	80	0	23	0	18
175.0	76	46	53	26	0
176.0	25	31	3	1	20
177.0	60	5	71	16	90
178.0	43	43	83	74	10
179.0	0	0	36	0	0
180.0	21	20	44	22	0
181.0	7	17	0	0	0
182.0	0	0	3	0	0
183.0	0	4	1	0	0
184.0	0	1	1	0	0
185.0	0	1	3	0	19
186.0	12	0	9	0	0
187.0	4	2	0	0	1
188.0	50	39	70	95	109
189.0	0	0	0	0	0
190.0	43	0	23	53	71
191.0	0	0	0	0	0
192.0	9	29	10	20	0
193.0	0	24	0	0	0
194.0	20	33	45	29	6
195.0	0	26	34	40	12
195.1		20		0	0
196.0	0	0	7	0	21
197.0	57	11	104	84	38
197.1		80		0	0
198.0	23	36	118	0	125
199.0	0	25	0	45	0
200.0	0	0	7	58	0
201.0	30	34	0	5	0
202.0	0	11	25	35	11
202.1					0
203.0	0	0	0	0	1
204.0	0	13	0	1	0
205.0	283	154	197	125	311
206.0	0	0	0	7	0
207.0	0	8	60	17	40

Site	A8	A83	M/J8	J83	J84
208.0	0	0	7	0	0
209.0	0	8	0	58	47
210.0	0	0	0	0	0
211.0	0	0	0	0	0
212.0	0	0	0	0	0
213.0	40	71	85	85	64
214.0	0	0	8	3	0
215.0	12	5	10	3	20
215.1					1
216.0	0	0	1	0	5
217.0	36	61	88	103	143
217.1					2
218.0	115	101	112	118	7
218.1		24		0	0
219.0	5	19	4	19	8
220.0	0	32	88	30	47
221.0	465	634	566	583	831
222.0	11	0	0	0	0
223.0	0	0	0	0	0
224.0	0	0	509	86	508
225.0	543	400	516	214	172
226.0	10	0	0	66	0
226.1				21	0
226.2				72	0
226.3				12	0
227.0	0	0	34	0	0
228.0	29	0	0	0	0
229.0	0	0	0	0	0
230.0	7	0	1	0	0
231.0	38	73	101	0	0
232.0	3	64	64	0	66
232.1					11
232.2					3
233.0	24	0	31	0	3
234.0	13	0	0	0	0
235.0	17	0	0	0	0
236.0	19	11	1	0	0
237.0	0	0	0	0	0
238.0	12	0	4	0	0
239.0	0	0	1	0	0
240.0	0	0	0	0	0
240.1		3		0	0
241.0	122	28	86	105	135
242.0	2	0	1	0	0
242.1		1		0	0
243.0	53	0	53	30	0
244.0	59	41	86	20	39
244.1					1
245.0	165	37	256	247	142
246.0	0	0	12	0	8
247.0	5	3	0	0	0
248.0	338	289	196	215	0
248.1					72

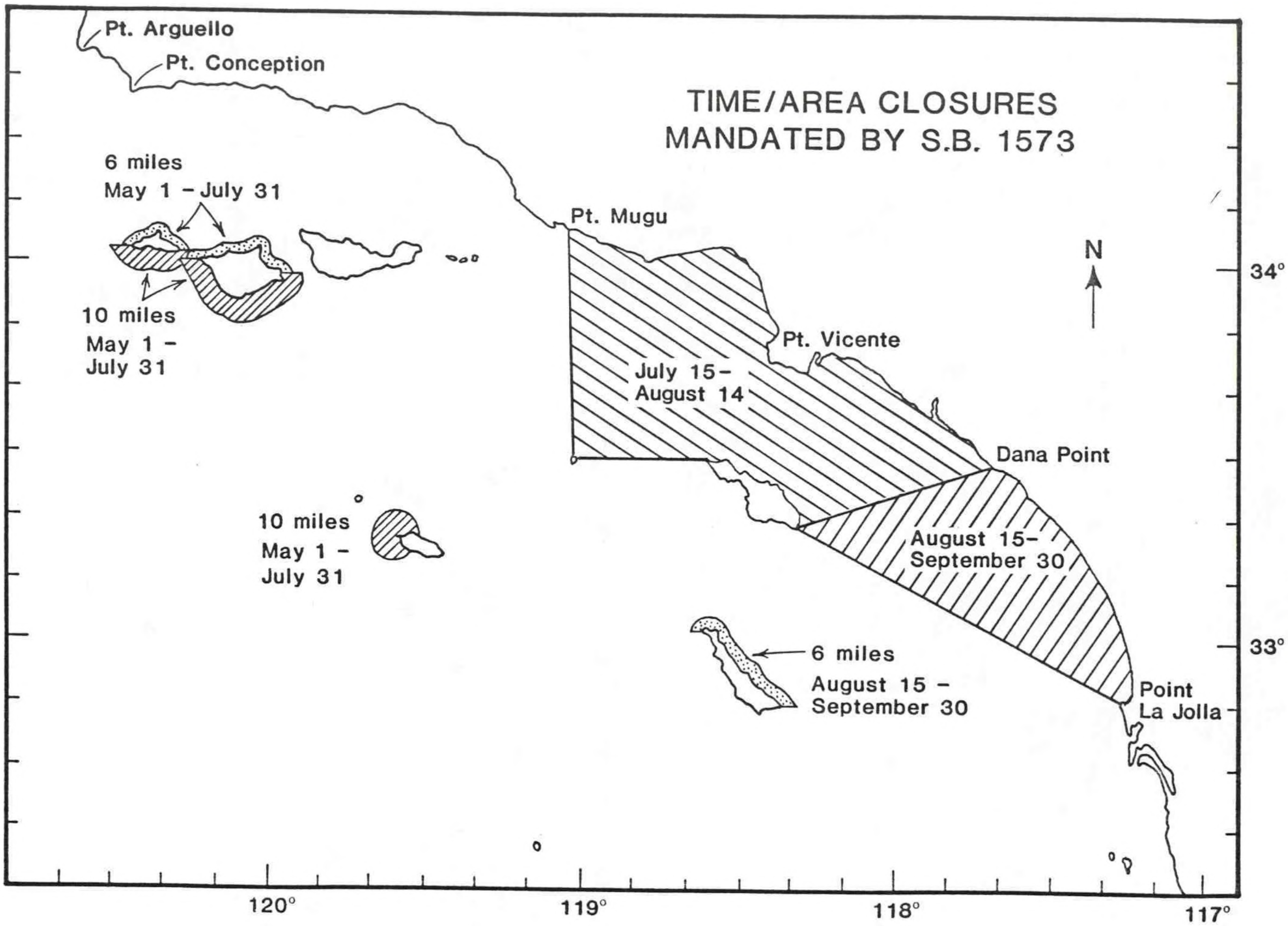
Site	A82	A83	M/J82	J83	J84
249.0	27	31	136	44	47
250.0	3	0	1	0	0
251.0	106	36	115	0	99
252.0	0	0	0	0	0
253.0	0	0	11	0	0
254.0	9	0	1	0	0
255.0	0	0	8	0	0
255.1					16
256.0	0	0	8	0	0
257.0	29	16	47	13	38
258.0	2	0	0	0	0
259.0	0	0	0	0	0
260.0	2	0	0	0	0
261.0	0	0	0	0	0
261.1		10		0	0
261.2		8		6	0
262.0	119	183	127	140	93
263.0	31	0	0	0	0
264.0	2	0	0	0	26
265.0	0	0	0	0	1
266.0	2	0	8	0	0
267.0	5	0	0	0	3
268.0	8	16	0	0	5
268.1				2	0
269.0	12	0	13	0	0
270.0	0	0	0	0	0
270.1		3		0	0
270.2		1		0	0
271.0	28	0	8	0	10
272.0	1	0	12	6	14
272.1					1
273.0	70	34	49	24	6
274.0	13	22	18	0	3
274.1		1		0	3
275.0	0	0	20	17	10
276.0	3	0	0	0	0
277.0	27	0	51	0	15
277.1		3		0	0
278.0	0	0	0	0	0
279.0	0	0	1	0	0
280.0	9	3	0	0	0
281.0	0	0	21	0	15
282.0	11	31	0	50	48
283.0	10	0	0	0	0
283.1					1
284.0	24	14	29	0	0
284.1				5	0
284.2					3
284.3					1
285.0	0	0	0	0	0
285.1					16
285.2					10
286.0	0	0	0	0	0

Site	A82	A83	M/J82	J83	J84
287.0	4	24	64	39	67
287.1		3		0	0
288.0	0	0	2	0	0
289.0	10	2	9	0	0
290.0	31	34	0	27	0
291.0	0	0	1	0	9
291.1					1
292.0	1	0	0	0	0
293.0	18	0	0	0	0
294.0	0	21	4	0	8
294.1					5
295.0	0	0	40	0	0
296.0	35	30	52	34	79
297.0	0	0	2	0	0
297.1		3		2	35
298.0	26	1	0	0	0
298.1		23		14	0
299.0	10	9	25	0	36
299.1					29
300.0	0	0	1	0	0
301.0	1	0	0	0	0
302.0	87	55	125	74	67
303.0	10	17	4	2	13
304.0	26	18	39	0	0
305.0	29	6	45	0	0
306.0	0	0	1	0	0
307.0	131	73	109	46	51
308.0	0	0	0	0	72
309.0	18	37	0	44	45
310.0	3	0	0	0	0
311.0	8	10	0	0	6
312.0	6	5	0	0	7
312.1					27
313.0	27	17	0	15	0
314.0	4	0	0	0	0
315.0	39	31	0	25	33
316.0	27	2	0	0	0
316.1		1		0	0
317.0	13	0	0	0	0
318.0	6	14	15	15	19
319.0	5	2	0	0	0
320.0	42	40	57	49	69
321.0	0	4	4	0	0
322.0	0	0	0	0	0
323.0	25	0	17	0	0
324.0	36	53	0	0	14
324.1					2
325.0	0	0	0	27	2
326.0	63	48	84	46	86
327.0	33	48	0	28	0
328.0	20	0	0	27	49
329.0	2	0	0	0	1
330.0	25	16	32	21	0

Site	A82	A83	M/J82	J83	J84
331.0	0	0	0	0	1
332.0	33	83	176	89	76
333.0	35	0	33	0	60
334.0	19	0	45	33	36
335.0	0	36	4	0	0
336.0	12	6	12	12	19
336.1		10		0	0
337.0	33	13	0	25	24
337.1		0		0	0
338.0	9	43	48	52	48
339.0	28	11	38	22	7
340.0	0	0	0	8	18
340.1					14
341.0	36	66	49	50	69
342.0	29	23	32	0	0
342.1				7	0
343.0	11	31	27	0	2
344.0	17	19	18	15	20
345.0	0	0	31	0	0
346.0	0	41	0	26	18
347.0	0	21	0	13	0
348.0	0	27	0	31	28
349.0	44	28	51	26	24
350.0	0	20	27	18	9
351.0	2	0	0	0	0
352.0	85	123	183	105	107
352.1		1		0	0
353.0	23	11	55	22	0
354.0	0	34	30	44	29
355.0	0	0	9	4	2
356.0	46	0	67	0	0
356.1	0	0	0	0	100
357.0	0	0	0	0	0
358.0	25	0	13	0	0
359.0	5	0	0	0	0
360.0	58	0	0	0	0
361.0	97	186	0	0	0
362.0	21	78	9	0	0
363.0	354	279	583	333	0
364.0	0	12	13	0	784
365.0	0	0	52	0	1
366.0	0	240	16	0	0
366.1				86	0
367.0	0	0	10	0	0
368.0	43	14	0	0	0
369.0	11	8	0	0	0
370.0	0	0	0	0	1
371.0	25	19	14	0	0
372.0	3	0	0	0	0
373.0	101	104	172	117	138
373.1		34		0	0
374.0	29	0	76	0	0

Site	A82	A83	M/J82	J83	J84
375.0	10	0	1	4	0
376.0	1	0	0	0	0
377.0	4	0	0	0	0
378.0	5	1	0	0	0
378.1		2		0	0
379.0	1	2	0	0	3
380.0	15	0	0	0	0
381.0	32	39	46	46	16
381.1		282		0	410
381.2					81
382.0	325	192	483	423	0
383.0	0	492	0	457	464
384.0	518	1	269	7	12
385.0	146	117	131	96	55
386.0	0	0	0	0	9
387.0	0	0	0	0	0
388.0	0	0	0	0	0
389.0	0	0	0	0	0
390.0	0	0	21	48	57
391.0	0	0	0	0	0
392.0	0	0	0	0	0
393.0	20	0	0	21	0
394.0	0	22	0	0	0
395.0	0	10	0	32	21
396.0	0	0	0	0	4
397.0	0	0	2	12	8
398.0	0	2	0	0	0
399.0	10	9	15	46	49
400.0	0	58	0	0	0
401.0	0	0	0	0	3
402.0	0	0	0	0	0
403.0	0	0	0	0	0
404.0	0	0	0	79	28
405.0	56	8	0	7	9
406.0	0	0	0	0	0
407.0	0	0	0	0	0
408.0	0	0	0	0	0
409.0	0	0	0	0	0
410.0	0	0	48	0	10
411.0	0	0	0	0	0
412.0	0	0	35	0	0
413.0	66	24	52	33	5
413.1		1		0	0
414.0	263	215	0	363	328
415.0	63	0	0	0	0
416.0	0	0	0	0	0
417.0	0	0	0	0	0
418.0	208	109	129	542	139
419.0	0		0	0	0
420.0	0		0	0	9
421.0	0	0	0	0	0
422.0	51	69	50	56	41
TOTALS	10669	9298	13026	10752	10885

APPENDIX III



SEASONS

February 1-April 30
No drift gill netting is allowed south of Point Arguello.

May 1-September 15
Incidental landings of swordfish shall not exceed landings of shark (thresher and bonito) in pounds during any calendar month.

September 16-January 31
Swordfish may be taken without restriction.

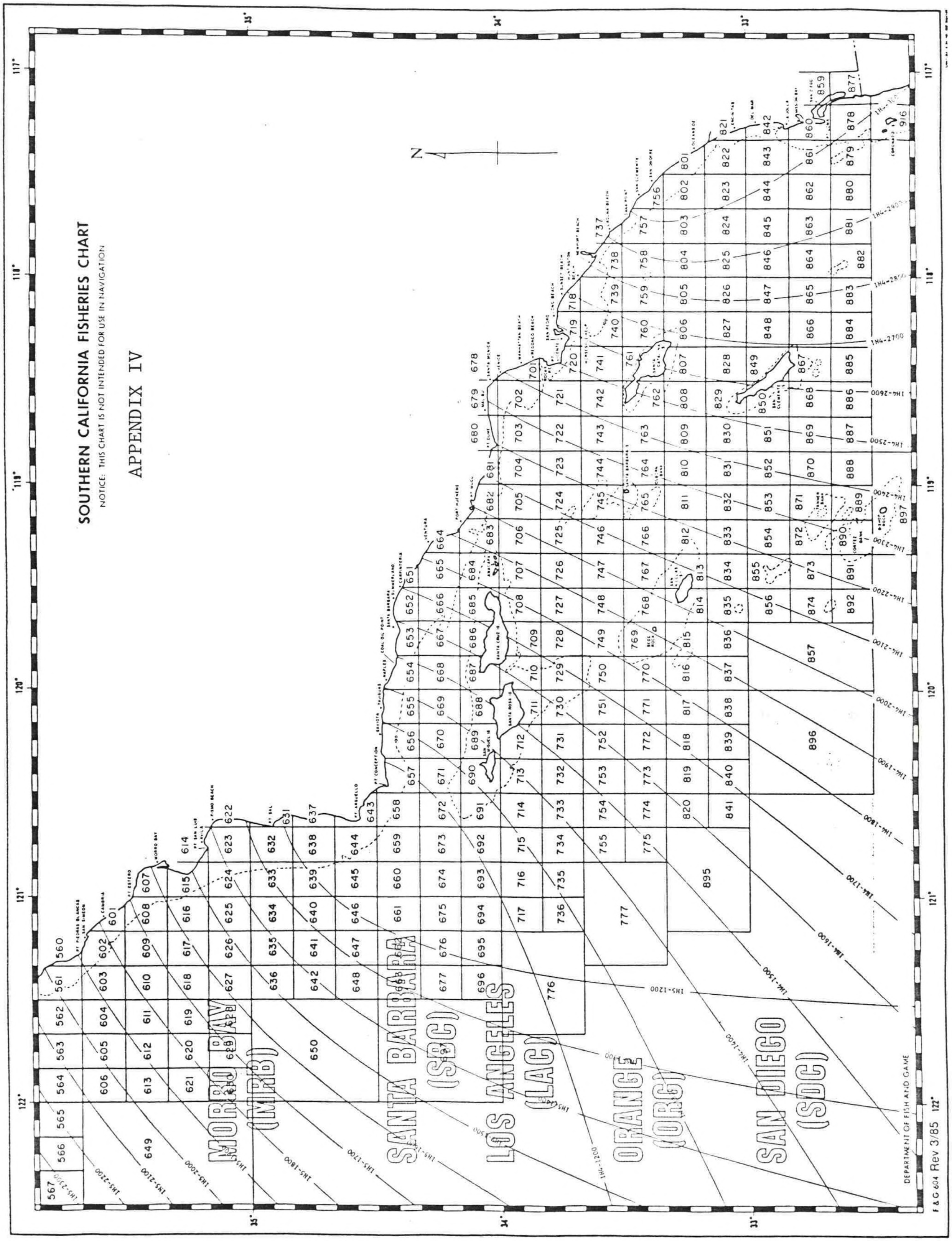
NETS IN THE WATER

Drift gill nets must not be in the water until two hours before legal sunset and must be out of the water by two hours after sunrise. Nets may be no longer than 6,000 feet long. The far end of the net must be marked by a pole with a red reflector to which the permittee's number shall be permanently affixed. Beginning May 1, 1985, drift gill nets must not be less than 14 inches in stretched mesh to take shark and swordfish.

TIME AND AREA CLOSURES

See map.

APPENDIX IV


SOUTHERN CALIFORNIA FISHERIES CHART
NOTICE: THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION
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