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NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES CENTER
P.O. BOX 271
LA JOLLA, CA 92038

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COASTAL MARINE MAMMAL STUDY, ANNUAL REPORT FOR THE PERIOD OF JULY 1, 1981-JUNE 30, 1982

by

Daniel J. Miller

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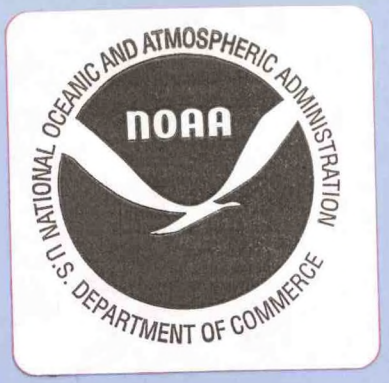

COASTAL MARINE MAMMAL STUDY, ANNUAL REPORT FOR THE PERIOD OF JULY 1, 1981-JUNE 30, 1982

Daniel J. Miller

California Department of Fish and Game
Marine Resources Branch
Marine Resources Laboratory
Monterey, California 93940

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INTRODUCTION

The results of the Marine Mammal Fisheries Interaction Study (Miller 1981; Miller et al. in press) revealed the areas of most intense interaction with marine mammals in California. Research activities of the California Department of Fish and Game in FY 1981-82 centered around assessment of the harbor seal population, determining the feasibility of the underwater acoustic harassment device developed at Oregan State University as a management tool, and determining the aesthetic value of marine mammals in the recreational boat fishery, particularly off southern California. Behavioral studies of the harbor seal were also designed, but difficulty in marking the animals precluded completion of this objective. Several of the studies were delayed in the first part of the FY, and only the basic development studies were completed for this annual report. The annual report for 1982-83 will present the final results of the acoustic harassment study and radio tagging of harbor seals at the Klamath River.

PART I

HARBOR SEAL, *PHOCA VITULINA*, CENSUSES IN CALIFORNIA, 1981 and 1982

Daniel Miller, Michael Herder, John Scholl and Philip Law

California Department of Fish and Game
Monterey, California 93940

PART I

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ABSTRACT

Three harbor seal censuses using vertical photography and ground truth observations were conducted in June 1981, April 1982 and May-June 1982. These censuses included all the mainland area between La Jolla to the Smith River, near the Oregon border. Hauled-out harbor seals were photographed through a port in a 185 Cessna using a Hasselblad camera with 100 mm lens and either 64 or 200 ASA Ektachrome film at 600 ft (184 m). A total of 183 ground truth stations was recorded by 96 observers in the three flights. The chi-square test of independence of sites and days were insignificant for each flight demonstrating that only one flight day per section of coastline is required. However, ground observations over at least 3 days in sequence at key sites are necessary to evaluate weather and human disturbance during the flight period. Optimum counts are made at tide heights ranging from 0.00 to +0.50 m during the midday to late afternoon period.

Counts of harbor seals were 10,717 and 13,066 in April and May-June 1982, respectively. The estimates for the April and May-June 1982 censuses were 12,216 and 14,700, respectively. The counts were adjusted for the maximum daily peak numbers hauling out as determined from ground observations to arrive at the estimates. The June 1981 flight data were not complete with reliable data collected from only 96 of the 426 known mainland hauling sites. About 11 percent of the total count in April 1982 were newborn pups. These pup data do not represent annual production because pupping extends for a prolonged period over the coastline. About a third of all hauling sites were not occupied during each flight.

INTRODUCTION

Harbor seal censuses in California have been conducted intermittently (Bonnot 1928; Carlisle and Aplin 1966; Frey and Aplin 1970; Carlisle and Aplin 1971; Mate 1977; Bonnell et al. 1978, 1981; Pierson et al. 1982; Stewart 1981, 1982). The California Department of Fish and Game censuses from 1965 through 1970 were designed to census California sea lions, Zalophus californianus, and Steller sea lions, Eumetopias jubatus. Harbor seals were tallied incidentally during the coastal and island coverage. These flights were conducted more during high tide levels, resulting in counts that did not accurately represent harbor seal abundance. None of the counts approached the numbers of harbor seals now present even when counts were made during lower tides substantiating the fact that harbor seals, as well as all the other pinnipeds except the Guadalupe fur seal, Arctocephalus townsendi, have been increasing in California waters.

The maximum counts of harbor seals for California in 1965, 1969, and 1970 were 1,062, 2,139 and 1,675, respectively. Mate (Mate 1977) tallied about 2,500 harbor seals in California in 1975, with 1,949 of these along the mainland from Pismo Beach to Oregon. Mate's census was not designed specifically for harbor seal censusing, and much of the area was at high tide

when covered.

The censuses under contract from the Bureau of Land Management in the southern California bight were more designed to cover each mammal species and a more accurate count of harbor seals was achieved (Bonnell et al. 1978). There is little distrubance at most of the hauling sites at the offshore islands, and there are sandy beaches on which harbor seals can haulout at all tide levels. Consequently, insular counts are more reliable than if the same coverage was made along the mainland coast where there is considerable human distrubance, especially during minus tides. The 1975-76, 1976-77, and 1977-78 harbor seal counts at the offshore islands of southern California were 1,192, 1,714, and 1,822, respectively.

Stewart (1981) emphasized harbor seals in his censuses and tallied 2,491 harbor seals hauled out on Santa Rosa, Santa Cruz, Anacapa, San Miguel and San Nicolas islands. The maximum count by Bonnell et al. for these five islands was 1,822 harbor seals. Stewart (1982) tallied 3,707 harbor seals for all the offshore islands of southern California in 1982.

The ongoing censuses by the BLM-OCS Surveys Project in the central and northern California area yielded a maximum count of harbor seals in 1980 of 6,778 animals. The 1982 count (M. L. Bonnell, University of California, Santa Cruz, BLM-OCS Surveys Project pers. comm.) was 10,754 harbor seals for this same area. Our maximum count in 1982 was 13,066 harbor seals for the central and northern California area.

The large increases presented by Stewart at the offshore islands and for the mainland in this paper are the result of improved censusing techniques as well as an acutual increase in harbor seals. This paper presents the results of the Department of Fish and Game June 1981 and April and May-June 1982 harbor seal censuses along the mainland coast of California from Oregon to Baja California.

METHODS

Optimum Censusing Conditions

Time of Year

Peak numbers of hauled-out adults and subadults occur during June and July in California (Loughlin 1979; Sullivan 1979; Bonnell et al. 1978, 1981; Stewart 1981). This time of the year is at the end of the pupping season, the beginning of breeding activity, and at the onset of the annual molt. The molting period may extend over two months before all animals have completed the molt. It is not known which of the above or possibly other behavioral or physiological parameters cause the animals to haulout in peak numbers each year in June and July. Studies in Oregon (Brown 1981; Beach et al. 1981) indicate that the peaks may vary between different estuaries and river systems and that the peak may also occur in August.

Pupping occurs from early spring, March through May, in the southern latitudes of California and from late April into late June in northern California. This confirms the results of the study by Bigg (1969) documenting earlier pupping in lower latitudes along the eastern Pacific coastline.

A total count of pups to achieve an estimate of the annual reproduction is not practical. There may be a prolonged pupping season of about 2 months (Bigg 1969; Bonnell et al. 1978), and the annual reproduction cannot be censused within a short period as with the other pinnipeds in California. The fastest growing first born pups of the year may approach the size of the slower growing yearlings from the previous year at the end of the pupping season, and pups may be considered yearlings, especially on aerial photographs. This was dramatically demonstrated in our May-June census (see below). New born pups are readily distinguishable from all others by size, but they may be difficult to locate on the film when they are wet and dark on dark rocky and algal substrates.

Our censuses are thus conducted in two aerial coverages of the coastline. The April census is designed to delineate the rookery areas and record a minimal count of pups at the major rookery areas. The June flight is made to record the peak population of hauled-out harbor seals to determine population trends in numbers and distribution. Two censuses near the annual peak haulout time also yeilds a more sound statistical evaluation of population trends. Two censuses are also important if adverse weather conditions should disrupt one of them.

Time of Day

Harbor seals on the southern California Channel Islands tend to haulout in increasing numbers as the day progresses (Stewart 1981). Our ground truth counts documented this behavior with harbor seals hauling-out in greater numbers after low tide than before on the average.

Early morning hours are not good for photography due to the deep shadows falling on beach hauling sites. Midday to late afternoon periods are optimum for both photographic quality (see below) and animal behavior.

Tidal Height

Low tide periods are necessary for hauling-out at nearly all the wave-swept rocky and beach hauling sites along the mainland coastline. There are a few still-water rocky areas where animals can haul out at moderate high tides such as in Yankee Cove, Whaler's Cove in Pt. Lobos State Reserve, and at Hopkins Marine Station, Pacific Grove. Low tide conditions are necessary for 420 of the 426 known hauling sites along the mainland.

In estuaries, bays, and some river mouth spits where the substrate is firm sand or mud and the total area is not covered by water at high tide, hauling-out can occur at high tides as well as low. In deep mud areas such as

in San Francisco and San Pablo Bays, hauling-out can occur only during high tides to enable the animals to reach the firmer substrate adjacent to the salt marshes.

A major concern of scheduling flights in relation to tidal height is that of human disturbance of hauling sites. Abalone pickers, poke-pole fishermen working tidepools, tidepool class studies, research studies, and tidepool pickers for small invertebrates and algae are present over most of the rocky coastline where there is public access on low minus tides. The flight made in June 1981 was conducted during an early morning minus tide, and many hauling sites were disturbed, especially in central California. The adverse effects of human disturbance can invalidate a harbor seal census.

The two 1982 censuses were scheduled during low tide periods in which the lowest tide was at 0.00 m. This tide height is not considered productive to tide-poolers and abalone pickers. There may be a few hauling sites that can be used only during minus tides, but evidence in our studies and by Hazard (1977) indicates these animals will most likely choose an alternative site and not be lost to the census as would animals frightened off a site immediately before the arrival of the census aircraft.

There are two low tide "windows" to be considered. It is important to keep the census period within the 0.0 to +0.50 m tide level. There is a minimum of human disturbance, and most all hauling sites are occupied at +0.50 m. Flight times extend from about 2.0 to 1.5 hours before low tide to about the same period after low tide to remain within this tide level at a base low tide of 0.00 m. The second "window" is the number of consecutive days in which the tide does not exceed 0.50 m during a 4-hour flight. This "window" can extend over a 9-day period if early morning low tides are utilized, but if midday and afternoon flights are adhered to, the flight "window" is limited to 4 or 5 days (Table 1).

Weather Conditions

Weather can be a factor in the airplane operation in that extremely turbulent air can be dangerous to the photographer who is lying on the floor with the camera equipment. The spring months from April through June are usually not periods of heavy storms with high swells, but strong, turbulent onshore winds can sometimes occur. These factors can also reduce hauling site substrate.

Census Procedures

Aerial Coverage

The aircraft used is a Cessna 185 with the back seat removed for installation of a photography port during the flight. The port is 8 in. in diameter and fitted with a piece of optical glass. There is one photographer, a recorder, and the pilot. The photographer lies on the floor and looks

through the port ahead of the plane searching for hauled out animals. The pilot flies the aircraft directly over the shoreline in the areas where animals can be expected to haulout and the recorder looks ahead of the plane for animals and keeps constant knowledge of the position of the airplane with landmarks. The recorder is equipped with maps upon which known hauling sites are entered and warns the pilot and photographer when approaching a known site. The time of coverage and number of exposed frames by roll number are entered on the map.

Flight patterns are flown from south to north to take advantage of the seasonal headwinds to reduce ground speed. The stalling speed of the aircraft is 55 mph, and ground speeds can vary from 70 to 100 mph depending upon the force and direction of the wind. The south to north direction also takes advantage of the low tide time differential along the coast which increases in time to the north (Table 1).

The flight height is at 600 ft (184 m). At this altitude, the width of the area taken on the film with the 100 mm lens is about 100 m. Nearly all hauling sites can be photographed on one overpass at this altitude. Higher altitudes may be more convenient when maneuvering the plane over the animals, but at higher altitudes the animals are harder to locate, and the images on the film are more "grainy."

Camera and Film

The camera ia a Hasselblad model 500-ELM with 100 mm f3.5 lens. A motor drive is used, with frames taken at about 1 sec intervals. A sighting frame attached to the side of the camera is used rather than the ground glass through-lens viewfinder. The shutter is closed as the film is advanced, eliminating the view of the hauling site, resulting in poor visual sighting of the animals when using the through-lens viewer.

Film used is perforated 70 mm 64 and 200 ASA Ektachrome. A Spot Sensor-II Soligor spotmeter is used to take light value readings of the substrate upon which the animals are hauled out. The light value readings are made vertically through the photography port because oblique readings may result in high values due to atmospheric reflection. When making a choice of f-stop settings at a borderline reading, the higher setting (less light) is chosen. Overexposed film cannot be corrected whereas underexposed film can be used.

The shutter speed is set at its fastest (1/500 sec), and the infinity setting is taped so it cannot inadvertently be moved during the flight. A shutter speed of 1/250 sec at 600 ft may result in blurring of the images, especially if the air is turbulent. When light values fall below 13, the 64 ASA film magazine is removed and 200 ASA film is used.

The sharpest images are made when flying at 600 ft using the 100 mm lens rather than at 750 ft using the 100 mm lens with a doubler.

Several problems occurred with the Hasselblad format. One of these is that the camera may keep making exposures after the last frame on the roll has been exposed. Normally, this does not happen, but on the June 1982 flight this occurred. Constant checking of the exposure counter when the last frames are expected will note if the number remains the same as exposures are taken indicating to the photographer that the camera is malfunctioning. In about a third of the canisters, the last two to four exposures are sometimes light-streaked or over-exposed. This may be due to used canister leakage or possibly to exposure made when loading or unloading the film. To correct for this, the last four exposures are retaken on the next roll of film.

Counting Harbor Seals on the Film

There are three methods of viewing the 70 mm film. One is to mount each frame and project the images on a smooth white or gray surface as described by Mate (1977) and Bonnell et al. (1978). The Southwest Fisheries Center, National Marine Fisheries Service, has a Vanguard Motion Analyser No. P-N which projects 35 mm and 70 mm film on a ground glass screen. The third way is to count the animals on the film under a dissecting microscope.

All three methods were tried, and the best results were with the dissecting scope. All the hauling sites in the April 1982 census were read using the motion analyzer and under the microscope, and 13.4 percent more animals were counted using the scope. Projecting mounted slides on a large screen was not as thoroughly tested, but the results were similar to the projection on the motion analyzer screen. Also, much time and expense is involved in mounting the 70 mm frames.

The microscope used is a Wild Model M5D using 6 or 12 magnifications. The light is sent up through the film using a ground glass diffuser. The film is elevated about 20 mm above the ground glass to avoid focusing the film images in the same plane as the ground glass. If this is not done, the resolution of the images is lessened. The edges of the animals become "grainy" as when using 400 ASA Ektachrome.

The first procedure is to tape the film rolls in sequence from south to north and place a small white label with the haulout number entered on each exposure. This is done on a light table with the rolls of film from previous flights to determine the exact hauling sites photographed and to detect new hauling sites. Errors can be made when entering the census data on the maps and checking with previous photographs of the hauling sites can avoid mistakes.

Counting is done by placing a thin clear plastic strip on the film and marking each animal with a dissecting needle or a Rapidograph 5x0 pen without ink. The mark makes a bright silver dot which is readily visible. The counting strips can be labeled and preserved for future reference.

Photo interpretation to separate species of pinnipeds is not difficult when harbor seals are the target animals. The problem with harbor seals is

that the April to June period is immediately before the annual molt, and the white portions of the pelage are usually a dull brown. The brown and black mottled pelage becomes difficult to distinguish from the substrate when the animals are hauled out on rocky algal covered areas. When harbor seals are on even textured sandy or mud substrate, there is no problem in locating the animals. Some harbor seals acquire a bright red or green pelage due to growths in the fur in certain estuary habitats. These animals are readily discernible on any substrate. One animal in Tomales Bay possessed a bright green body with a bright red head.

Pups are readily visible on any substrate when they are dry and the pelage is silver. The pelage is black and shiny when they are wet, and these animals are difficult to note on rocky substrates but are readily visible on sand and mud haulouts.

Harbor seals will not tolerate each other closer than about 0.5 m when hauled out and do not present a crowded mass as do elephant seals, Mirounga angustirostris, and California sea lions. Harbor seals in the water can be seen when the water is clear and if they are near the surface. During the three censuses, no more than about 10 were seen in the water on the census film, mainly because our attention is only toward hauled-out animals. Ground truth observers record the number of animals in the water, and these data are utilized in estimates.

Ground Truth Information

Ground truth data are utilized for several corrections and evaluations. These are: (i) to determine the accuracy of the aerial photographs; (ii) to determine haulout patterns during the census period; (iii) to determine the maximum count at each station to establish factors for adjusting the aerial counts to an estimate of total animals hauling out for the flight period; (iv) to establish adult-pup ratios; (v) count the number of animals in the water adjacent to the hauling site; and (vi) to ensure that certain major hauling sites which are likely to be disturbed or fogged-in are covered.

The number of persons available are assigned to certain hauling sites. The coverage at each site is for 3 or 4 consecutive days and between 1.5-2.5 hours before and after low tide each day. Counts are made every 0.25 hour except when one ground observer covers two nearby hauling sites, counting at 0.50 hour interals at each. Other exceptions are when there are too many animals to count within 0.25 hour, such as when there may be over 500 animals in which case hourly counts are made. Ground truth stations are chosen at hauling sites where the animals are readily observable from the shore and are thus nonrandom.

Harbor Seals Not Included in the Census

Seals can sleep under the water, a behavior called "bottling" (Hewer and Blackhouse 1959; Ridgway et al. 1975; Sullivan 1979). Periods of underwater

sleep are up to 8 min. These seals, unless they are bottling near ground truth stations, are not available to the census.

Pitcher and McAllister (1981) reported that only about 35 to 60 percent of the radio tagged harbor seals in their Alaska experiment hauled out during the day. These values are minimal in that there was prolonged disturbance in their study area due to capturing, and not all days were covered continuously, including a prolonged period of about a month in which the animals were not tracked. Other studies indicate that the degree of hauling out may be higher. Boulva and McLaren (1979) mention that "some individuals could be recognized hauled out in the same area day after day" ... Finley (1979) indicated that midday counts may reveal 70 percent of ringed seals based on the occurrence of a recognizable animal. Other animals in the water that may be missed would be those feeding and not hauling out.

Hazard (1977) noted that there was movement between hauling sites in the Chicagof Island area of Alaska. During our experimental flights in April 1981, harbor seals were noted moving from a rocky hauling site to a nearby protected sandy beach as the incoming tide made their off-shore site unusable. The "turnover" of different animals entering and leaving a site was noted by several of the ground truth observers. Insufficient data are available to estimate the number of animals missed due to the turnover, but the degree of error is probably small.

Even though Pitcher and McAllister (1981) indicated a high degree of fidelity to certain hauling sites, they also noted that there was considerable wandering of some individuals. Initial results of our radio tagging studies at the Klamath River indicate usage of four alternate sites within a 6 km range of the tagging area by the same animals. As mentioned above, Hazard (1977) noted there was movement between hauling sites and that seals sometimes used several hauling sites within a 24-hour period. She also noted that only one of the 16 hauling sites in the study was occupied during all the censuses. The accumulative number of days censused for the 16 sites was 195, but only 101 sites were occupied by seals. Thus, there were 49 percent of the known hauling sites not occupied during Hazard's censuses. This compares with 33 percent of the hauling sites not occupied in both the April and May-June 1982 censuses in our study. Thus, the behavioral significance of utilizing alternative sites tends possibly to reduce the expected number of animals hauling out at a certain site.

Other groups of animals that may be missed on a census are those hauling out at high tide and those hauling out at night. Again, without an intensive radio tagging study in an area where there are nighttime hauling sites, it would not be known if indeed some of these animals were also hauling out during the day at an alternative site. Likewise, animals hauling out at high tide sites may also be hauling out during the day at an alternative site. The known sites which are predominately used at night are in areas where there is common human disturbance during the daytime. These are east of the Standard Oil Pier at Carpinteria (site #5), at Ellwood, north of Santa Barbara (site #10), at Strawberry Spit in Richardson's Bay (site #212), and at the Klamath River spits (site #409) during the salmon fishing season from June through September.

RESULTS

Hauling Sites

A hauling site is defined as substrate used for hauling out that in some way is separated from another site by a point of land, across an area of deeper water such as between the shore and offshore rocks, or merely shoreline substrates separated from each other by water by around 150 to 200 m. There are a few arbitrary decisions separating two nearby sites that others may consider the same site, but these are rare, and the hauling sites listed are easily distinguished from each other. The sites have been entered on 7.5 min Geological Survey topographic maps and are listed (Appendix II) to seconds of degrees if the exact location is known. A total of 348 of the 426 known mainland California hauling sites (including the Farallon Islands) are known to exact location. The remainder will be located in more detail during the next census. An exception to the listing of specific location of sites occurs in Drakes Estero, Tomales Bay, and Humboldt Bay where there are extensive muddy and sandy areas on which harbor seals can haul out in different areas from day to day. These bays are considered as single hauling sites.

Hauling sites were determined by recording the site on maps during flights, by noting sites referred to in the literature, and by contacting researchers and naturalists who are familiar with known hauling sites. In most cases it was not possible to determine the exact location of a site on the 70 mm census film because not enough land area appeared in the frame. A series of vertical 35 mm slides was taken at 200 ft of most areas where sites could not be located from shore. With this series of slides, hauling sites in these areas could be delineated to exact location. Subsequent to the 1982 censuses, a day was spent with M. Bonnell and M. Pierson (BLM-OCS Studies, UCSC) comparing their harbor seal census slides with our 70 mm census film, and 22 additional hauling sites were determined from their slides that were not recorded during our censuses. These sites have been entered into our hauling site listing.

Except for 15 of the new sites made aware to us after the 1982 flights, each site has been classified by habitat type (Appendix II). These types are: extended reef, offshore rock, onshore rock, ocean beach, harbor and estuary, and miscellaneous. An extended reef is a broken rocky area often interspersed with sandy patches that extends from shore. The area is exposed during low tides to the extent that humans can wade close to the outermost part. An offshore rock is a solid rock or series of rocks that cannot be reached by waders during low tides. An onshore rock is a solid rocky shelf that extends out into the ocean directly from a cliff. An ocean beach is exposed to swells, is usually inundated at high tide, and consists of sand or fine gravel often intermixed with boulders. Harbors and estuaries include the inside of major rivers and are always in calm water with sand or mud substrate.

More than half (53.1) of the mainland sites are offshore rocks where human distrubance is minimal or not possible (Table 2). About 26% are reefs

extended from shore where human disturbance is possible during minus tides. The onshore rock (4.7%) and ocean beach areas (4.0%) are in protected areas where access at this time is not possible or difficult. Even though only 5.4% of the sites are in harbors and estuaries, 19% of the harbor seals along the mainland are in these sites. Maximum known counts for each site are also given (Appendix II). A summation of these counts for all hauling sites totals 19,031 harbor seals (Table 2).

Harbor seals are becoming accustomed to human presence at several sites where they are not harassed. On April 17, 1982, the senior author observed the harbor seals hauled out at Carpinteria State Beach (site #7). As the tide receded, the rocky shelf where the seals were hauled out could be reached by the public. When the first seal watchers approached to within about 50 m, the 12 subadults present went into the water and swam to a reef about 50 m farther offshore that humans could not reach. Six adult harbor seals remained at the first site and allowed eight people to surround them to within about 3 m. After about 20 min. a child close to a seal reached out and touched the hind flippers. The reaction was of mild alarm by the animal, but it did not move. Throughout the remainder of the low tide for about 1.5 hours, there was steady flow of up to 9 humans at a time climbing onto the hauling site to closely observe the seals.

Other sites at which the seals allow close approach by humans are at La Jolla Cove (site #3), Cypress Point parking lot (site #152), and the Russian River spit (site #262).

Haulout Variation Between Consecutive Days

A total of 195 ground observations from 62 different hauling sites are available for replicate count analysis (Table 3). There was a 0.5 percent difference between minimum and maximum counts at sites where a 2-day replicate series was available. Comparable percentage differences between the minimum and maximum tallies for the 3-day and 4-day replicates were 4.5 and 6.1 percent, respectively.

Chi-square tests indicate independence between hauling sites and consecutive day counts for each flight except for three counts at site #165 (Soquel Point) which was the only ground truth site seriously affected by tidal height, and one count at site #225 which may have been influenced by human disturbance. The analysis for each flight follows.

June 1981. The chi-square test of independence between the hauling sites and days of census based on counts is not significant ($x^2 = 88.04$, $df = 19$, $p = 0.26$). Levene's test for equality of variances of counts among days is not significant ($p=0.24$). Also, oneway ANOVA of differences of mean counts among days is not significant ($p=0.65$) indicating that there is no difference in site counts among the days.

April 1982. The chi-square test of independence between sites and days is highly significant ($x^2=138.25$, $df=68$, $p=<0.001$). It is rendered

insignificant when the two low counts on days 1 and 4 at site #165 are excluded from this analysis (x^2=84.9, df=66, p=0.059).

May-June 1982. The chi-square test of independence between hauling sites and days is highly significant (x^2=88.04, df=38, p=<0.001). However, this lack of independence is heavily contributed by two particular counts, day 1 for site #165 and day 3 for site #225. When both were excluded from the analysis, the chi-square test is not significant (x^2=41.70, df=36, p=0.94). Variances and mean counts are not significantly different based on Levene's test (p=0.92) and oneway ANOVA test (p=0.94).

Computation of Correction Factors for Maximum Daily Haulout Estimates

Instantaneous counts at each hauling site where there was no ground count were adjusted to an estimate derived from maximum counts recorded in the ground truth series (Appendices III and IV). Factors (Table 4) were computed by recording the percentage of the maximum count of each day at 0.25 hour intervals for each station. These percentages of maximum counts for all flights were then summed for each 0.25 hour interval and averaged to yield a factor to project instantaneous counts to an estimated maximum number of harbor seals hauling out at each site throughout the census.

The maximum peak values on the average fall between low tide and 1.5 hours after low tide for all size groups (Figures 1 and 2). Harbor seals hauled out in estuaries are less variable in numbers over a wide period of the tide with instantaneous counts ranging nearly 95 percent of the maximum over most of the period from 1.5 hours before to 1.5 hours after low tide. By size groupings, a higher percentage of the maximum peak is recorded by instantaneous counts as the size of the cluster increases (Table 4; Figure 1), demonstrating increased stability of hauling behavior in larger groups. This may result from the fact that the smaller clusters of animals are utilizing sub-optimum hauling substrate and tend to have a greater turnover of animals hauling out during each low tide period.

On the average, aerial counts recorded around 90 percent of the maximum number of harbor seals hauled out each day (see below).

Accuracy of Aerial and Ground Truth Counts

There were 29 rocky substrate and 4 estuary hauling sites at which aerial counts were directly compared with ground counts (Tables 5 and 6). In April, the aerial counts on rocky substrate recorded 98.3 percent of the animals tallied by the ground observers. However, the aerial counts were 106.2 percent of the ground counts in estuaries where the observers were at a low profile counting large numbers of animals. In the May-June 1982 flight, aerial counts were 93.1 percent of the ground observer counts at rocky hauling sites and 106.9 percent of the ground estuary counts. When both rocky and estuary substrates are combined, the aerial counts exceeded the ground counts by 1.6 percent.

For the April 1982 series, the chi-square test of independence between hauling sites and survey method (aerial and ground) based on total counts is not significant (x^2=4.0, df=17, p=0.99). Twoway ANOVA for differences in mean counts among surveys (ground vs aerial) and group (adult vs pup) show the mean count between ground and aerial surveys are not significantly different (p=0.90).

The principal animals not recorded on the film were pups. Some pups were apparently considered as subadults in the photographic analysis, especially in the May-June census. Identification of pups is also a problem for ground observers. Pups of the year are difficult to distinguish from slow growing yearlings during the June period if both are wet.

June 17-22, 1981 Census

This flight was designed to develop flight coverage patterns and photographic techniques, to delineate hauling sites, and to census all hauled out harbor seals. The flight was conducted during an early morning minus low tide, and several photographs were underexposed due to early morning shadows falling across the hauled out animals. There was considerable human disturbance by tide pool users along the central and northern California coastline where the public had access. Several hauling sites were lost to fog in southern and central California, and extremely turbulent winds precluded coverage of about 30 km of coastline north of Fort Bragg. Turbulent air at other locations resulted in blurring of some exposures, and one roll of overexposed film resulted in the loss of 30 additional sites.

The results were that much was learned to develop a routine census, but a total count for statewide annual comparisons was not achieved. There were 96 hauling sites in 72 areas in this census for which usable aerial counts are available. Haulout "areas" consist of more than one hauling site in which the sites are nearly contiguous, yet spaced so that distinct substrates can be recognized and recorded each census. Major shoreline hauling site areas are: from Pt. San Luis to Diablo Cove (sites 31-39); Cayucos Point (sites 49-62); between Adobe Creek and Pt. Piedras Blancas (sites 76-80); Pt. Reyes Headlands (sites 226-235); Tomales Point (sites 239-246); Sea Ranch (sites 300-311); and Patricks Point (sites 358-405).

There was a high degree of difference between counts at most sites between censuses, indicating that it is not statistically correct to use a site count made during one census to represent a count missed at that site on another census. The chi-square test of independence between the 72 areas and the three censuses based on counts is highly significant (x^2=2614, p=<0.0001). Counts for each hauling site varies from census to census. However, oneway ANOVA of differences of mean counts among the three censuses is not significantly different (p=0.34). Levene's test for equal variances is also not significant (p=0.075).

The apparent increase from 4,368 harbor seals in 1981 to 6,256 in June 1982 is partly due to large variances within each census. In addition, the 96

hauling sites in both series were not contiguous and possible movement of animals between these sites and sites not included in this analysis precludes use of these data for population trends. Also, the increase of 1,888 harbor seals for these 96 sites in one year far exceeds the possible maximum increase in recruitment.

April 18-22, 1982 Census

The flight was from south to north flying at 184 m, using the Hasselblad with 100 mm lens. A 0.00 low tide period was chosen falling during midday and afternoon. Weather was excellent with mild winds and no fog except for the hauling sites at Point Conception (site #11) and St. George Reef (site #421). Point Conception (site #11), La Jolla Cove (sites #2 and 3), and the Farallon Islands (site #422) were censused by ground observers only. The southern California offshore islands were censused by Stewart (1982).

Human disturbance occurred at six of the 32 ground truth stations (Tables 7 and 8) for which there are both instantaneous aerial and ground counts. The degree of disturbance is biased in that several ground truth sites were chosen because disturbance was most likely to happen at these sites, and a ground count was desired in case the distrubance occurred before the arrival of the plane. There were 27 disturbances occurring out of the total 149 stations. These 27 disturbances took place at 18 different sites (Table 7). The number of harbor seals lost to the census due to human disturbance was probably not more than about 300 animals or 2.8 percent of the total mainland count (Table 9). Over 200 animals of this possible loss occurred at Double Point (site #221) where disturbance was caused due to a boat, which had been lost at sea, drifting onto the center of the beach. Law enforcement officials, press personnel, and interested public disturbed the area for 4 days. Sarah Allen, Point Reyes Bird Observatory, was present and recorded the animals' behavior during this period. It is possible that some of the animals that apparently left the site may have moved to nearby sites such as at Duxbury Reef or Drakes Estero. The data for the 15 other sites at which disturbance took place indicate that human disturbance during a 0.00 low tide does not preclude a reliable census as could happen during low minus tides in the morning. Ground truth observations are essential during each flight to evaluate disturbance.

Total Counts and Estimates

A total of 10,669 harbor seals was counted for an estimate of 11,675 when adjusted for maximum hauling peaks (Table 9). There were 48 additional animals observed in the water by ground observers on flight days resulting in a total count of 10,717 harbor seals.

From a total 113 ground truth stations for which there were maximum counts, 1.58 percent of the total animals tallied were in the water. Projecting this ratio (minus the 48 tallied in the water, the total estimate for the flight was 11,815 harbor seals, not including an additional estimate for pups (see below).

A total of 2,770 harbor seals was tallied at the ground-truth-aerial direct comparison stations for a sample of 25.8 percent of the total count.

Census by Counties and Dynamics of Hauling Patterns

The greatest concentrations of harbor seals were in Marin County followed by San Luis Obispo, Mendocino, and Humboldt counties (Tables 9 and 10). About 60 percent of the total was recorded north of San Francisco, and only about 5 percent of the total was south of Pt. Conception along the mainland.

There were ten estuary and river mouth spit hauling sites totaling 2,581 estimated animals (22 percent of the total estimate). A total of 1,559 harbor seals (13 percent of the total estimate) was hauled out on ocean sandy beaches.

The largest clusters were in Drakes Bay, south Humboldt Bay, and Double Point with 543, 518, and 465 harbor seals counted respectively (Appendix IV).

Fifty-five percent of the animals counted were in clusters greater than 100 animals (Table 10). There was a peak concentration in the 21-30 group size (10 percent of the total count), but only 340 (3 percent of the count) were recorded in the 1-10 size group. Only eight single harbor seals were sighted hauled out, demonstrating the strong social clustering behavior of this species.

Rookery Areas and Adult-Pup Ratios

There were 12 ground truth stations for which adult-pup ratios could be compared to aerial counts (Table 11). Pups represented 15.4 percent of the animals recorded in the ground sample and 11.6 percent of the aerial count. Some of the pups "missed" on the film may have been tallied as subadults and actually not lost to the census but resulted in a distorted adult-pup ratio. Also, ground observers may err in determining whether an animal is a pup or a small yearling. This error would occur more in June than April for both ground and aerial observers.

The film count recorded about 89 percent of the maximum count of adult and subadult animals in this series, but only 64.3 percent of the pups were recorded. The total mainland pup count was 842 (7.9 percent of the total count). The estimate was 908 pups when correcting for peak hauling. However, when the estimate of 401 additional pups for those missed on the film are added, the total pup estimate was 1,309 (10.7 percent of the estimated 12,216 adults, subadults, and pups). Due to the prolonged pupping season and because some pups are missed by both aerial and ground observers, these estimates are minimal annual reproduction values and are not usable for total pup production. Future censuses will determine the value of these computations as indices of productivity.

There were 76 hauling sites (20 percent of the total) at which pups were observed (Appendix IV). Single pups (with mother) were observed at six sites, but it is not certain if these were rookery areas. A site was considered a rookery area when more than one newborn pup was present.

The principal rookery sites were, from south to north: Mugu Lagoon, Point Conception, the area between Point San Luis and Diablo Cove, the Cayucos Point area, between San Simeon and Pt. Piedras, a beach near Gamboa Point, Cypress Point and Seal Rocks in the Monterey Peninsula area, Waddell Creek and Año Nuevo Island, Mowry Slough in San Francisco Bay, Double Point, Drakes Bay, Tomales Bay, Bird Rock off Tomales Point, Sea Ranch properties in Sonoma County, Northport Cove, Hair Seal Rock, south Humboldt Bay, north Humboldt Bay, a beach area south of Endert's Beach, and Castle Rock. These 20 sites accounted for 86.5 percent of the pups observed.

May 31-June 2, 1982 Census

Weather conditions were good with clear skies and light to moderate winds and turbulence. Fog was not a problem, but several exposures were slightly blurred due to air turbulence in the central portion of the state. Fewer ground truth stations were occupied due to the flight period falling on a major holiday and many students were finishing the academic term. A total of 84 ground truth observations was recorded at 32 different hauling sites (Appendix IV).

Human disturbance occurred at only one of the ground truth-aerial direct comparison sites. The animals returned to the site and became more numerous than before the disturbance by the time the aircraft arrived.

Total Counts and Estimates

A total of 13,026 harbor seals was counted, and an estimate of 14,489 was derived from maximum daily hauling peak data. There were an additional 20 harbor seals tallied in the water by ground observers yielding a total 13,046 harbor seals counted (Table 12). There were 1,855 harbor seals tallied in the aerial-ground truth station, comparisons yielding a ground truth sample of 14.3 percent of the total count.

There were slightly fewer animals tallied in the water near the hauling sites than in April 1982 with 1.44 percent of the animals recorded by ground observers being in the water near the sites. Projecting this ratio to the total estimate yields, 211 animals were estimated in the water for an estimate of 14,700 harbor seals for the flight.

There were eight hauling sites not covered on the flight due to a mechanical failure of the camera. These sites were numbers 310 through 317 in the Sea Ranch area, Sonoma County. During April, 127 harbor seals were counted for these eight sites.

The greatest concentrations were essentially at the same areas as in April 1982 (Table 13) with the most animals recorded in Marin, Monterey, and Mendocino Counties.

Sixteen estuary and river mouth hauling sites were utilized totaling 3,830 animals (19.2 percent of the total estimate). Five ocean beach hauling sites were utilized totaling 1,329 animals for 9.0 percent of the estimate. The largest concentrations were at Drakes Estero, Northport Cove, and Double Point with 705, 612 and 566 harbor seals counted respectively.

There was an increase in clusters in the 100 to 200 group size (Table 13) compared to the April 1982 census. There were about the same numbers of animals in the 1-10 size group but fewer in clusters over 200 animals.

Rookery Areas and Adult-Pup Ratios

Ground truth tallies recorded 10.2 percent pups at 13 stations wereas only 4.1 percent of the animals tallied on the film were pups (Table 11). Some pups had grown to the extent that the first born of 1982 had approached the size of small yearlings, and these differences could not be accurately distinguished on the film, especially if the animals were wet. When the animals are dry at this time of the year, the pups of the year have bright coats whereas the yearlings possess dull brown "white" areas. Experienced observers can usually distinguish the age classes before the molt, even if individuals are the same approximate size.

Accuracy of Hauling Site Location From the Plane

A malfunction of the camera resulted in loss of eight sites, but due to this occurrence, there was a replicate of sightings of hauled out clusters from north of Haven's Neck (site #318) to Laguna Point (site #352), a distance of 90 km, encompassing 32 hauling sites.

On the first time through, it was not known that the camera was not functioning properly, and the recorder entered the number of frames taken at the sites on the maps. During the replicate flight one hour later, one of the clusters previously located was not relocated, and one additional cluster was located not previously seen. It was possible that over the hour time that lapsed between flights that the animals could have moved and that there were no site location errors, but even if one or both of the sites were in error, the clusters were small and the sighting error was negligible. There were four animals in the additional site out of the total 1,031 harbor seals tallied in these 32 sites.

DISCUSSION AND RECOMMENDATIONS

A reliable count and estimate of hauled out harbor seals can be obtained by conducting a vertical photography census during the spring months.

Possibly an index of productivity can also be derived from these data. Ground truth information is essential in this type of census.

There was a high degree of constancy of number of animals hauling out over a 4-day period of a low tide sequence. Therefore, only one day's flight is required per section of coast as long as ground truth observations are conducted to record possible disruption in the normal hauling pattern due to weather changes. Human disturbance is minimal when conducting censuses during 0.00 to +0.50 m tidal heights.

Aerial censuses do not determine the number of harbor seals that are at sea during the flight period. This unknown parameter has been acknowledged by all pinniped researchers. Animals at sea may include those that are foraging offshore for a prolonged period, and those resting in the water near a hauling site.

The fact that about a third of the usable hauling sites during each flight were not occupied by harbor seals leads to several possibilities. One is that the large majority of animals of the population are in fact actually hauled out during the flight period. Another is that if hauling sites are a limiting factor to population increase, then the Calfiornia mainland population is probably not at maximum levels. However, if rookery hauling space is specifically limiting, then the fact that a third of all hauling sites are not used is not necessarily relevant. Our census data have not revealed whether pupping areas are presently saturated, and it is not certain if this kind of information can be derived solely from aerial censuses.

The number of harbor seals not hauling out on any given day during a low tide may be a function of the availability of optimum hauling substrate. This availability can change with the tidal height and swell strength. If censuses can be conducted in comparable conditions each year, then the results will be accurate values of population trends. If hauling substrate can be a limiting factor to population growth, then as the population nears maximum levels, a relatively larger portion of the population will not be hauled out during ideal conditions.

Recommendations

A study to determine the relationship of hauling out with available hauling substrate is needed. This can be accomplished with extensive use of radio tagged animals in a zone in which all the possible hauling sites within at least 40 km of the release area can be monitored each day of a low tide sequence. Movemement between hauling sites during a low tide period has been observed by several researchers, and all sites must be covered to ensure that the animals are actually bottling and remaining in the water and not moving between sites from day to day. This type of study can be conducted at open ocean areas such as along the Monterey Peninsula.

The censuses should be continued each year to determine the trends of population growth throughout the mainland area. Vertical photography methods

are more accurate than oblique and should be continued for consistency of results. After 1983, only one "maximum count" census need be made during either June or July.

SUMMARY

Aerial Census Methods

A Cessna 185 aircraft is flown from south to north to take advantage of both the low tide period which advances up the coast and to face the usual headwinds blowing during the April-June period. The optimum altitude to fly is 600 ft (184 m). It is more difficult to locate the animals at higher altitudes, and at 600 ft, the swath of substrate recorded on the film is about 100 m wide which will encompass nearly all hauling clusters. ASA 64 Ektachrome is preferred, but when the light value (recorded on a spot meter) drops below 13, ASA 200 film is used. The camera is a Hasselblad with 100 mm lens and motor drive. All exposures are taken vertically through a 8 in. port fitted with optical glass.

Minus tides are avoided because human disturbance can bias the results along the northern coastline where abalones are sought in the intertidal zone. In central and southern California, tidepool pickers and fishermen also disturb hauling sites at minus tides. Optimum tide heights are from 0.00 to +0.50 m in the midday or afternoon. Flights are kept to about 6 days maximum to remain in the +0.50 m range, and the flight day is about 4 to 5 hours.

The film images are counted under a Wild dissecting microscope at 6 or 12 magnifications. The film is kept about 20 mm above the ground glass light diffuser. The animals are counted by placing a thin clear velum strip on the film and making a bright dot over each animal with a needle or 5 x 0 Rapidograph pen when tallying.

Two flight periods are scheduled each year. There is a peak of hauling out from June to July, and for statistical reliability, it is desired to record two data points near the annual haulout peak. One flight is conducted in April to record the peak of pupping and near the seasonal peak of hauling out, and the other can be conducted in June or July to record the peak. It is possible that inclement weather or airplane operation problems could render one of the flights unusuable, and the alternate flight could be used in population trend analysis.

Ground Truth Data

Ground truth information is essential to evaluate the accuracy of the flight and to ensure that certain key hauling sites are covered in case of human disturbance or fog. Ground counts yield hauling out patterns during the census period including the maximum number of animals hauling out on each day, the number in the water near the site, the degree of human disturbance, adult-pup ratios, and the exact number hauled out as the census plane flies over.

Ground counts should extend over at least a 3-day period at each site and are scheduled between about 1.5 before to 2.0 hours after low tide each day.

During the three flights made in 1981 and 1982, 283 ground truth stations were occupied yielding 211 data points for computation of factors to yield an estimate based on daily maximum haulout numbers. There was about a 10 percent increase in the film counts when adjusted for maximum daily haulout peaks.

Accuracy of the ground counts and photographic record as revealed by ground observations indicates that there are conservative errors in both series. Aerial counts were about 95.4 percent of the harbor seals counted on rocky substrate by ground observers. Aerial counts of harbor seals hauled out in estuaries and sandy beaches were 106.2 percent of the ground counts. Aerial counts were 101.6 percent of the ground counts for all flights and substrates. A high percentage of the animals missed on the film were pups in rocky areas. The lower counts of ground observers in estuaries were due to the low oblique viewing of large concentrations of animals.

June 1981 Census

This census was exploratory, and a total haulout count was not achieved. Camera failure, dangerous turbulent winds, fog, and inexperience in the airplane and ground truth procedures all contributed to an incomplete census. Valuable information was gathered to develop a routine annual census. Delineation of hauling sites and rookery areas was made over most of the mainland coast, and valid aerial and ground counts were recorded for 96 of the total 426 known mainland hauling sites.

April 1982 Census

The aerial count was 10,669 harbor seals. All hauling sites were covered except for the high tide sites in San Francisco Bay. The total estimate adjusting for daily maximum peak and animals in the water near the sites was 11,815 harbor seals. The ground truth sample was 25.5 percent of the total count.

About 60 percent of the mainland population was tallied north of San Francisco with only about 5 percent recorded below Pt. Conception. By county, the largest concentrations were in Marin, San Luis Obispo, Mendocino, and Humboldt Counties. Nearly half of the harbor seals were in clusters of greater than 100 animals. Only three percent of the animals were in groups of from 1 to 10 animals demonstrating the strong social clustering behavior of this species.

A total of 842 newborn pups was tallied for all hauling sites. Pups, when they are wet, are difficult to distinguish on dark rocky and algal substrate with the result that 36 percent of the pups observed by ground counters were missed on the film. The estimate of pups for the flight was 1,309 (10.8 percent of the total estimated 12,076 adults, subadults, and

pups). These are minimal estimates in that both the aerial and ground counts miss animals, especially pups. Pup data are not considered to represent an index of annual productivity.

May-June 1982 Census

A total of 13,026 harbor seals was counted, and an estimate of 14,485 was derived from daily maximum count data. There were an additional 20 harbor seals tallied in the water near hauling sites by ground observers yielding an aerial count of 13,046 animals. The total estimate, including animals observed in the water, was 14,700 harbor seals. There were eight sites not censused due to camera failure, and, if these had been covered, the total estimate would probably have been at least 15,000 animals. The ground truth sample count was about 14.3 percent of the total count.

Pup data were not reliable from aerial exposures in that the earliest born pups had approached the size of the slow growing 1981 pups and could not be accurately distinguished. Ground observers also had difficulty in identifying pups.

About 33 percent of the known hauling sites were not occupied by harbor seals during this flight. Good weather conditions, including low swells, could not account for this lack of widespread use of hauling sites. A study is needed to investigate the number of animals not hauling out during the day.

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The list of those who contributed to development of statistical techniques, and ground truth observations is too long to list here, involving 97 individuals. This type of census which utilizes a large number of ground observations to collect data to evaluate the aerial counts has been highly successful. Without these helpful students, librarians, State and federal employees, academic instructors, and naturalists, our censuses would not have been possible. To all these people who have contributed to our efforts, a hearty thanks is given.

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Table 1. Low tide heights in the April 15-24, 1982 flight period demonstrating the "Window" used in the census with actual tidal heights given for the beginning and ending of each day's flight.

Date	On Los Angeles		On San Francisco		On Humboldt Bay		Actual tidal heights (m)	
	Time	Ht (m)	Time	Ht (m)	Time	Ht (m)	start	ending
15	0917	0.2	1029	0.2	1121	0.2		
16	1031	0.2	1133	0.2	1223	0.2		
17	1124	0.1	1235	0.1	1322	0.2		
18	1159	0.0	1325	0.1	1417	0.2	0.18	0.07
19	1235	0.0	1409	0.0	1503	0.1	0.33	0.20
20	1303	0.0	1451	0.0	1543	0.1	0.19	0.45
21	1335	0.0	1529	0.1	1625	0.2	0.33	0.13
22	1403	0.1	1608	0.2	1701	0.2	0.37	0.27
23	1435	0.1	1647	0.2	1740	0.3		
24	1511	0.2	1726	0.4	1821	0.5		

_____ = Flight Day

Table 2. Number and percent of mainland (including Farallon Islands) harbor sea hauling sites and maximum known number and percent of animals recorded* in these sites.

Substrate type	Hauling Sites Number	Hauling Sites Percent	Maximum Count Number	Maximum Count Percent
Offshore Rock	226	53.1	7556	39.4
Extended Reef	110	25.8	3968	20.7
Harbor and Estuary	23	5.4	3585	18.7
Ocean Beach	17	4.0	2144	11.2
Extended Reef+ Offshore Rock	12	2.8	764	4.0
Offshore Rock+ Onshore Rock	2	0.5	107	0.6
Logs, Floats	22	0.5	33	0.1
Undetermined	14	3.3	229	1.2
Totals	426	100.1	19,165	100.0

*Data sources for maximum counts included CDFG censuses; BLM-OCS censuses, (Michael Bonnell, pers, commun.); Sarah Allen, Point Reyes Bird Observatory; Gary Fellers, Pt. Reyes National Seashore; Lyman Fancher, Audubon Society; Ron Jameson and Jim Bodkin, Fish and Wildlife Service, Pt. Piedras Blancas.

Table 3. Replicate maximum ground counts of harbor seals at certain hauling sites in the June 1981, April 1982, and May-June 1982 censuses.

Site number	June 1981 Day 1	2	3	4
2	23	25	18	-
4	92	96	-	-
142	16	25	30	-
145	13	11	12	-
147	19	37	48	-
152	42	41	-	-
153	32	37	34	-
154	39	26	37	-
155	44	45	33	-
157	135	155	-	-
162	84	86	94	-
165	22	25	-	-
393	79	86	-	-
Total June 1981				
2-day:	640	695		
3-day:	270	292	306	
	April 1982			
3	17	19	13	14
5	30	21	19	-
6	15	26	21	-
7	29	14	24	31
11	199	216	215	216
74	35	40	33	30
78	47	30	54	53
79	38	43	42	34
142	12	11	13	-
145	20	23	-	-
147	22	23	-	-
152	28	22	29	35
153	16	16	14	-
157	138	145	145	141
160	30	32	30	31
161	11	7	17	-
162	101	97	100	88
165	1	33	21	0
166	86	41	85	64
169	32	39	32	28
174	57	74	84	86
175	80	76	74	81
190	16	16	19	10
192	25	34	24	15
215	14	12	17	5
262	190	164	174	-

Haulout number	April 1982 Day 1	2	3	4
422	51	48	45	48
Total April 1982				
2-day:	1340	1322		
3-day:	1298	1276	1344	
4-day:	1024	1031	1086	1010
	May-June 1982			
3	5	6	3	-
4	71	84	85	-
11	392	387	412	-
79	32	49	-	-
83	48	58	-	-
152	42	36	24	-
154	58	47	43	-
157	145	121	137	-
161	49	41	44	-
162	129	129	149	-
165	5	28	52	-
166	97	133	138	-
169	39	37	-	-
175	53	53	-	-
188	10	9	8	-
190	23	31	39	-
192	1	0	0	-
202	25	26	31	-
221	570	541	615	-
225	516	474	416	-
399	71	71	68	76
422	50	54	54	-
Total May-June 1982				
2-day:	2431	2415		
3-day:	2259	2218	2318	
4-day:	71	71	68	76
Total All Censuses				
2-day:	4411	4432		
3-day:	3827	3786	3968	
4-day:	1095	1102	1154	1086

Table 4. Expansion factors derived from maximum counts by ground observers to estimate hauled out harbor seals.

Hours from low tide	Rocky Areas size groups 1-10	11-30	31-60	61+	Estuary and sandy beach
Before Low Tide					
0.00	1.19	1.14	1.11	1.06	1.06
0.25	1.23	1.16	1.14	1.08	1.06
0.50	1.22	1.20	1.15	1.09	1.05
0.75	1.25	1.25	1.16	1.10	1.05
1.00	1.27	1.28	1.18	1.12	1.06
1.25	1.27	1.28	1.18	1.15	1.09
1.50	1.32	1.25	1.20	1.22	1.09
1.75	1.43	1.22	1.32	1.28	1.08
2.00	1.59	1.23	1.56	1.41	1.08
2.25	1.67	1.25	1.79	1.49	1.10
2.50	-	1.28	-	1.59	1.12
After Low Tide					
0.25	1.15	1.14	1.10	1.06	1.08
0.50	1.15	1.14	1.10	1.06	1.08
0.75	1.20	1.14	1.11	1.06	1.08
1.00	1.23	1.15	1.11	1.05	1.06
1.25	1.22	1.18	1.12	1.05	1.08
1.50	-	1.20	1.14	1.04	1.08
1.75	-	1.22	1.19	1.05	1.08
2.00	-	1.23	1.22	1.09	1.08
2.25	-	1.20	1.22	1.10	1.09
2.50	-	1.19	1.20	1.12	1.10

Table 5. Comparison of instantaneous aerial and ground counts on rocky and estuarian substrates, April 1982.

Hauling site number	Aerial Count			Ground Count		
	Adult	Pup	Total	Adult	Pup	Total
Rocky Substrate						
7	13	0	13	12	2	14
9	0	0	0	0	2	2
74	27	3	30	25	5	30
78	51	0	51	48	2	50
79	40	5	45	38	4	42
142	10	0	10	8	3	11
145	25	0	25	22	1	23
148	27	4	31	25	5	30
152	20	2	22	24	2	26
156	9	2	11	10	4	14
157	138	6	144	137	7	144
160	28	0	28	27	0	27
161	4	0	4	7	0	7
165	30	0	30	28	0	28
169	37	0	37	39	0	39
171	11	0	11	10	2	12
262	21	0	21	23	0	23
393	16	0	16	16	0	16
Total Rocky Substrate	507	22	529	499	39	538
Percent Aerial/Ground	101.6	56.4	98.3			
Estuarian and Sandy Beach Substrate						
205	226	57	283	212	61	273
221	314	59	373	254	80	334
225	486	34	520	489	11	500
Total Estuary and Sandy Beach	1026	150	1176	955	152	1107
Percent Aerial/Ground	107.4	98.7	106.2			
Total All Substrates:	1533	172	1705	1454	191	1645
Percent Aerial/Ground	105.4	90.0	103.6			

Table 6. Comparison of instantaneous aerial and ground counts on rocky and estuarian substrates, May-June 1982, and summation of the April and May-June censuses.

Hauling site number	Aerial Count			Ground Count		
	Adult	Pup	Total	Adult	Pup	Total
Rocky Substrate						
7	53	0	53	39	0	39
11	284	4	288	309	31	340
79	48	0	48	48	0	48
152	32	0	32	30	5	35
165	28	0	28	28	0	28
166	126	2	128	125	3	128
190	20	0	20	20	1	21
192	9	0	9	10	0	10
202	21	0	21	24	1	25
294	16	0	16	17	0	17
Total Rocky Substrate	637	6	643	650	41	691
Percent Aerial/Ground	98.0	14.6	93.1			
Estuarian and Sandy Beach Substrate						
225	463	46	509	454	22	476
Percent Aerial/Ground	102.0	209.1	106.9			
April and May-June Counts Combined						
Rocky Substrate	1144	28	1172	1149	80	1229
Percent Aerial/Ground	99.6	35.0	95.4			
Estuarian and Sandy Beach Substrate	1489	196	1685	1409	174	1583
Percent Aerial/Ground	105.7	112.6	106.2			
Totals:	2633	224	2857	2558	254	2812
Percent Aerial/Ground	102.3	88.1	101.6			

Table 7. Ground truth station* collection and application of the June 1981, April 1982, and May-June 1982 harbor seal censuses.

	June 1981	April 1982	May-June 1982
Number of volunteers	23	69	45
Number of different hauling sites where ground truth stations were recorded	20	45	32
Total number of stations collected during flight period	50	149	84
Number of stations for which there is an aerial count for direct-comparison (Appendix III)	7	32	25
Number of stations useable for computation of maximum estimates (Table 3)	36	110	65
Number of stations useable for replicate variation analysis (Table 2)	13	27	22
Disturbance:			
Number of different hauling sites	3	18	5
Total number of all stations	5	27	6
Percent Disturbance	**	18%	7%
Number of sites disturbed in direct comparison with an aerial count	**	6	1
Approximate number of harbor seals considered lost to the census due to disturbance (Table 8).	**	300	insignificant

* A station is a ground count made at a hauling site on one day. At several hauling sites, stations were made for up to 4 consecutive days.

** Many hauling sites north of San Francisco were disturbed during the early morning census, and no valid data are available to estimate this loss for the flight.

Table 8. Human disturbance of hauled out harbor seals at six ground truth stations during the April 1982 flight.

Haulout number	Location	Possible number of animals lost in count	Remarks
4	Mugu Lagoon	0	The maximum peak had taken place before helicopter disturbance and after the census plane had departed.
5	Standard Oil Pier, Carpinteria	8	The area was disturbed before the flight period. Eight animals were hauled out the next day.
10	Ellwood, N. of Goleta	20	The area was disturbed before the flight started. Twenty animals were in the water when the plane flew over.
221	Double Point, Pt, Reyes Nat. Seashore	200	A sailing boat was lost at sea and had drifted onto the center of the beach. There was much human disturbance and about 200 animals may have been kept off the beach. Some may have gone to nearby hauling sites.
225	Drakes Bay	20	A canoe came by the hauled out animals and frightened about 100 into the water. They began hauling out again and by the time the plane arrived about 80 had returned.
262	Russian River Spit	50	Harbor seal watchers (public) frightened about 50 animals into the water. There was not time for them to haul out again or move to an alternative site.
Total		298	

Table 9. Counts and estimates of harbor seals by county, the Farallon Islands, and San Francisco and San Pablo Bays in the April 1982 census.

County	Count			Estimate			
	Adult	Pup	Total	Adult	Pup	Total	Percent
San Diego	19	0	19	19	0	19	0.2
Ventura	38	5	43	38	5	43	0.4
Santa Barbara	419	28	447	442	31	473	4.1
San Luis Obispo	1262	64	1326	1482	82	1564	13.4
Monterey	1319	39	1358	1423	44	1467	12.6
Santa Cruz	283	9	292	286	9	295	2.5
San Mateo	398	6	404	435	7	442	3.8
Farallon Islands	51	0	51	51	0	51	0.4
San Francisco-San Pablo Bays	263	60	323	284	65	349	3.0
Marin	1892	214	2106	2004	217	2221	19.0
Sonoma	963	20	983	1112	21	1133	9.7
Mendocino	1238	124	1362	1380	131	1511	12.9
Humboldt	1131	224	1355	1229	242	1471	12.6
Del Norte	550	50	600	582	54	636	5.4
Totals	9827	842	10669	10767	908	11675	100.0

Table 10. Number of hauling sites (HS) and number of harbor seals by size groups along the mainland coast of California in the April 1982 census.

Group size	San Diego, Ventura, S. Barbara		San Luis Obispo		Monterey		Santa Cruz, San Mateo		Marin S.F. Bay, Farallon I		Sonoma		Mendocino		Humboldt, Del Norte		Total	
	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total
1	0	0	2	2	1	1	0	0	0	0	2	2	1	1	2	2	8	8
2	1	2	0	0	3	6	0	0	1	2	3	6	3	6	0	0	11	22
3	1	3	1	3	0	0	0	0	2	6	2	6	0	0	1	3	7	21
4	0	0	0	0	2	8	1	4	0	0	1	4	1	4	1	4	6	24
5	0	0	1	5	2	10	0	0	2	10	1	5	2	10	1	5	9	45
6	0	0	0	0	2	12	0	0	0	0	1	6	1	6	0	0	4	24
7	0	0	0	0	2	14	0	0	1	7	0	0	0	0	0	0	3	21
8	1	8	3	24	0	0	0	0	0	0	1	8	0	0	0	0	5	40
9	0	0	2	18	0	0	1	9	0	0	1	9	1	9	0	0	5	45
10	0	0	1	10	1	10	0	0	1	10	4	40	0	0	2	20	9	90
1-10	3	13	10	62	13	61	2	13	7	35	16	86	9	36	7	34	67	340
11-20	5	81	13	205	7	101	2	32	6	84	6	83	6	92	3	46	48	724
21-30	0	0	9	226	9	235	6	129	2	53	8	216	8	200	2	54	44	1113
31-40	0	0	3	105	4	139	2	72	3	114	3	97	7	245	1	32	23	804
41-50	1	43	3	132	0	0	4	177	0	0	0	0	3	132	1	43	12	527
51-60	1	60	1	53	1	51	2	117	3	163	1	55	1	58	1	56	11	613
61-70	1	70	2	135	1	61	0	0	0	0	0	0	1	63	2	129	7	458
71-80	0	0	2	151	1	71	2	156	0	0	0	0	0	0	0	0	5	378
81-90	0	0	3	257	0	0	0	0	0	0	1	87	1	85	0	0	5	429
91-100	0	0	0	0	1	100	0	0	0	0	0	0	1	97	0	0	2	197
101-200	0	0	0	0	2	273	0	0	3	402	3	359	0	0	2	247	10	1281
201-300	1	242	0	0	1	266	0	0	1	283	0	0	0	0	2	471	5	1262
301-400	0	0	0	0	0	0	0	0	1	338	0	0	1	354	1	325	3	1017
401-500	0	0	0	0	0	0	0	0	1	465	0	0	0	0	0	0	1	465
501-600	0	0	0	0	0	0	0	0	1	543	0	0	0	0	1	518	2	1061
Totals	12	509	46	1326	40	1358	20	696	28	2480	38	983	38	1362	23	1955	245	10669

Table 11. Adult-pup ratio comparisons between aerial and maximum ground counts in the April and May-June 1982 censuses.

Haulout No.	Aerial Adult	Aerial Pup	Aerial Total	Aerial %	Maximum Ground Count* Adult	Maximum Ground Count* Pup	Maximum Ground Count* Total	Maximum Ground Count* %
April								
4	23	4	27	14.8	38	5	43	11.6
74	27	3	30	10.0	28	5	33	15.2
142	10	0	10	0.0	8	3	11	27.3
144	16	0	16	0.0	27	1	28	3.6
145	25	0	25	0.0	24	1	25	4.0
148	27	4	31	12.9	29	7	36	19.4
152	20	2	22	9.1	26	3	29	10.3
157	138	6	144	4.2	138	7	145	4.8
175	63	3	66	4.5	73	3	76	3.9
205	226	57	283	20.1	212	61	273	22.3
221	224	56	280	20.0	334	131	465	28.2
225	486	34	520	6.5	507	36	543	6.6
Totals	1285	169	1454	11.6	1444	263	1707	15.4
May-June								
4	78	4	82	4.9	79	6	85	7.1
11	284	4	288	1.4	346	41	387	10.6
152	32	0	32	0.0	32	9	41	22.0
157	109	1	110	0.9	132	13	145	9.0
160	22	0	22	0.0	21	2	23	8.7
161	44	0	44	0.0	45	4	49	9.0
162	129	4	133	3.0	122	7	129	5.4
166	126	2	128	1.6	136	2	138	1.4
190	20	0	20	0.0	22	1	23	4.3
202	21	0	21	0.0	24	1	25	4.0
221	508	28	536	5.2	476	90	566	15.9
225	594	58	652	7.1	491	25	516	4.8
382	480	3	483	0.6	221	44	265	16.6
Totals	2447	104	2551	4.1	2147	245	2392	10.2

*Maximum counts were usually larger than the instantaneous ground-aerial counts (see Tables 5 and 6).

Table 12. Counts and estimates of harbor seals by county, the Farallon Islands, and San Francisco and San Pablo Bays in the May-June 1982 census.

County	Count			Estimate			
	Adult	Pup	Total	Adult	Pup	Total	Percent
San Diego	6	0	6	6	0	6	
Ventura	79	6	85	79	6	85	0.6
Santa Barbara	586	48	634	657	49	706	4.9
San Luis Obispo	1635	17	1652	1841	19	1860	12.8
Monterey	1781	74	1855	2119	92	2211	15.3
Santa Cruz	435	14	449	479	14	493	3.4
San Mateo	674	23	697	751	28	779	5.4
Farallon Isls.	47	3	50	47	3	50	0.3
San Francisco-San Pablo Bays	344	13	357	365	13	378	2.6
Marin	2363	221	2584	2517	224	2741	18.9
Sonoma	1033	22	1055	1224	26	1250	8.6
Mendocino	1766	110	1876	1921	115	2036	14.1
Humboldt	1209	31	1240	1265	37	1302	9.0
Del Norte	484	2	486	590	2	592	4.1
Totals	12442	504	13026	13861	628	14489	100.0

Table 13. Number of hauling sites (HS) and number of harbor seals by size groups by county along the mainland coast of California in the May 31-June 2, 1982 census.

Group size	San Diego, Ventura, S. Barbara		San Luis Obispo		Monterey		Santa Cruz, San Mateo		Marin S.F. Bay, Farallon I		Sonoma		Mendocino		Humboldt, Del Norte		Total	
	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total	HS	Total
1	0	0	1	1	7	7	5	5	6	6	6	6	2	2	1	1	28	28
2	0	0	0	0	1	2	0	0	0	0	2	4	0	0	1	2	4	8
3	0	0	0	0	1	3	3	9	0	0	0	0	0	0	0	0	4	12
4	0	0	2	8	0	0	0	0	2	8	2	8	2	8	0	0	8	32
5	0	0	0	0	1	5	0	0	0	0	0	0	1	5	0	0	2	10
6	1	6	1	6	3	18	0	0	0	0	0	0	0	0	0	0	5	30
7	0	0	1	7	4	28	2	14	1	7	0	0	1	7	0	0	9	63
8	0	0	1	8	1	8	1	8	1	8	4	32	0	0	0	0	8	64
9	1	9	1	9	2	18	1	9	0	0	1	9	1	9	0	0	7	63
10	0	0	0	0	3	30	1	10	1	10	0	0	0	0	1	10	6	60
1-10	2	15	7	39	23	119	13	55	11	39	15	59	5	29	3	13	79	368
11-20	2	36	5	80	8	115	2	25	1	12	5	79	8	120	2	29	33	496
21-30	1	24	7	177	7	181	5	127	0	0	2	54	3	84	1	21	26	668
31-40	1	38	3	102	4	145	3	107	2	65	2	79	5	166	0	0	20	702
41-50	2	87	5	225	4	177	2	89	1	50	3	141	4	185	2	94	23	1048
51-60	1	53	5	279	2	112	1	53	2	113	2	103	5	266	0	0	18	979
61-70	0	0	1	67	0	0	2	139	1	64	1	64	0	0	0	0	5	334
71-80	0	0	0	0	1	71	1	71	0	0	0	0	0	0	1	76	3	218
81-90	1	85	0	0	0	0	0	0	5	434	0	0	1	84	1	87	8	690
91-100	0	0	0	0	2	190	0	0	0	0	0	0	0	0	0	0	2	190
101-200	0	0	5	683	5	745	4	480	5	740	4	476	2	359	3	432	28	3915
201-300	0	0	0	0	0	0	0	0	1	256	0	0	0	0	2	491	3	747
301-400	1	387	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	387
401-500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	483	1	483
501-700	0	0	0	0	0	0	0	0	2	1218	0	0	1	583	0	0	3	1801
Totals	11	725	38	1652	56	1855	33	1146	31	2991	34	1055	34	1876	16	1726	253	13026

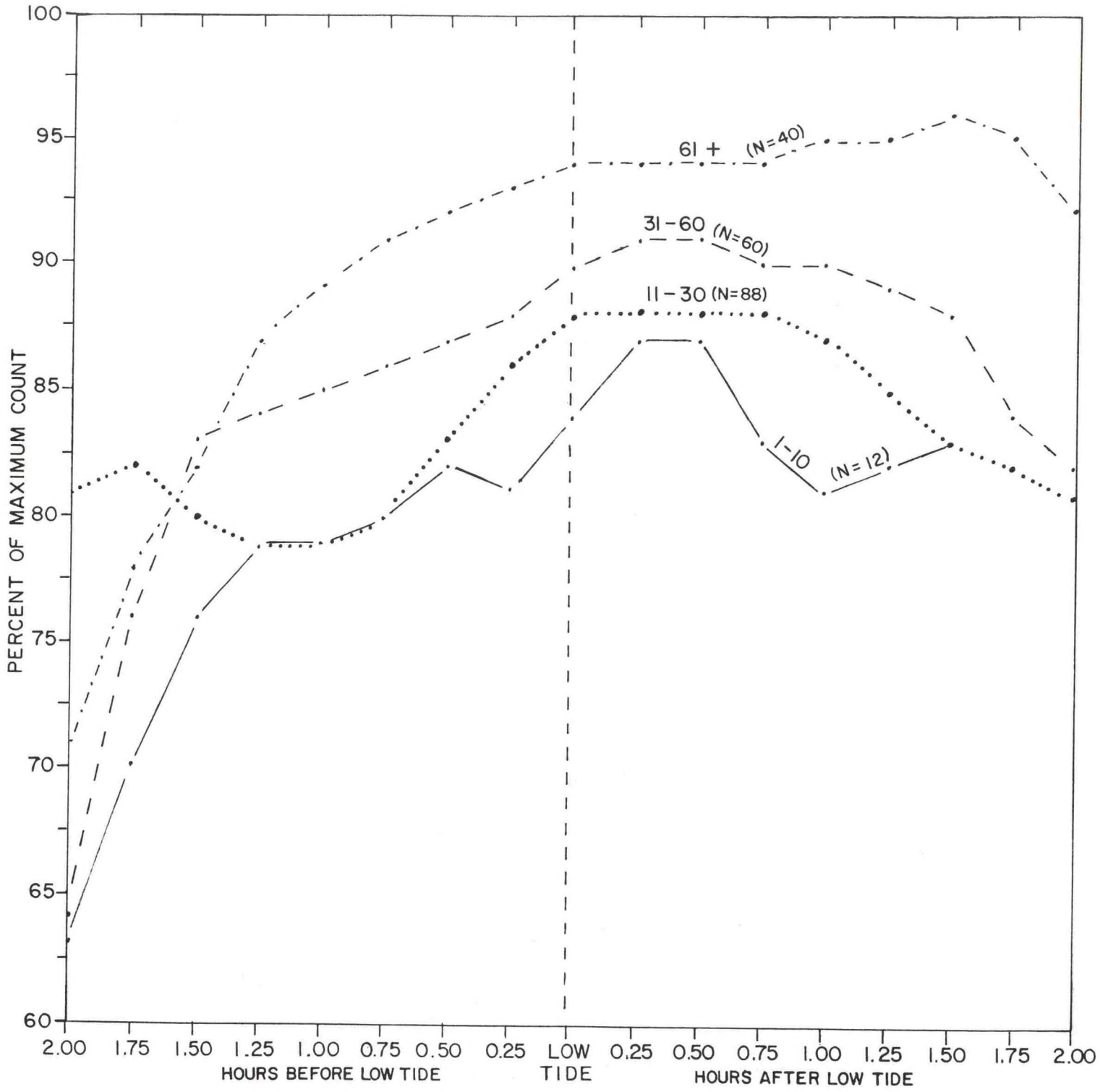

FIGURE 1. Mean percent of harbor seals hauled out on rocky substrate during 0.00 – +0.50 m low tides at quarter hour intervals from 2 hours before to 2 hours after low tide by 1-10, 11-30, 31-60, and 61 + group sizes.

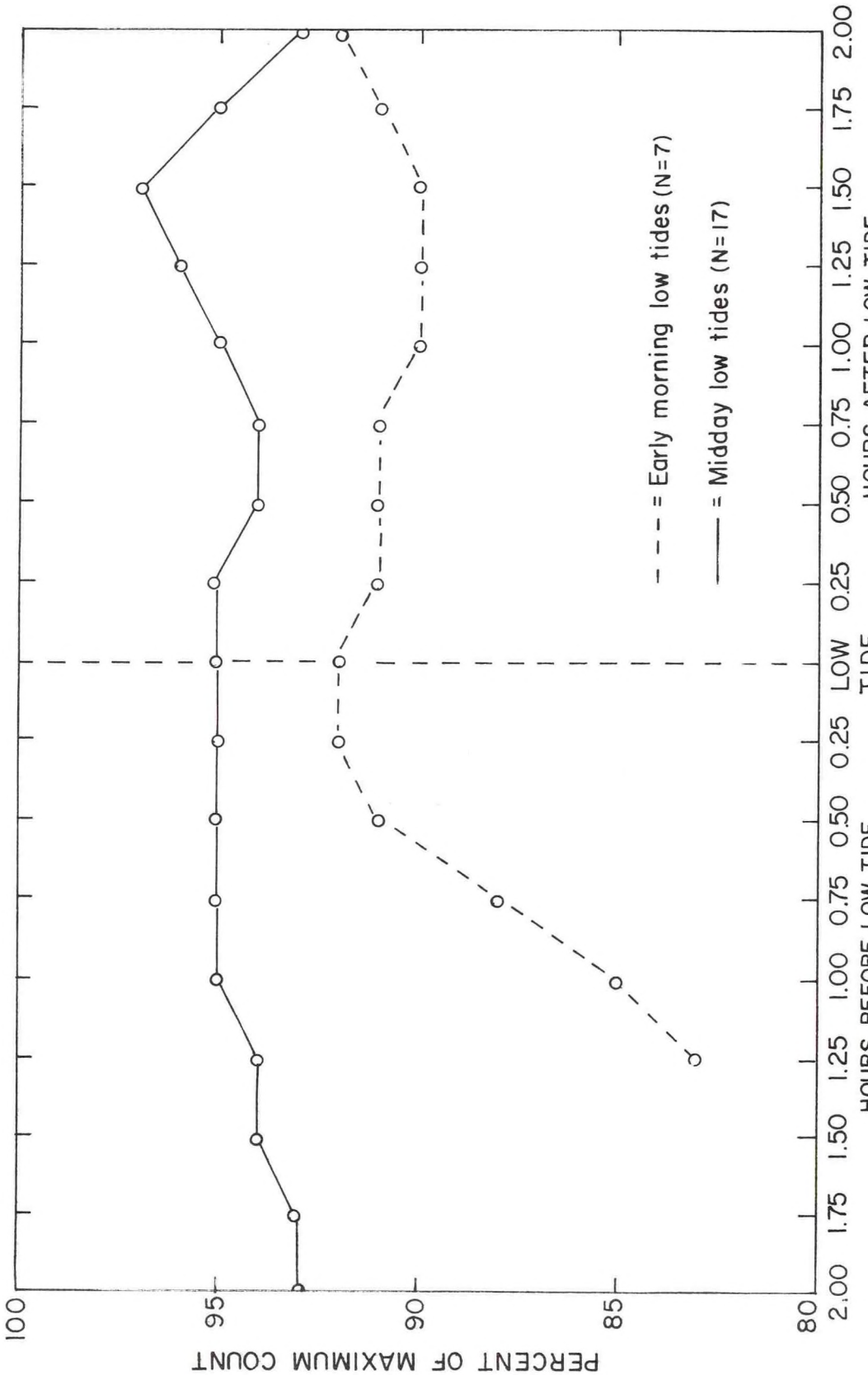

FIGURE 2. Mean percent of harbor seals hauled out in estuaries at quarter hour intervals from 2 hours before to 2 hours after low tides during early morning and midday.

PART II
HARBOR SEAL CAPTURE EXPERIMENTS

Daniel Miller, John Scholl, Michael Herder and Jack Ames

California Department of Fish and Game
Marine Resources Branch
Marine Resources Laboratory
Monterey, California 93940

HARBOR SEAL CAPTURE EXPERIMENTS

OBJECTIVES

Harbor seal capture and tagging experiments were designed for the Klamath River. The purpose of the study was to investigate the use of the underwater acoustic harassment device as a management tool for the Klamath River. Part of this study was to determine seasonal distribution of harbor seals present during the summer and fall salmon run. The experiment had to be completed in a short period of time to coincide with the July-October salmon run period. Therefore, the study necessitated a highly organized and successful capturing operation and availability of operating acoustic devices.

The permit to capture harbor seals was not received until the end of August 1981 and due to budgetary problems, the capture gear was not available until September. Consequently, it was not possible to conduct the Klamath River experiments in FY 1981-82 other than to determine the feasibility of the acoustic device (see next section) and to develop capture techniques. Permit No. 351 was amended (December 1981) to include capture of 12 additional harbor seals for radio tagging, totaling 40 animals for the Klamath River.

RESULTS

It was not feasible to utilize the pelage attachment of radio tags until after the molt which occurs from late June until mid-August in this area. Experiments in May and June, 1981 were designed to enable capture of animals in an efficient manner so that a large number of the harbor seals required for the acoustic harassment study could be captured immediately before the appearance of the salmon run. Five animals were captured in June 1981, but only streamers and rototags were attached.

Capture experiments in May 1981 were designed to develop how to lay out the capture net and to determine if harbor seals could be driven into the net with the acoustic device. It was originally planned to capture the animals by rapidly laying out the net adjacent to hauled out animals at the north spit. This method has been developed in the Columbia River fishery-marine mammal interaction study (Beach et al., 1981). Continual disturbance of the animals at the north spit in the Klamath River preclude use of this method and alternate methods were used.

The first phase of the capture experiments was to determine the behavior of the animals when being driven from upriver with use of the acoustic device. Some animals rest in the "estuary" area when they are not hauled out at the sand spits at the river mouth or on rocky areas north of the river on the outer coast. The usual natural distribution pattern is when the animals are frightened off the spits by the first fishermen at daybreak (if they are hauling out that night), about 20 to 30 of the 100-300 animals usually present in summertime will move to the estuary area (Figure 1) where they will rest by bottling or will engage in interaction activity. Some of these animals

remained in the area throughout the day, but others would travel upriver to forage at gill nets at the Department of Fish and Game seining site or frequent the riffle above the bridge where recreational fishermen were active. When traveling downriver, the usual pattern was to remain near the southern river bank.

First acoustic device driving attempts were made to force the animals into a side channel on the south bank. The capture net was placed at an area where the channel narrowed and when an animal was driven past this point, the net was to be laid across the channel entrapping the seal (Figure 1, site A). On two occasions a harbor seal was driven back into the channel but would not go beyond a certain point (Figure 3, site B) which was not beyond the netting area. Even though the device skiff was within 3 m of the animals, they remained close to the bank with their heads out of the water and would rather bear the sounds than be forced farther up the channel. Once when the skiff passed them, they swam rapidly out of the river.

The usual response of harbor seals in the river estuary area was to immediately splash at the surface and disappear from view when the device was activated. Animals as far away as 300-400 m would respond as much as those closer. Most of the animals would not reappear at the surface, and it was assumed they went out the river mouth about 2.0 km downriver. Subsequent experiments in FY 1982-83 confirmed this behavior of leaving the area by traveling along the southern river bank without surfacing for most of the animals. Some of the animals did remain within 50 to 100 m of the device skiff and would surface several times before reaching the river mouth area. Occasionally, an animal would remain in the shallow water areas where they apparently were in a zone where the acoustic sounds may have been dampened in strength due to topography. There appeared to be one or two animals that were not as affected by the device as were the others.

The skiff with the device activated was maneuvered back and forth across the southern half of the river attempting to drive the animals into the open segment of the capture net. On most occasions, when an animal was captured, the harbor seal would not be seen since the initial activation of the device until it was seen surfacing in the net attempting to find a way out. On several occasions, an animal would be seen traveling toward the net making periodic surfacing to look at the device skiff. Continued slow pursuit of the animal would drive it into the net area in most cases.

The capture net was of 10 in stretched mesh, of #16 green dyed nylon thread, 100 m in length and 3 m depth. The floats were spaced at 1.5 m intervals and were large enough to preclude looping into the mesh. The bottom line was weighted line rather than rope with lead weights. The method of net laying out and pulling is described below.

After the unsuccessful attempts to drive the animals up the side channel, the net was placed at the mouth of the side channel with the opening facing downriver (Figure 1, site C) in hopes that the animals could again be driven up the channel a short distance into the net and then pull the open end to the shore. After four attempts, the animals could be driven into the area but

except for one occasion, they swam into the outside of the net from upriver, came around the net on the outside, and continued down river.

The next placement (Figure 1, site D) took advantage of the behavior to swim down the southern edge of the main channel by facing the open end of the net upriver (Figures 1 and 2). On the first attempt with the acoustic device in this new site, three animals were captured. Two more were captured on subsequent sets. Subsequent experiments in placement of nets and use of a "fence" to herd animals tending to travel downriver in deeper water from the bank were developed in FY 1981-1983, but the results will be presented here to complete the description of this operation.

The fence was of netting borrowed from Peter Howorth (Santa Barbara) and from webbing purchased for this purpose of the same size mesh and twine as in the capture net. The distal (upriver) end of the capture net was attached to the downriver end of the fence by a release mechanism (Figure 4) which was tripped from shore by use of a 3/8 in line. When the pin was pulled from between the metal rings attached to each net, the nets were free except for a thin cotton string which was threaded into the meshes of the two nets to prevent harbor seals from passing through this small aperature. The string was easily broken, and the nets were free within seconds of the initial pulling operation. The fence section was anchored at both ends. After each capture attempt, the capture net section was put aboard the net skiff, taken to the downriver end of the fence net, laced together with string and the release mechanism, then laid out downriver to the shore forming a cul-de-sac.

Harbor seals were able to pass through a small unlaced area between the nets, and it is not known how many animals were lost in this manner until it was noticed from shore. Of the 32 harbor seals known to enter the capture net section, five escaped over the corks, one escaped back out the opening when the net snagged on a submerged piece of driftwood, two escaped before the mouth of the net could be brought to shore, and two apparently went under the weighted bottom line when the cork line was pulled in ahead of the lead line (Figure 2D). One additional animal was drowned in the fence section. This was the only mortality in the tagging operation.

One of the more important aspects of the capture operation was to use a truck with 4-wheel drive to pull the distal (upriver) end (and later the center pull line) to shore when animals appeared in the capture section.

This could only be done, however, when there were not too many people and other vehicles in the way. The center pull line was used because most of the animals were beached in the section of the net farthest downriver. By pulling in the center line, only half of the net needs to be beached. This was of importance when the truck could not be used. The animals rarely become entangled in the meshes. The net acts as a beach seine, and it is not difficult to remove the animals from the capture net and place them in the holding hoops which are pegged down in the sand with the animals within awaiting their turn to be processed. These hoops were developed by researchers in Oregon and Washington and resemble large 2 m socks of small, strong mesh tied to 1 m hoops.

When using the truck, the net could be pulled to shore and the animals beached within about 5 min. The optimum number of people to have on hand to capture and tag harbor seals in this operation would be about 10. On the day 15 animals were captured in one set, only 6 persons were present (only 5 were present most of the time). However, with the use of the truck to pull the net to shore and with sufficient hoops to hold the 11 animals that did not escape, it took an average of 18 min to weigh, measure, attach roto tags on the flippers, and attach radios and streamers with epoxy to each animal.

It was discovered that one acoustic harassment device was actually better for driving the animals than when using two, one from each skiff. It was theorized that two devices, one being moved downriver close to shore, and the other being kept about mid-river would enhance driving the animals along the shore into the net. In several instances when the animals could be watched from shore, the directional ability to drive the animals was lost when using two devices. In one case, instead of the animal going down the edge of the river toward the net, the two devices actually drove the animal out of the water onto the bank where it had to be chased back into the water by one of the skiff operators. The most efficient operation was to drive the animals with one device at high tide from the estuary area, place a 100 m fence out into the river to herd the animals toward shore, and use two lines attached to the capture net pulled in by a truck.

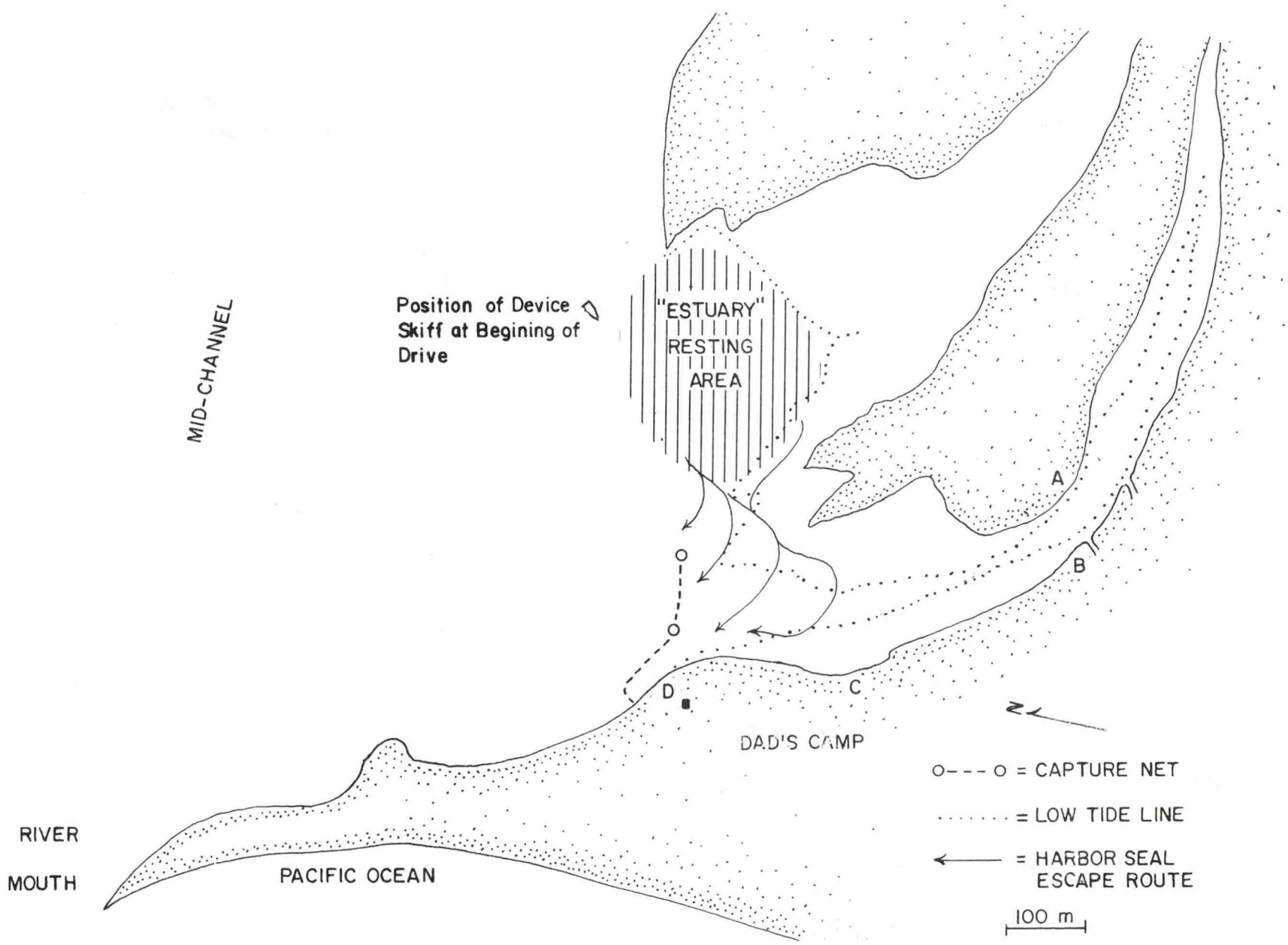

FIGURE 1. Harbor seal capture area in the Klamath River.

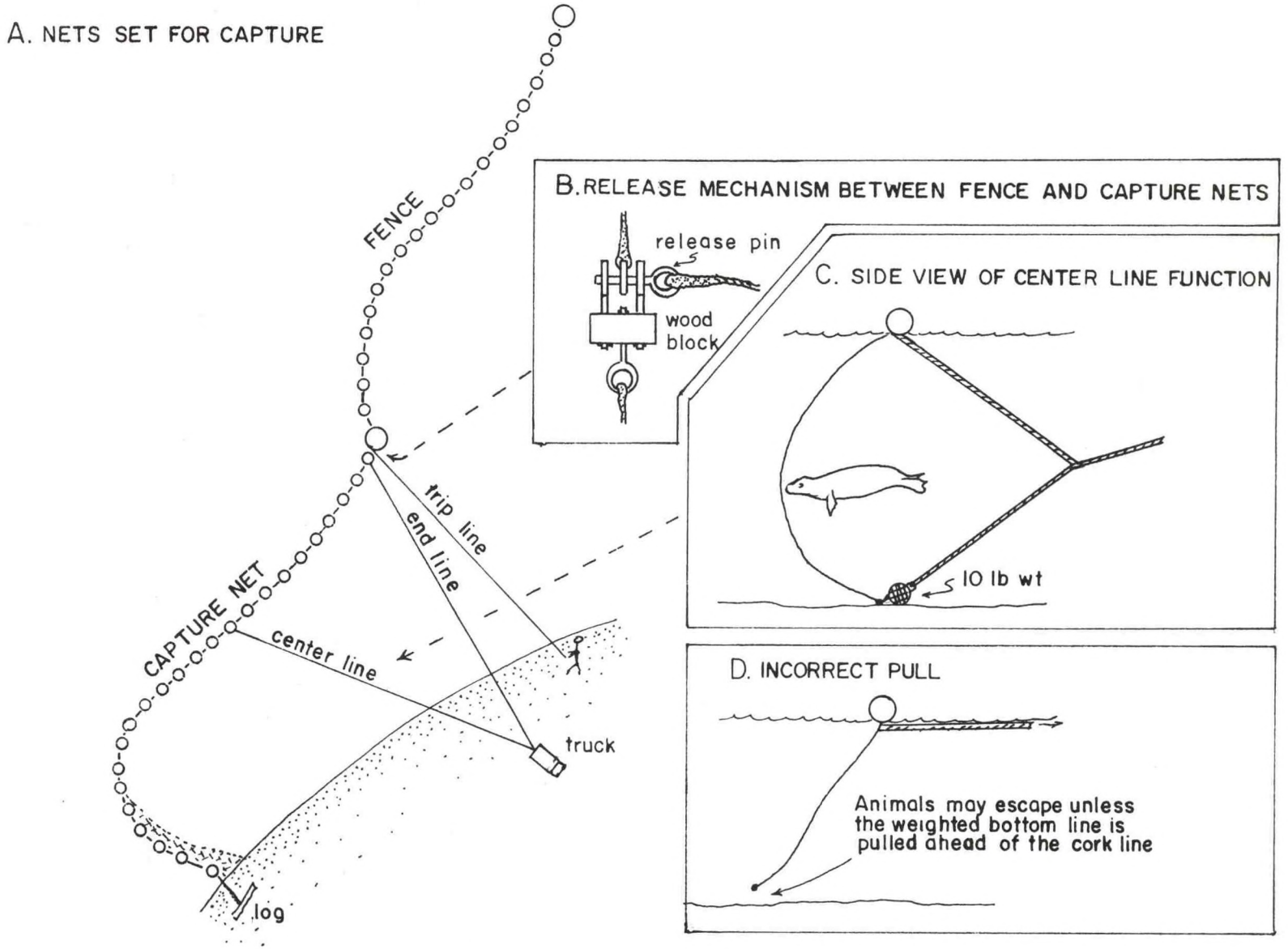

FIGURE 2. Description of: (A) placement of capture and fence net sections, (B) the release mechanism, (C) function of the center pull line, and (D) incorrect pulling.

PART III
ACOUSTIC HARASSMENT EXPERIMENTS ON HARBOR SEALS IN THE KLAMATH RIVER, 1981

Bruce Mate

Oregon State University
Marine Science Center
Newport, Oregon 97365

and

Daniel Miller

California Department of Fish and Game
Marine Resources Branch
Monterey, California 93940

ACOUSTIC HARASSMENT EXPERIMENTS ON HARBOR SEALS IN THE KLAMATH RIVER, 1981

OBJECTIVES

Harbor seals depredate about 13% of the salmon tangled in Native American gill nets annually in the Klamath River, and about 25% of the salmon captured in beach seines for tagging and release by the California Department of Fish and Game are estimated to be captured by harbor seals soon after release. The Department of Fish and Game Anadromous Fisheries Branch has been studying the behavior of harbor seals at the seine site for 2 years and has not been able to alleviate the losses of tagged fish. A permit to use seal bombs was approved by the National Marine Fisheries Service in 1981, but the use of explosives near the seine site has not reduced losses.

Anadromous Branch personnel affixed underwater sonic devices to released tagged salmon in 1980. The results of the study demonstrated that most of the released stressed salmon swam downriver into the shallower estuarine areas where the river widened. It is between the release site and these shallow areas downriver that the depredation of released salmon takes place.

Acoustic harassment appears to be the only procedure now available to alleviate the losses at the seine site and at the gill nets. In the 1981-82 federal fiscal year contract to the Department of Fish and Game, one of the studies is to determine the feasibility of acoustic harassment devices to preclude harbor seal depredation in the Klamath River and in the squid and mackerel fisheries in which California sea lions and pilot whales are a problem. This report presents the results of the feasibility study.

METHODS

Throughout the summer Anadromous Fisheries Branch personnel were stationed at an observation point (Figures 1 and 2) near the CDF&G seine site on each day that seining took place. This survey had been underway since July, and the behavior of harbor seals was documented. Effects of the use of seal bombs at the seine site was also studied. We requested that seal bombs not be used at the seine site for at least 3 days before our experiments. Intensive observations were made on harbor seal activity in the study area two days before and 3 days after the experiments. During the acoustic experiments, two observers were stationed at key locations on shore at the observation point and at the old bridge (Figure 1). A third observer moved along the road bordering the river to follow the location of the device boat (DB) and record the reaction of seals to the device as the DB moved down the river.

The study site was in an area in which a paved roadway paralleled the river with complete visibility of the river for about 2 km. The width of the river in this area ranged from about 200 to 400 m. All harbor seal surfacings were recorded by time and location and later entered on new study maps

(Figure 2) to facilitate analysis. Anadromous Fisheries Branch personnel loaned us the use of a 12 ft flatbottomed jet boat. A portable power generator and the acoustic instrumentation were supplied by Bruce Mate and Charles Greenlaw, Oregon State University.

RESULTS

September 28

Harbor seal activity was recorded at the seine site from 0730 to 1600. One harbor seal appeared at 0835 (Figure 1) with a second animal observed at about 1020. Seining operations were initiated at 1315, but no fish were caught until 1340. Three harbor seals were present at the time, and within an hour at least two salmon were caught in the area. One was tagged, but the other could not be observed sufficiently to determine if it was tagged.

According to the Anadromous Fisheries Branch observer, seal activity on the 28th was typical for the area. The animals usually arrive at the site about when the seining operation routinely starts and remain slowly searching the area from about 100 m upriver of the seine site to at least 600 m downriver. Considering the large area of river to be watched by one person, the surfacings recorded are those that were seen and are not all the surfacings that may have occurred. At times, a seal's head may appear for only a second or two at the surface and some of these short term surfacings may not be observed.

Surface and dive times were recorded on two individual harbor seals when each was the only animal present. The average dive time for 13 dives was 1 min 57 sec., with a range of from 1 min 05 sec to 4 min 00 sec. Surface times averaged 18 sec, with a range of from 01 sec to 40 sec. These dives were of seals searching for fish with no fish caught.

Apparently two of the four tagged fish were taken by harbor seals on this day. The four fish represented a poor catch indicating few fish in the river on that day.

September 29

Seining started at 1200 with larger numbers of fish captured per set indicating a heavy run had entered the river the previous night. Sport-fishermen catches also revealed an increase in steelhead catches that day. Observations started at 0700 (daylight) at the shore fishing area about 1 km upriver of the seine site. No harbor seals were sighted in the study area at the fishing area at the base of McDonald Riffle (Figure 3). On the previous day fishermen reported that a harbor seal had taken a salmonid from a fisherman's line at that fishing area. There was a heavy ground fog obscuring the river until about 0900. By 1000, the fog had cleared and the entire study area could be observed. No harbor seals were noted until 1020. One harbor seal was present until 1200 when two more animals were sighted. Seining was

initiated at 1151 (Figure 4).

The acoustic device was turned on near McDonald Riffle at 1206, and the DB moved at an angle across the river as it came downriver. The three harbor seals off the observation point headed downriver when the DB was about 400 m from them off the observation point. The animals moved out of the study area and did not pass the DB when it was anchored in midriver off the old bridge. The sonic device was turned off at 1300, and the DB returned upriver of Highway 101 bridge for another sweep of the river.

In the interim, three harbor seals returned as soon as the device was turned off and proceeded to search for salmon. One salmon was captured at 1325 as the DB was working down the river. The harbor seal with the fish moved downriver along with the other two seals as the sound came toward them. The DB was anchored again off the old bridge with no animals going past upriver and remained about 250 m downriver of the boat. At this time, the seals were starting to investigate the sound, and two of them came to within about 100 to 150 m before retreating downriver.

One harbor seal allowed the DB to pass by it by remaining near the north bank with its head out of the water. The observer at the old bridge observed the animal but, the DB crew did not. The observer at the observation point noted the animal and notified the DB crew about the event. The sound was turned off at 1407, and the DB headed upriver to sweep this animal back downriver. As the DB headed upriver past the observation point, the seal was underwater in pursuit of a salmon. The DB crew did not see the animal when passing by.

The sound was turned off at 1402, on at 1403, and off again at 1407 at which time the DB was taken upriver to initiate another sweep. When the sound was turned off, the animals immediately went upriver to search near the observation point and seining site. No salmon were captured this time when the five animals returned. On this third sweep, the seals disappeared when the DB was about 500 m upriver, and they did not remain in sight of the shore observers when the DB was anchored off the old bridge. Two harbor seals moved back into the study area about 10 min after the experiment was terminated. Observations ended at 1530.

The behavior of the seals when the sonic device was on and the boat anchored was distinctly different than that observed on searching and foraging animals. There were no frantic movements, but the animals remained primarily on the surface with little diving. The noise dominated their activity and even though they proved to have a strong desire to return upriver, none would pass under water through the sound.

September 30

Observations started at 0730. Seining started at 0904 with good catches of fish, better than on the previous two days. More fish were caught than could be tagged due to the weakening of the fish in the nets and holding pens

before they could be processed. There were thus relatively larger numbers of weakened fish present for harbor seal predation, and consequently a higher number were taken that day, 11 in all (Figure 4).

Harbor seals first appeared at 0820 but soon disappeared with another observed at 0910. The DB started downriver from the Highway 101 bridge at 0955. The one animal present departed for downriver when the DB was about 300 m from it. No other animals came into view as the DB was anchored off the old bridge, and the decision was made to take the sonic device to the estuary area and experiment with animals in a wide section of the river. Herding of animals was attempted and indicated some success. One animal, however, did not want to be herded upstream and passed within 10 m of the DB when pressed against the shoreline. The animal exhibited stress and swam rapidly past the DB.

While the DB was in the estuary area, harbor seals appeared at 1100 in the study area. Between 1100 and 1200 three harbor seals had captured five salmon. There was nearly continuous harbor seals foraging activity downriver of the seine site. At 1207 the DB returned upriver to the study area, driving three additional animals before it. The total now at the study area was seven harbor seals. From 1200 to 1245, three additional salmon were captured before the DB returned downriver at 1245. As before, all animals went downriver, remaining at least 200 m from the DB.

The third sweep downriver started at 1317, came as far as the seine site and returned upriver to start back again at 1326. At this time, there were four harbor seals in the study area in pursuite of a salmon as the DB approached. The animals allowed the boat to get to within about 200 m before heading downriver. A salmon was caught and the harbor seal went downriver rapidly with the fish, apparently due to the sonic device. When the harbor seal with the fish reached a point about 700 m downriver of the observation point, two other harbor seals began taking bites out of the salmon and a feeding frenzy was initiated. The DB headed for these animals and was able to approach to within about 30 to 50 m before they all retreated farther downriver away from the DB.

The device was turned off at 1350. At 1355 another salmon was caught about 800 m downriver of the observation point.

October 2

There was no seining, and the maximum number of animals present at one time was two (Figure 5). One salmon was observed being eaten and another possible capture was recorded during the 4-hour observation period. Observations started at 0915 and terminated at 1315. Harbor seals appeared only occasionally and moved about throughout the study area from the seine site to about 800 m downriver of the observation point. Most of the searching activity was downriver of the observation point. A light rainfall started at 1315.

October 3.

No seining was conducted on this day. Observations started at 0800 (Figure 5) and continued until 1530. A maximum of three harbor seals were noted at any one time, and no salmon were caught. There was one possible pursuit and capture but only splashing was noted with no fish observed. Most surfacings were recorded downriver of the observation point.

SUMMARY

The acoustic harassment device passed the feasibility test for river application. Harbor seals reacted whenever they were within at least 400 m of the activated device. Herding of harbor seals was accompanied, with one animal, however, determined to not be herded upriver and was forced to pass close to the boat without any apparent adverse stress to the animal. Two events occurred indicating possible learned avoidance or habituation to the device. One was when an animal allowed the device to pass by it by keeping its head out of the water. The other was during a feeding frenzy of three harbor seals during which the activated device was allowed to approach to within 30-50 m before rapidly swimming away.

It is recommended that an intensive experimentation be initiated:

1. Determine the degree of potential habituation to the device by use of marked animals during the intensive beach seining and gill netting period from July to November 1982.

2. Determine the possibility of using the sonic device to herd animals to facilitate capture in tangle nets in the Klamath River.

3. Determine if harbor seals can be swept out of the narrow areas of the river, upriver from the seine site and kept from returning upriver in the July-November gill netting period. At least two of the devices will be needed for this experiment.

PART IV
AESTHETIC VALUES OF MARINE MAMMALS DERIVED FROM PARTYBOAT FISHERMEN SURVEYS

John Scholl

California Department of Fish and Game
Marine Resources Branch
Long Beach, California 90813

INTRODUCTION

The results of the 1979-81 interaction study demonstrated that California sea lions were involved in harassment of partyboat fishermen in southern California. Animals were observed and reported taking fish off hooks and eating live bait that was tossed out, and there was some evidence that the fish catch rate either slowed or stopped completely when sea lions were present. Several partyboat operators have requested permits to take or harass sea lions interfering with fishing operations. The use of seal bombs, crackershells, and shooting are presently being considered as possible control measures.

One of the studies in the FY 1981-82 contract was to determine the attitudes of the fishermen on whether harassment should be allowed as a mitigating measure for this fishery. One of the factors in determining the feasibility of harassment and take would be the public opinion of such action. This is a summary of fishermen's opinions collected at the end of partyboat trips.

METHODS

The study plan was to sample southern and central California recreational fishing ports once a month for a 10-month period. These ports were San Diego, Long Beach, Santa Barbara, Santa Cruz and Sausalito. It was determined in the interaction study that mammal harassment took place in all southern California ports, especially at San Diego. A very small number of interactions occurred in central California being related only to the salmon sport fishery.

The sampling form (Appendix 1) contained five questions including experiences with marine mammals that day and during previous fishing trips. The last question centered upon the fisherman's personal opinion of control including whether the animals should be controlled and if so, whether underwater sounds of shooting were acceptable.

The survey was conducted after the fisherman had left the vessel and was alone or with his own party. This was done to avoid any influence the vessel's crew or other fishermen might have on the individual's answers. Only uniformed older department employees did the interviewing. This was determined necessary as it was discovered that some fishermen did not always trust young people who were in or just out of college and portrayed an "environmentalist image." Answers in this case could be biased toward pro "environmental" values. To prevent drawing answers from participants, questions were presented in a neutral and consistent dialogue. Most interviews conducted in this manner resulted in the interviewed person's willingness to expound on the subject.

The information was also separated into whether the interviewee was male or female and further separated into small (juvenile), medium or obviously elderly age (gray hair) groups.

RESULTS

Most people interviewed spoke freely and were open about why potential management tools should or should not be used. A total of 77 interviews was collected in southern and central California (Table 1). The mean interview sample size was 4.9 individuals.

Due to unforseen constraints on field day allocation to fulfill all objectives of the contract, fewer days were allocated to this study than proposed. One reason is that in central California, the interviews all reflected a common attitude; that of unanimous "no shooting" of animals and possible use of underwater acoustic control methods.

Only salmon fishermen in central California reported losing fish to sea lions and in none of the 13 samples taken in 1981 (Table 1) was there a loss reported the day of the interview. Sixty-nine percent (9 of 13) of those interviewed in central California would accept some form of non-take control.

Southern California sampling (Table 1) was continued as often as possible until it was felt that a representative opinion was acquired. Seventy-two percent (46 of 64) of this group opposed shooting as a control measure but 64% (41 of 64) would accept proposed nonlethal control measures. Over half of the southern California fishermen interviewed had a prior loss of fish to sea lions which mostly occurred out of San Diego. Fishermen categorized into this group (Table 1) showed 66% (25 of 36) desiring some form of control and 77% (28 of 36) accepting the proposed nonlethal controls. Overall, group opposition to shooting ranged from 72 to 100 percent whereas nonlethal control acceptance ranged from sixty-four to seventy-four percent.

Opinions referenced to sex and age class were examined but not listed in the text. The medium male class was defined between juvenile (up to college) and elderly (gray hair). This class, making up 55% (42 of 77) of all interviews, showed a high group acceptance (81%) of the proposed nonlethal take. Elderly males made up twenty-two percent of the interviews, and females, combining all age classes, made up only 12%. These individuals were chosen as random as possible, and the percentage age and sex breakdown probably approximates actual composition of fishermen of partyboats. The data are too few to compare attitudes between each of these groups but in working with the data, no exceptional differences from the overall result appear. The strongest opinion, with all ports combined, was against shooting (77%). If the 11 people surveyed as unsure for this answer were included, the actual figure could be as high as 91% against this kind of control.

Question 2 (Appendix #1) dealing with personal enjoyment of viewing marine mammals was brought in after several surveys had already taken place. The question was included to allow participants the opportunity to express an

overall feeling for marine mammals as a group. Sixty-four percent (49 of 77) of the interviews included the question. Of those answering the question, 96% (47 of 49) reported enjoying the sight of marine mammals in general.

Surveys were conducted both on weekends and weekdays. This was necessary as skippers of partyboats have mentioned that weekday fishermen tend to prefer catching fish for food whereas weekend users are more demanding for surface action. Considering this information, weekday fishermen may have been more upset with losses to sea lions whereas, weekend groups might have viewed losses to sea lions as part of the action. The same may hold true where long partyboat trips are more for food to take home. Sixty-nine percent of the survey dates occurred on weekdays, and 44% of the interviews were with fishermen from three-quarter day or all-day fishing trips whereas, the other 56% (43 of 77) were half-day trip interviews.

The survey further asked the 36 fishermen having previously lost fish about the species and the location of occurrence. Seven species of fish were reported taken at four of the five interview fishing ports (Table 2). The most common species taken was bonito, and the port of highest interaction was San Diego.

The results of this survey strongly indicate that harming sea lions in an effort to improve fishing will probably alienate rather than satisfy the user public onboard. Further research is presently being conducted to test the effectiveness of nonlethal controls.

A list of comments taken verbatim from interviews (Appendix #2) is included as further recognition of the strong feelings expessed.

Table 1

Opinion Survey Groups	Answers	Enjoys marine mammals	Prior fish taken?	Wanted some form of control	Underwater sound deterrent OK?	Shooting OK?
Central California Ports (13 interviews)	yes	5 (38%)	3 (23%)	5 (38%)	9 (69%)	0
	no	0	10 (77%)	8 (62%)	1 (8%)	13 (100%)
	*N/A	8 (62%)	0	0	3 (23%)	0
Southern California Ports (64 interviews)	yes	42 (66%)	36 (56%)	28 (43%)	41 (64%)	7 (11%)
	no	2 (3%)	28 (44%)	34 (54%)	12 (19%)	46 (72%)
	*N/A	20 (31%)	0	2 (3%)	11 (17%)	11 (17%)
All Ports Combined (77 interviews)	yes	47 (61%)	38 (49%)	33 (43%)	49 (64%)	7 (9%)
	no	2 (3%)	39 (51%)	42 (55%)	13 (17%)	59 (77%)
	*N/A	28 (36%)	0	2 (3%)	15 (19%)	11 (14%)
Fishermen Having Previously Lost Fish (38 interviews)	yes	27 (71%)	38 (100%)	25 (66%)	28 (74%)	5 (13%)
	no	4 (11%)	-	14 (37%)	8 (21%)	32 (84%)
	*N/A	9 (24%)	-	1 (3%)	3 (9%)	3 (9%)

*N/A = No comment or not sure

Table 2. Fish reported taken off fishing lines by pinnipeds at various locations.

Location	Bonito	Kelp bass	Yellowtail	Barracuda	Mackerel	Rockfish	Salmon	Unk	Totals
San Diego (includes Coronado Isls)	5	3	3	1	2	-	-	7	21
Long Beach	-	1	1	1	-	1	-	4	8
Santa Barbara	-	1	-	-	-	-	-	-	1
San Francisco	0	0	0	0	0	0	2	0	2
Unknown	0	0	0	0	0	0	0	2	2
Totals	5	5	4	2	2	1	2	13	34

APPENDIX 1

Marine Mammal Opinion - Partyboat Fishing

Date_____ Port_____

Sampler_____ Fishing Location_____

Fish species or aggregate being sought_____ M____ F____ S____ M____ E____

1. Did you see any marine mammals today? Y_____ N_____

   If yes: What kind?_____

2. Do you get enjoyment from seeing whales, porpoises and seals on your fishing trip? Y_____ N_____

3. Did you see any near your boat while fishing? Y_____ N_____

   If yes: Did it (they) take any fish from you or other passengers?

   Y_____ N_____ Remarks:_____

4. Have marine mammals ever bothered you on previous partyboat trips? (Take fish off lines, take a bite out of a fish, or scare fish away from boat).

   Y_____ N_____

   If yes: What kind of trip (species sought) and out of what port?

   _____

5. Do you feel that these animals should be controlled in some way to lessen loss to fishermen on partyboats? Y_____ N_____

   If yes: Would you approve of:

   a) Keeping them away from the boat by use of underwater sounds?

      Y_____ N_____

   b) Allowing the boat operator to shoot animals when they come near the boat? Y_____ N_____

Remarks:_____

_____

_____

_____

_____

APPENDIX 2

Fishermen Comments - "Against Control"

1. "They have right to live also."
2. "They were here first."
3. "The half-day boat doesn't need to make controls."
4. "Move to other spot rather than do something to animal."
5. "No killing."
6. "No hurting in any way - it's their ocean."
7. "Leave the seals alone."
8. "They were there first."
9. "Go to other place rather than kill."
10. "I feel like hitting them sometimes, but I don't want to see them killed."
11. "It's exciting to watch the seals come around. Controlled only if you don't hurt them."
12. "Sea lions never take rockfish. Shooting is dangerous because of ricochet."
13. "We're in their area, it's their habitat and not ours."
14. "Don't need to go to the length of shooting."
15. "The seal is free to do as it pleases. It's the seals natural habitat."
16. "Seals have just as much right to nip the bait as the rest of the fish do. Wouldn't like sound system either because then you wouldn't have seen the animals that we saw today."
17. "I like the whales; I like the seals; I think everybody has a place in life."
18. "Don't let them do it. I'd rather lose the fish."
19. "There must be a way that we could trap the animal and move it away. I don't think it's a good idea to reduce the population, because if you reduce one species then you're going to find another species that's going to take its place and cause you a problem, cause an imbalance."

APPENDIX 2 - Cont'd

Fishermen Comments - "For Control"

1. "Not destroy the population only the pests."
2. "Shoot over the heads of the animals."
3. "Shoot to scare away - OK."
4. "Ruining sport fishing."
5. "If it's a problem, then they should be controlled."
6. "I don't like to see deer shot but "seals" OK.
7. "Sterilize the male sea lions."
8. "Nobody really likes that (shooting) but seals do shut the bite off. Everybody pays good money out there. You come back with nothing - everybody is kind of pissed off. After a while, you hate to see them come around."

APPENDIX I

Number of harbor seals counted from the air at each hauling site in the April and May-June 1982 censuses (NC=site not covered by either air or ground; ()=ground count, no air count made; a "0" during both censuses represents no animals were present during both flights at a known hauling site).

APPENDIX I.

Site	April	May-June	Site	April	May-June	Site	April	May-June
1-3	19	6	62	0	17	120	2	0
4	27	82	63	8	19	121	2	3
5	NC	NC	64	27	0	122	0	18
6	8	0	65	32	42	123	0	1
7	13	53	66	17	0	124	0	1
8	NC	NC	67	8	0	125	13	7
9	NC	0	68	0	0	126	0	11
10	0	(2)	69	9	15	127	71	97
11	(242)	288	70	18	11	128	0	0
12	3	38	71	23	8	129	4	39
13	19	9	72	68	23	130	266	190
14	0	0	73	8	0	131	29	0
15	0	24	73.1	0	0	132	32	0
16	0	0	74	30	50	133	61	158
17	0	41	75	17	0	134	6	0
18	17	18	76	71	82	135	38	12
19	70	0	77	5	0	136	5	10
20	2	18	78	51	41	137	5	0
21	0	0	79	45	55	138	0	26
22	60	46	80	12	33	139	0	11
23	0	0	81	0	0	140	0	10
24	19	0	82	0	0	141	22	43
25	81	138	83	0	0	142	10	21
26	51	0	84	0	0	143	0	1
27	22	29	85	67	122	144	16	8
28	0	0	86	25	18	145	25	4
29	0	0	87	80	138	146	0	0
30	NC	NC	88	0	0	147	0	32
31	40	67	89	0	0	148	10	25
32	0	1	90	0	0	149	21	71
33	13	0	91	0	0	150	51	93
34	11	0	92	0	0	151	36	53
35	20	58	93	0	1	152	22	32
36	0	22	94	0	2	153	28	6
37	16	60	95	1	1	154	0	18
38	9	0	96	0	1	155	0	29
39	29	132	97	22	1	156	11	40
40	0	0	98	19	59	157	144	110
41	23	57	99	0	0	158	2	0
42	17	9	100	0	9	159	6	0
43	0	21	101	14	9	160	28	22
44	24	0	102	20	44	161	4	44
45	1	0	103	0	1	162	73	133
46	41	29	104	0	7	163	NC	NC
47	1	0	105	0	6	164	0	15
48	19	0	106	0	1	165	30	28
49	15	0	107	29	34	166	(41)	128
50	86	53	108	0	15	167	0	28
51	15	0	109	4	0	168	0	1
52	23	24	110	128	125	169	37	(37)
53	90	153	111	0	13	170	0	1
54	0	42	112	13	7	171	0	8
55	0	35	113	0	0	172	0	120
56	30	0	114	0	27	173	23	12
57	46	0	115	0	0	174	29	23
58	0	0	116	0	0	175	66	(53)
59	3	0	117	0	29	176	25	3
60	10	0	118	7	10	177	60	71
61	0	4	119	0	0	178	43	83

APPENDIX I. - Continued

Site	April	May-June	Site	April	May-June	Site	April	May-June
179	0	36	238	12	4	297	0	2
180	21	44	239	0	1	298	26	0
181	7	0	240	0	0	299	10	25
182	0	3	241	122	86	300	0	1
183	0	1	242	2	1	301	1	0
184	0	1	243	53	53	302	87	125
185	0	3	244	59	86	303	10	4
186	12	9	245	165	256	304	26	39
187	4	0	246	0	12	305	29	45
188	50	70	247	5	0	306	0	1
189	NC	NC	248	338	193	307	131	109
190	31	20	249	0	136	308	0	0
191	NC	NC	250	3	1	309	18	0
192	9	9	251	109	115	310	3	NC
193	0	0	252	0	0	311	8	NC
194	19	45	253	0	11	312	6	NC
195	0	34	254	9	1	313	27	NC
196	0	7	255	0	8	314	4	NC
197	57	104	256	0	8	315	39	NC
198	23	118	257	29	47	316	27	NC
199	0	0	258	2	0	317	13	NC
200	0	7	259	0	0	318	0	15
201	30	0	260	2	0	319	5	0
202	0	21	261	NC	NC	320	42	57
203	NC	NC	262	(119)	127	321	0	4
204	(Included in 205)		263	31	0	322	0	NC
205	273	197	264	2	0	323	25	17
206	(Included in 205)		265	0	0	324	36	0
207	NC	60	266	2	8	325	0	0
208	NC	7	267	5	0	326	63	84
209	NC	NC	268	8	0	327	33	0
210	NC	NC	269	6	0	328	20	48
211	NC	NC	270	0	0	329	2	0
212	NC	NC	271	8	8	330	25	32
213	40	(85)	272	1	12	331	0	0
214	NC	(8)	273	70	49	332	33	176
215	11	10	274	0	16	333	35	33
216	0	(1)	275	0	0	334	19	45
217	36	88	276	3	0	335	0	4
218	115	112	277	27	51	336	12	12
219	5	4	278	0	0	337	33	0
220	93	88	279	0	1	338	9	48
221	280	536	280	9	0	339	28	38
222	11	0	281	0	21	340	0	0
223	0	0	282	11	0	341	36	49
224	(Included in 225)		283	10	0	342	29	32
225	520	656	284	24	29	343	11	27
226	10	0	285	0	0	344	17	18
227	0	34	286	0	0	345	0	31
228	29	0	287	4	64	346	0	0
229	0	0	288	0	2	347	0	0
230	7	1	289	10	9	348	0	0
231	38	101	290	31	0	349	44	51
232	3	64	291	0	1	350	0	26
233	24	31	292	1	0	351	2	1
234	13	0	293	18	0	352	215	183
235	17	0	294	0	4	353	23	55
236	19	1	295	0	40	354	0	30
237	NC	NC	296	35	52	355	0	9

APPENDIX I. - Continued

Site	April	May-June	Site	April	May-June	Site	April	May-June
356	46	67	379	1	0	402	0	0
357	0	0	380	15	0	403	0	0
358	25	13	381	32	46	404	0	0
359	5	0	382	325	483	405	30	0
360	58	0	383	NC	NC	406	0	0
361	97	0	384	518	269	407	0	0
362	21	7	385	146	127	408	0	0
363	354	583	386	0	0	409	0	0
364	0	13	387	0	0	410	0	48
365	0	52	388	0	0	411	0	0
366	0	16	389	0	0	412	0	35
367	0	10	390	0	21	413	66	52
368	43	0	391	0	0	414	263	0
369	11	0	392	0	0	415	63	0
370	0	0	393	16	0	416	0	0
371	25	14	394	0	0	417	0	0
372	3	0	395	0	0	418	208	129
373	101	172	396	0	0	419	0	0
374	29	76	397	0	2	420	NC	0
375	10	1	398	0	0	421	0	0
376	1	0	399	10	15	422	51	50
377	4	0	400	0	0			
378	5	0	401	0	0			

APPENDIX II

Location, substate description, maximum known count, and pup-total count of harbor seal hauling sites.

*EXR = extended reef

OFR = offshore rock

ONR = onshore rock

HES = harbor and estuary sand

OBE = ocean-sandy beach

APPENDIX II

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
1.	1.2 km S. Point La Jolla	32°50.56'	117°16.90'	EXR	-	
2.	0.6 km S " "	32°50.87'	117°16.68'	EXR	-	
3.	0.5 km S. " "	32°50.90'	117°16.62'	OFR	19	
4.	Mugu Lagoon	34°06.10'	119°04.44'	HES	96	5-43
	Standard Oil Pier			OBE+ONR		
5.	0.1 km E. Carpinteria	34°23.11'	119°30.33'	Night+H.O.	116	
6.	0.3 km W. "	34°23.13'	119°30.47'	OFR	26	
7.	Carpinteria State Beach	34°23.36'	119°31.09'	EXR+OFR	53	2-14
8.	Sand Point (minus tide only)	34°23.60'	119°32.30'	OFR	10	
9.	Moore Mesa, 2.0 km E Goleta Pier	34°24.98'	119°48.39'	OFR	70	
10.	1.2 km W. Ellwood Oil Pier	34°26.10'	119°55.75'	OBE	148	3-12
11.	0.8 km E. Pt. Conception	34°26.90'	120°27.78'	OBE+EXR	412	10-242
12.	N. Pt. Conception	34°27. '	120°28. '	OFR	38	
13.	N. "	34°28. '	120°28. '	EXR	19	4-19
14.	Sudden	34°32. '	120°34. '		-	
15.	1.0 km S. Rocky Point	34°33. '	120°37. '	ONR	24	
16.	" "	34°33. '	120°37. '		-	
17.	S. Point Arguello	34°34. '	120°38. '	EXR	57	
18.	S. Purisima Point	34°44. '	120°37. '	ONR	127	2-17
19.	S. " "	34°44. '	120°37. '	EXR	70	4-70
20.	Purisima Point	34°45.35'	120°38.20'	EXR	38	1-2
21.	Point Sal Area	34°51. '	120°37. '	ONR		
22.	N. Side Point Sal	34°54.40'	120°40.10'	ONR	60	2-60
23.	Mussel Point	34°55.76'	120°40.04'	EXR	1	
24.	1.7 km N. Pismo Beach Pier	35°08. '	120°38. '	OFR	19	2-19
	(Isolated O.R. north					
25.	Shell Beach of Browns Island)	35°09.10'	120°40.14'	OFR	138	
	(O.R. distinct					
26.	0.1 km N. site #25 at low tide)	35°09.15'	120°40. '	EXR	51	5-20
26A.	E. Mallagh Landing	31°10. '	120°42. '			

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
27.	Pirates Cove (Mallagh Landing)	35°11.07'	120°42.86'	OFR	29	
28.	(New) Fossil Point	35°10. '	120°43. '	OFR	20	
29.	(New) 0.8 km S. Pecho Rock	35°10. '	120°49. '	EXR	1	
30.	Pecho Rock	35°10.75'	120°48.95'	OFR	2	
31.	Deer Canyon (Outside S)	35°11.26'	120°48.73'	EXR	67	
32.	Deer Canyon (Inside Cove)	35°11.29'	120°48.74'	EXR	4	
33.	0.9 km N. Deer Canyon	35°11.55'	120°49.25'	EXR	13	2-13
34.	1.0 km N. Deer Canyon	35°11.56'	120°49.28'	ONR	11	
35.	1.2 km N. " "	35°11.65'	120°49.44'	OFR	58	
36.	1.5 km N. " "	35°11.73'	120°49.60'	EXR	22	
37.	2.0 km N. " "	35°11.79'	120°49.92'	EXR	7	2-6
38.	2.1 km N. " "	35°11.80'	120°49.99'	EXR	60	1-9
39.	2.4 km N. " "	35°11.88'	120°50.18'	EXR+OFR	132	2-29
40.	Entrance to (New) 0.4 km S. Diablo Cyn Harbor	35°12. '	120°52. '		126	
41.	0.6 km N. Lion Rock	35°13.42'	120°52.16'	OFR	57	2-23
42.	1.8 km N. " " (opp.-Reservoir)	35°13.94'	120°52.66'	EXR	19	2-17
43.	2.3 km N. " "	35°14.15'	120°53.04'	OFR	21	
44.	0.8 km S. Islay Creek	35°16. '	120°53. '	OFR	24	
45.	0.5 km S. Hazard Cyn.	35°17. '	120°52. '	EXR	1	
46.	Morro Bay (Inside Harbor)	35°20.25'	120°51.07'	HES	41	6-41
47.	0.2 km W. Cayucos Pier	35°26.91'	120°54.44'	OFR	13	
48.	1.0 km W. " "	35°26.84'	120°54.59'	EXR	22	
49.	1.3 km W. " "	35°26.82'	120°55.20'	EXR+OFR	15	2-15
50.	0.1 km W. Black Rock	35°26.78'	120°55.41'	OFR	66	
51.	0.9 km E. Cayucos Point	35°26.81'	120°55.80'	EXR	8	2-15
52.	0.2 km E. " "	35°26.79'	120°56.22'	EXR	23	1-23
53.	Cayucos Point	35°26.76'	120°56.37'	EXR	153	5-90
54.	0.2 km W. Cayucos Point	35°26.77'	120°56.47'	EXR	65	
55.	0.4 km W. " "	35°26.76'	120°56.66'	EXR	60	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
56.	2.1 km NW Cayucos Point	35°27.76'	120°57.66'	EXR	38	7-30
57.	0.4 km SE Villa Creek	35°27. '	120°58. '	EXR	4	
58.	(New) Point Estero	35°27. '	121°00. '	EXR	67	
59.	0.4 km S. China Shack	35°28.80'	121°01.35'	EXR	2	
60.	0.3 km " " "	35°28.87'	121°01.39'	EXR	4	
61.	0.1 km " " "	35°28.94'	121°01.42'	OFR	4	
62.	0.1 km N. " "	35°29.06'	121°01.44'	EXR+OFR	17	
63.	0.4 km N. " "	35°29.06'	121°01.58'	EXR	19	3-8
64.	0.5 km N. " "	35°29.08'	121°01.65'	EXR	27	2-27
65.	0.7 km N. " "	35°29.18'	121°01.71'	EXR	42	3-32
66.	1.9 km S. Radar Station	35°30.33'	121°03.05'	EXR	38	3-17
67.	0.4 km S. " "	35°30.89'	121°03.82'	OFR	26	
68.	(New) 1.2 km N. Radar Station	35°31. '	121°04. '	EXR	15	
69.	Castle Inn, Cambria (Opp. Cambria Rock)	35°34.28'	121°06.71'	OFR	15	
70.	0.9 km N. San Simeon Cr.	35°36.04'	121°08.03'	EXR	11	
71.	1.3 km N. " " "	35°36.11'	121°08.26'	EXR	51	
72.	1.6 km N. " " "	35°36.22'	121°08.43'	EXR	62	4-62
73.	1.8 km N. " " "	35°36.29'	121°08.58'	EXR	4	
73A.	Pico Creek Cove	35°37.04'	121°09.01'	OFR	22	
74.	0.6 km E. San Simeon Pier	35°38.47'	121°10.80'	OFR	68	5-33
75.	1.3 km W. San Simeon Point	35°38.44'	121°12.30'	EXR	17	
76.	0.4 km W. Adobe Creek	35°39.05'	121°13.54'	EXR	76	
77.	1.6 km W. " "	35°39. '	121°14. '	EXR	15	reported
78.	1.8 km W. " "	35°39.00'	121°14.53'	OFR+EXR	104	reported
79.	2.0 km W. " "	35°39.19'	121°14.66'	EXR	64	6-44
80.	2.7 km E. Piedra Blancas Lighthouse	35°39.57'	121°15.23'	EXR	33	reported
81.	2.3 km E. Piedra Blancas Lighthouse	35°39.75'	121°15.48'	EXR	18	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
82.	Offshore - Pt. Piedras Blancas	35°39.76'	121°16.62'	OFR	70	
83.	Beach area at Pt. Piedras Blancas	35°39.86'	121°16.56'	EXR	25	
84.	(New) Harleck Castle Rock Area	35°41. '	121°17. '	EXR	10	
85.	La Cruz Rock	35°42.40'	121°18.68'	OFR	122	reported
86.	0.3 km S. Pt. Sierra Nevada	35°42.68'	121°18.82'	OFR	68	reported
87.	0.9 km S. Breaker Point	35°44.15'	121°19.07'	OFR	138	reported
87A.	N. Breaker Point	35°44.93'	121°19.07'	EXR	new	
88.	(New) N. Ragged Point	35°46. '	121°19. '		5	
89.	(New) N. Ragged Point	35°47. '	121°20. '		20	
90.	(New) 1.0 km S. Salmon Creek	35°48. '	121°21. '		15	
91.	1.6 km S. Salmon Creek	35°48.30'	121°21.49'	EXR	1	
92.	0.3 km S. " "	35°48.36'	121°21.59'	OFR	12	
93.	0.5 km N. " "	35°48.65'	121°22.10'	OFR	1	
94.	Redwood Gulch	35°50.02'	121°23.74'	OFR	2	
95.	0.3 km S. Alder Creek	35°51.37'	121°24.86'	OFR	7	
96.	0.8 km N. " "	35°51.49'	121°25.01'	OFR	1	
97.	1.3 km N. " "	35°51. '	121°26. '	OFR	22	
98.	Bird Rock (Gorda Rock)	35°52.54'	121°27.15'	OFR	59	
99.	0.6 km S. Cape San Martin	35°53.08'	121°27.59'	OBE	5	
100.	1.5 km S. Plaskett Rock	35°54.56'	121°28.03'	OFR	9	
101.	0.7 km S. Prewitt Cr.	35°55.75'	121°28.39'	OFR	14	
102.	0.4 km S. " "	35°55.91'	121°28.58'	OFR	44	
103.	0.7 km N. " "	35°56.47'	121°28.64'	OFR	1	
104.	0.1 km S. Wild Cattle Cr.	35°57.43'	121°29.02'	OFR	7	
105.	1.0 km E. Lopez Point	36°01.17'	121°33.31'	OFR	6	
106.	0.1 km E. " "	36°01.15'	121°33.96'	OFR	1	
107.	0.1 km W. " "	36°01.19'	121°34.03'	EXR	34	
108.	0.7 km S. Vicente Creek	36°02.30'	121°34.84'	OFR	4	
109.	Vicente Creek	36°02.68'	121°35.10'	OFR	15	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
110.	0.6 km N. Big Creek (Beach R)	36°04.35'	121°36.35'	OBE	201	6-128
111.	1.0 km S. Dolan Rock	36°04.66'	121°36.62'	OFR	13	
112.	0.6 km S. " "	36°04. '	121°37. '	OFR	13	
113.	(New) Dolan Rock	36°05. '	121°37. '	OFR	12	
114.	0.2 km N. Rat Creek	36°05.61'	121°37.23'	OFR	71	
115.	0.3 km S. Lime Creek	36°07.10'	121°37.94'	OFR	46	
116.	0.4 km S. Anderson Canyon	36°08.97'	121°39.70'	OFR		
117.	N. Anderson Canyon	36°09. '	121°40. '	OFR	29	
118.	0.1 km S. McWay Rocks	36°09.80'	121°40.62'	OFR	13	
119.	McWay Rocks	36°09.80'	121°40.67'	OFR	3	
120.	0.3 km N. McWay Rocks	36°09.95'	121°40.77'	OFR	2	
121.	1.2 km S. Partington Creek	36°10.09'	121°41.17'	OFR	3	
122.	0.6 km S. " "	36°10.25'	121°41.57'	OFR	18	
123.	0.8 km S. Torre Canyon	36°11.24'	121°42.46'	OFR	1	
124.	La Fler Canyon	36°11.98'	121°43.70'	OFR	1	
125.	0.1 km N. La Fler Canyon	36°12.00'	121°43.74'	OFR	13	
126.	0.8 km N. " "	36°12. '	121°44. '	ONR	11	
127.	2.7 km S. Pfeiffer Point	36°13. '	121°47. '	EXR	97	
128.	(New) Cooper Point	36°14. '	121°50. '	OFR	1	
129.	2.4 km N. Cooper Point	36°16.13'	121°50.69'	OFR	42	
130.	1.7 km N. Big Sur River	36°17.30'	121°52.47'	EXR	184	
131.	1.6 km S. Pt. Sur Lighthouse	36°17.97'	121°53.05'	OFR	27	
132.	1.2 km S. " "	36°18.13'	121°53.26'	EXR	32	
133.	1.1 km S. " "	36°18.17'	121°53.35'	OFR	158	
134.	0.7 km S. " "	36°21.10'	121°54.09'	ONR	6	
135.	Castle Rk. (Bixby Ldg.)	36°22.44'	121°54.35'	OBE	38	2-38
136.	0.5 km N. Palo Colorado Canyon	36°23.99'	121°54.55'	OFR	10	
137.	0.8 km S. Soberanes Point	36°26.59'	121°55.43'	OFR	5	
138.	Near Soberanes Point	36°27. '	121°55. '	OFR	26	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
139.	0.9 km S. Malpaso Creek	36°28.40'	121°56.20'	OFR	14	
140.	Yankee Point Cove	36°29.27'	121°56.52'	OFR	19	
141.	Yankee Point	36°29.41'	121°56.65'	ONR	71	
142.	Bird Island (Pelican Point)	36°30.40'	121°56.63'	OFR	31	
143.	0.3 km N. Bird Island	36 '	121 '	OFR	1	
144.	Headland Cove	36°31.17'	121°57.01'	ONR	28	
145.	Whalers Cove	36°31.20'	121°56.14'	OFR+EXR	25	
146.	The Pit, Whalers Cove	36°31.30'	121°56.13'	OFR	(included in 147)	
147.	Moss Cove (Pt. Loloos Reserve)	36°31.35'	121°56.04'	OFR	32	
148.	Arrowhead Point (outside)	36°33.65'	121°56.35'	EXR	25	1-10
149.	" " (inside)	36°33.73'	121°56.35'	EXR	71	3-21
150.	Pescadero Rocks	36°33.70'	121°56.62'	OFR	96	2-51
151.	0.5 km N. Pescadero Pt. (Still-water Cove)	36°33.92'	121°56.97'	ONR+OFR	53	
152.	Cypress Pt. Parking Lot (South)	36°34.58'	121°58.36'	EXR+OFR	42	2-26
153.	0.1 km S. Cypress Point	36°34.75'	121°58.60'	OFR	93	
154.	Cypress Point	36°34.82'	121°58.62'	OFR	18	
155.	0.1 km N. Cypress Point	36°34.83'	121°58.52'	EXR	3	
156.	0.4 km N. " "	36°34.94'	121°58.48'	OFR	40	4-14
156A.	(New) Near Fan Shell Beach	36°35. '	121°57. '	EXR		
157.	Seal Rock	36°35.30'	121°57.90'	OFR	151	7-145
158.	1.3 km N. Seal Rock (Ocean Ave.)	36°35.97'	121°57.76'	EXR	2	
159.	0.2 km S. Point Joe	36°36.54'	121°57.48'	EXR	6	
160.	Asilomar (Arena Ave.)	36°37.60'	121°56.47'	EXR	35	
161.	0.5 km W. Lovers Pt (Pacific Ave)	36°37.70'	121°55.17'	OFR	49	
162.	Hopkins Marine Station	36°37.28'	121°54.14'	EXR+OFR	147	1-73
163.	Monterey Harbor (0.2 km S. Breakwater)	36°36.42'	121°53.60'	OFR	2	
164.	Elkhorn Slough (1.6 km E Hwy 1)	36°48.87'	121°46.00'	HES	17	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
165.	Soquel Point	36°57.20'	121°58.48'	OFR	52	
166.	2.0 km N. Terrace Point	36°57.25'	122°05.27'	ONR	138	
167.	Table Rock	36°58. '	122°08. '	EXR	28	
168.	1.2 km N. Yellow Bank Creek	36°59. '	122°10. '	OFR	1	
169.	Davenport Cement Plant (0.5 km N. Pier)	37°00.80'	122°12.26'	ONR	39	
170.	El Jarro Pt.	37°01. '	122°13. '	EXR	1	
171.	N. Scott Creek	37°03. '	122°14. '	EXR	8	
172.	2.6 km S. Greyhound Rock	37°03.50'	122°15.03'	OFR	120	
173.	1.7 km S. " "	37°03.93'	122°15.27'	EXR	28	
174.	1.3 km S. " "	37°04.04'	122°15.42'	ONR	80	
175.	1.0 km N. " "	37°05.12'	122°16.26'	OFR	81	3-76
176.	Ano Nuevo Pt.	37°06.76'	122°19.75'	EXR	25	
177.	Ano Nuevo Isl.	37°06.55'	122°20.15'	OFR	71	
178.	0.7 km N. Ano Nuevo Pt.	37°06.98'	122°20.12'	EXR	83	3-43
179.	1.1 km N. " " "	37°07.11'	122°20.29'	EXR	36	
180.	1.3 km N. " " "	37°07.22'	122°20.32'	OFR	44	
181.	1.8 km S. Franklin Point	37°08.35'	122°20.71'	OFR	7	
182.	Franklin Point	37°08. '	122°21. '	OFR	3	
183.	3.4 km N. Franklin Point	37°10.66'	122°22.45'	EXR	1	
184.	1.4 km S. Pigeon Pt.	37°10.81'	122°22.66'	OFR	1	
185.	0.4 km S. " "	37°10.93'	122°23.31'	OFR	3	
186.	1.4 km N. " "	37°11.60'	122°24.01'	EXR+OFR	12	
187.	1.7 km N. " "	37°11.67'	122°24.16'	OFR	4	
188.	1.7 km S. Bean Hollow	37°12.62'	122°24.43'	EXR	50	2-50
189.	0.5 km N. " "	37°13.74'	122°24.75'	OFR	11	
190.	0.8 km N. " "	37°13.90'	122°24.85'	EXR	43	
191.	1.0 km N. " "	37°13.98'	122°24.94'	OFR	20	
192.	0.2 km N. Pescadero Pt.	37°14.56'	122°25.11'	OFR	10	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
193.	0.3 km N. Pescadero Pt.	37°14.66'	122°25.11'	OFR	8	
194.	Butano Creek Mouth	37°16.04'	122°24.84'	OFR	45	
195.	Eel Rock	37°24.48'	122°25.66'	OFR	34	
196.	Miramontes Point	37°26.48'	122°26.66'	OFR	7	
197.	Sail Rock, Pillar Point	37°29.59'	122°29.98'	OFR	115	
198.	1.0 km N. Pillar Point	37°30.29'	122°30.21'	OFR	118	
199.	1.5 km N. " "	37°30.46'	122°30.56'	EXR	12	
200.	Moss Beach (Seal Cove)	37°30.54'	122°30.83'	EXR	7	
201.	Moss Beach (N. Seal Cove)	37°30.61'	122°30.83'	OFR	30	
202.	Pt. San Pedro (N. Side)	37°35.70'	122°31.14'	EXR	31	
203.	Guadalupe Slough	37°26.70'	122°02.14'	HES	4	
204.	Calaveras Point	37°28.02' to 37°28.68'	122°02.99' to 122°03.12'	HES	14	4-14
205.	Mowry Slough	37°29.32' to 37°29.58'	122°01.98' to 122°03.07'	HES	327	
206.	Plummer Creek	37°30.12' to 37°30.35'	122°04.95' to 122°05.13'	HES	(included in 205)	
207.	Greco Island	37°31.05' to 37°31.26'	122°10.78' to 122°10.86'	HES	65	
208.	Corkscrew Slough	37°38.79'	122°12.88'	HES	17	
209.	Yerba Buena Island			OFR	2	
210.	0.4 km W. Blunt Pt., Angel Isl.	37°51.27'	122°25.23'	OFR	1	
211.	Sausalito Small Craft Harbor	37°52.30'	122°29.69'	Floats	30	
212.	Strawberry Spit	37°53.27'	122°29.89'	EXR	97	
213.	Castro Rocks	37°55.97'	122°24.98'	OFR	85	
214.	Tubbs Island	38°07. '	122°26. '	HES	8	
215.	Pt. Bonito (0.6 km N. on inside)	37°49.24'	122°31.59'	OFR	34	
216.	0.4 km N. Tennessee Cove	37°50. '	122°33. '	OFR	1	
217.	Bolinas Lagoon	37°54.68'	122°40.06'	HES	138	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
218.	Duxbury Reef	37°53.30'	122°41.77'	EXR+OFR	164	
219.	Bolinas Point	37°54.16'	122°43.54'	EXR	5	
220.	Rocks at S edge Double Point	37°56.58'	122°46.54'	EXR	93	3-93
221.	Double Point Beach	37°56.80'	122°46.54'	OBE	822	56-280
222.	Beach 0.4 km N. Double Point	37°57. '	122°47. '	OBE	11	
223.	Millers Point	37°59.08'	122°48.64'	OFR	1	
224.	Limantour Spit	38°02.50'	122°55.77'	HES	(included in 225)	
225.	Drakes Estero	38°02.00' to 38°03.70'	122°55.78' to 122°56.74'	HES	726	46-652
226.	1.7 km W. Chimney Rock	37°59.51'	122°58.83'	OFR	10	
227.	1.8 km W. " "	37°59.55'	122°59.03'	OFR	34	
228.	1.9 km W. " "	37°59.50'	122°59.07'	OFR	29	
229.	2.1 km W. " "	37°59.57'	122°59.17'	OFR		
230.	2.5 km W. " "	37°59.61'	122°59.51'	OFR	7	
231.	2.7 km W.	37°59.55'	122°59.57'	OBE	101	
232.	3.6 km W. " "	37°59.58'	123°00.22'	OBE+OFR	64	
233.	3.7 km W. " "	37°59.01'	122°00.31'	EXR	31	1-24
234.	4.2 km W. " "(Sea Lion Cove)	37°59.70'	123°00.58'	OFR	13	
235.	4.3 km W. " "(Sea Lion Cove)	37°59.70'	123°00.67'	OFR	17	
236.	1.4 km S. Elephant Rock	38°10.23'	122°57.22'	EXR	19	
237.	0.6 km S. " "	38°10.69'	122°57.50'	EXR	1	
238.	0.2 km E. " "	38°10.80'	122°57.80'	OFR	12	
239.	N. End Driftwood Beach	38°12.18'	122°58.12'	OFR	1	
240.	3.2 km S. Bird Island	38°13.30'	122°58.29'	OFR		
241.	2.9 km S. " "	38°12.50'	122°58.42'	OBE+EXR	122	
242.	1.7 km S. " "	38°13.05'	122°58.88'	OFR	2	
243.	0.7 km SE " "	38°13.55'	122°59.18'	OBE+EXR	53	3-53
244.	0.6 km SE " "	38°13.67'	122°59.20'	EXR	86	4-59
245.	Bird Island	38°13.77'	122°59.57'	OFR	419	16-165

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
246.	0.6 km S. Tomales Bluff	38°14.12'	122°59.56'	ONR	12	
247.	Tomales Bluff	38°14.47'	122°59.61'	EXR	5	
248.	0.5 km N. Toms Pt., Tomales Bay	38°13.00' to 38°13.50'	122°57.26' to 122°57.50'	HES	338	23-238
249.	Hog Island (E. Spit)	38°11.90'	122°55.88'	HES	236	2-27
250.	Pinnacle Rock Area	38°18. '	123°01. '	OFR	3	
251.	Bodega Rock	38°17.75'	123°02.82'	OFR	115	
252.	New Bodega Head	38°17. '	123°03. '	EXR	11	
253.	Mussel Point	38°19.32'	123°04.63'	EXR	11	
254.	Arched Rock S. Carmet	38°22.20'	123°04.40'	EXR	9	
255.	0.7 km S. Duncans Pt.	38°23.47'	123°05.21'	OFR	8	
256.	0.3 km E. " " (Cove)	38°23.65'	123°05.46'	OFR	8	
257.	Wrights Beach	38°24.27'	123°06.01'	OFR	47	
258.	Furlong Gulch Area	38°24. '	123°06. '	OFR	1	
259.	0.9 km N. Shell Beach	38°25.28'	123°06.84'	OFR	1	
260.	1.2 km N. " "	38°25.39'	123°06.90'	OFR	2	
261.	Penny Island, Russian River	38°26.75'	123°06.83'	Up river logs	3	
262.	Russian River Spits	38°27.02'	123°07.64'	HES	190	
263.	1.3 km N. Russian River	38°27.34'	123°08.51'	OFR	31	
264.	1.6 km N. " "	38°27.39'	123°08.67'	OFR	2	
265.	2.0 km N. " "	38°27.61'	123°08.90'	OFR	10	
266.	1.6 km N. Russian Gulch	38°28.60'	123°10.18'	OFR	13	
267.	1.7 km N. " "	38°28.59'	123°10.26'	OFR	5	2-8
268.	1.9 km N. " "	38°28.63'	123°10.32'	EXR	8	
269.	0.3 km S. Meyer Gulch	38°28.96'	123°10.87'	OFR	13	2-13
270.	1.8 km S. Fort Ross Reef	38°29.75'	123°12.46'	OFR	9	
271.	0.3 km S. " "	38°30.10'	123°13.59'	OFR	28	
272.	Fort Ross Reef	38°30.06' to 38°30.12'	123°13.92' to 123°13.75'	EXR	12	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
273.	0.2 km N. Fort Ross Reef	38°30.23'	123°13.85'	EXR-OFR	49	
274.	Fort Ross Cove	38°30.68'	123°14.63'	OFR	22	
275.	Northwest Cape (0.1 km S)	38°30.70'	123°15.17'	EXR	20	
276.	Northwest Cape	38°30.72'	123°15.27'	OFR	2	
277.	0.3 km N. Northwest Cape	38°31.87'	123°15.22'	EXR	51	3-51
278.	0.9 km N. " "	38°31.12'	123°15.54'	EXR		
279.	0.2 km S. Windermere Point	38°31.42'	123°16.01'	EXR	9	
280.	0.1 km N. " "	38°31.55'	123°16.09'	OFR	1	
281.	0.5 km N. Timber Cove Gr.	38°31.88'	123°16.68'	OFR	11	
282.	0.9 km N. " "	38°32.15'	123°16.91'	ONR	20	
283.	Stillwater Cove (inside)	38°32.78'	123°17.96'	OFR	10	
284.	Salt Point	38°33.90'	123°19.98'	EXR	29	
285.	0.3 km N. Salt Point	38°34. '	123°20. '		57	
286.	0.8 km N. " "	38°34.23'	123°20.26'	OFR		
287.	0.3 km S. Chinese Gulch	38°35.21'	123°20.54'	OFR	64	
288.	0.7 km N. Cannon Gulch (Fisk Mill Cove)	38°35.82'	123°21.47'	OFR	2	
289.	0.7 km S. Horseshoe Point	38°36.14'	123°21.94'	OFR	10	
290.	0.7 km N. " "	38°36.76'	123°22.02'	OFR	31	
291.	0.7 km N. Horseshoe Cove	38°36.95'	123°22.42'	EXR	1	
292.	0.5 km S. Rocky Point	38°37.62'	123°23.15'	ONR	1	
293.	Sandy Point	38°38.65'	123°23.98'	ONR	18	
294.	0.7 km S. Stewarts Point	38°38.98'	123°24.15'	OFR	4	
295.	0.2 km S. " "	38°39.19'	123°24.39'	ONR	40	
296.	Stewarts Point Island	38°39.28'	123°24.50'	ONR	52	4-52
297.	0.6 km N. Stewarts Point	38°39.58'	123°24.54'	OFR	2	
298.	1.0 km S. Blacks Point	38°40.48'	123°25.31'	OFR	26	
299.	0.4 km N. " "	38°40.90'	123°26.33'	OFR	25	1-25
300.	2.8 km N. " "	38°42.06'	123°27.08'	OFR	1	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
301.	3.8 km N. Black Point	38°42.48'	123°27.16'	OFR	1	
302.	5.2 km N. " "	38°42.92'	123°27.63'	OFR	125	1-87
303.	6.0 km N. " "	38°43.27'	123°28.21'	OFR	10	
304.	6.2 km N. " "	38°43.30'	123°28.27'	OFR	39	2-26
305.	6.7 km N. " "	38°43.46'	123°28.64'	OFR	45	
306.	7.1 km N. " "	38°43.58'	123°28.92'	OFR	1	
307.	7.3 km N. " "	38°43.67'	123°29.00'	OFR	131	10-131
308.	7.4 km N. " "	38°43.71'	123°29.02'	OFR	38	
309.	7.7 km N. " "	38°43.74'	123°29.09'	EXR	18	
310.	1.3 km S. Del Mar Pt.	38°44.25'	123°29.90'	OFR	3	
311.	Del Mar Pt.	38°44.95'	123°30.75'	EXR	8	
312.	1.3 km N. Del Mar Pt.	38°45.12'	123°31.42'	EXR	6	
313.	Gualala Pt.	38°45.12'	123°31.60'	EXR	27	
314.	Robinson Reef	38°46.04'	123°32.74'	OFR	4	
315.	Bourns Rock	38°46.73'	123°33.37'	OFR	39	
316.	Fish Rocks	38°48.05'	123°35.44'	OFR	27	
317.	Havens Neck (0.3 km N., inside cove)	38°48.62'	123°35.87'	OFR	13	2-13
318.	1.2 km N. Havens Neck	38°49.21'	123°36.19'	OFR	15	
319.	0.6 km S. Steen's Landing	38°49.48'	123°36.69'	OFR	5	
320.	Morrison Gulch	38°50.38'	123°37.99'	ONR/OFR	57	1-42
321.	Iverson's Landing (S. side)	38°50.67'	123°38.51'	OFR	4	
322.	" " (N. side)	38°50.72'	123°38.66'	OFR		
323.	Saunders Reef area (inside)	38°52. '	123°40. '	OFR	25	
324.	0.8 km N. Galloway Cr.	38°53.41'	123°39.79'	OFR	36	
325.	0.8 km S. Arena Cove	38°54. '	123°42. '		6	
326.	Pt. Arena	38°57.38'	123°44.42'	OFR	84	
327.	0.4 km N. Mallo Pass Cr.	39°02.21'	123°41.49'	EXR	33	
328.	0.9 km N. " " "	39°02.52'	123°41.59'	OFR	48	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
329.	1.0 km N. Mallo Pass Cr.	39°02.52'	123°41.59'	OFR	2	
330.	0.6 km S. S. Elk Cr.	39°05. '	123°42. '	OFR	32	
331.	Elk Cr.	39°06. '	123°42. '	OFR		
332.	Cuffey's Pt.	39°08.70'	123°44.39'	OFR	176	
333.	Devil's Basin	39°10. '	123°44. '	OFR	35	
334.	0.3 km S. Saddle Pt.	39°10.48'	123°45.03'	OFR	45	
335.	0.2 km S. " "	39°10.53'	123°45.06'	OFR	4	
336.	0.4 km S. Salmon Pt.	39°12. '	123°46. '	OFR	12	
337.	1.8 km N. Albion Head	39°14. '	123°47. '	OFR	33	
338.	0.2 km N. Stillwell Pt.	39°15.35'	123°47.03'	OFR	48	
339.	Van Damme S.B.	39°16.18'	123°47.66'	OFR	38	2-28
340.	0.7 km N. Van Damme S.B.	39°16.31'	123°48.01'	ONR	0	
341.	1.5 km N. Van Damme S.B.	39°17.31'	123°48.01'	OFR	49	
342.	near Goat Isl., Mendocino City	39°18.34'	123°48.70'	OFR	32	
343.	0.6 km N. Goat Island	39°18.67'	123°48.59'	OFR	27	
344.	1.2 km N. Russian Gulch	39°20.03'	123°48.98'	OFR	18	
345.	Point Cabrillo	39°21.02'	123°49.69'	OFR	31	
346.	Caspar Anchorage area	39°21. '	123°49. '			
347.	S. Mitchell Cr.	39°23. '	123°49. '			
348.	Soldier Pt. Area	39°26. '	123°49. '			
349.	0.7 km N. Soldier Pt., Ft. Bragg area	39°26.72'	123°48.91'	OFR	51	
350.	1.8 km N. Pudding Cr.	39°28.48'	123°48.21'	OFR	27	
351.	0.8 km S. Laguna Pt.	39°29. '	123°48. '	OFR	2	
352.	Laguna Pt.	39°29.38'	123°48.24'	EXR	183	
353.	0.3 km N. Kibesillah Rock	39°34.94'	123°46.72'	OFR	55	
354.	Bruhel Pt.	39°36.28'	123°47.20'	OBE	30	
355.	Bell Pt.	39°37.66'	123°47.27'	OFR	9	
356.	Cape Vizcaino	39°43.66'	123°49.81'	OFR	51	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
357.	0.4 km N. Cottoneva Cr.	39°44.30'	123°49.88'	OFR		
358.	Williams Pt.	39°45. '	124°50. '	EXR	25	
359.	0.3 km N. Soldier Frank Pt.	39°45. '	124°50. '	OFR	5	
360.	0.5 km S. Anderson Gulch	39°50.91'	124°53.11'	OBE	58	
361.	0.3 km S. Anderson Gulch	39°51.01'	124°53.21'	OBE	97	
362.	0.3 km N. " "	39°51.16'	124°53.44'	OBE	21	
363.	Northpoint Cove	39°51.32'	124°53.57'	OBE	839	
364.	0.6 km N. Mistake Pt.	39°51.85'	124°54.41'	OBE	13	
365.	Jackass Creek area	39°51. '	124°54. '	OBE	52	
366.	Seal Rock 1.5 km S. Bear Harbor	39°54.08'	124°55.61'	OFR	16	
367.	Pt. No Pass	39°58. '	124°59. '	OFR	10	
368.	1.4 km N. Pt. Delgada	40°01.76'	124°04.82'	OFR	43	
369.	5.0 km N. Big Flat Cr.	40°09. '	124°12. '	OFR	11	
370.	Sea Lion Gulch	40°14. '	124°20. '			
371.	1.7 km S. Punta Gorda	40°14. '	124°21. '	OFR	25	
372.	1.3 km S. " "	40°14. '	124°21. '	OFR	3	
373.	Hair Seal Rock	40°19.67'	124°21.14'	OFR	172	
374.	1.6 km N. Hair Seal Rock	40°20. '	124°21. '	OFR	76	
375.	2.2 km N. " " "	40°20. '	124°21. '	EXR	10	
376.	2.7 km N. " " "	40°20. '	124°21. '	EXR	1	
377.	1.7 km S. Sugarloaf Rock	40°25. '	124°24. '	OFR	4	
378.	0.4 km S. " "	40°26.12'	124°24.56'	OFR	5	
379.	0.2 km S. " "	40°26.24'	124°24.66'	OFR	1	
380.	0.3 km S. Sugarloaf Rock	40°26.48'	124°24.69'	OFR	15	
381.	False Cape	40°30.60'	124°23.17'	OFR	46	
382.	Fel River Spit	40°38.41'	124°18.75'	HES	442	
383.	S. Humboldt Bay	40° '	124° '	HES	487	
384.	Daby Island	40°48.68'	124°08.97'	HES	5	
385.	N. Humboldt Bay	40°50.30' to 40°50.38'	124°06.50' to 124°06.55'	HES	84	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
386.	Luffenholtz Cove	41°02.44'	124°07.20'	OFR	2	
387.	Cap Rock	41°02.65'	124°07.51'	OFR	17	
388.	Tower Rock	41°03.10'	124°07.80'	EXR	39	
389.	Seal Rock Shoals	41°03.04'	124°07.96'	OFR	31	
390.	Jamieson Cove	41°03.25'	124°08.14'	OFR	79	
391.	Dome Rock	41°03.39'	124°08.43'	OFR	43	
392.	Lighthouse Shoals	41°03.40'	124°08.63'	OFR	19	
393.	Marine Lab Shoals	41°03.52'	124°09.45'	OFR	93	
394.	Flatiron Shoals	41°03.60'	124°09.61'	OFR	22	
395.	Myers Cove	41°04.29'	124°09.46'	OFR	23	
396.	Bench Cove	41°05.36'	124°09.32'	EXR	23	
397.	Seal Rock	41°05.90'	124°09.56'	OFR	11	
398.	Seagull Rock	41°07.45'	124°09.72'	OFR	15	
399.	Midway Rock	41°07.48'	124°09.72'	OFR	69	
400.	Close Rock	41°07.51'	124°09.65'	EXR	62	
401.	Flat top Rock	41°07.52'	124°09.84'	OFR	24	
402.	Little Gibralter	41°07.58'	124°09.72'	OFR	15	
403.	Spearhead	41°07.63'	124°09.88'	EXR	27	
404.	Palmers Pt.	41°07.75'	124°09.84'	EXR	31	
405.	Cannonball Beach	41°07.88'	124°09.80'	EXR	27	
406.	Sharp Pt.	41°14.18'	124°06.48'	ONR	55	
407.	Redwood Creek Spits	41°17.55'	124°05.34'	HES	9	
408.	Major Creek	41°19.74'	124°05.01'	OFR	10	
409.	Klamath R Spits	41°32.71' to 41°32.82'	124°04.75' to 124°04.74'	HES	341	
410.	N. Klamath Rock	41°33.16'	124°05.41'	OFR	31	
411.	Saddle Rocks	41°33.68' to 41°33.80'	124°05.76' to 124°05.78'	OFR	20	
412.	Klamath Cove	41°33.98' to 41°34.13'	124°05.86' to 124°06.01'	OFR	56	

APPENDIX II - Continued

Site No.	Location	Latitude	Longitude	Description	Maximum count	Rookery count (pup-total)
413.	Two Rocks	41°34.35' to 41°34.46'	124°06.09' to 124°06.07'	OFR&ONR	50	
414.	Scat Beach	41°40.23'	124°08.22'	OBE	201	
415.	Millers Point	41°40.35'	124°08.45'	EXR	100	
416.	Mates Point	41°40.97'	124°08.41'		61	
417.	Battery Point	41°44.81'	124°12.34'	EXR	3	
418.	Castle Rock	41°45.68' to 41°46.00'	124°14.55' to 124°14.53'	OFR	354	
419.	Pt. St. George	41°46.00'	124°15.53'	OFR	3	
420.	Mouth of Smith River	41°56.37' to 41°56.52'	124°11.82' to 124°11.82'	HES	9	
421.	NW Seal Rock	41 '	124 '	OFR	9	
422.	Farallon Islands (There are actually four separate sites in Southeast Farallon, and the coordinates given are near center of the island.)	37°42.00'	123°00.00'	OFR	84	

APPENDIX III

Harbor Seal Counts by Ground Observers. Counts are given in quarter hour intervals before and after low tide. Upper values are hauled-out animals, lower values are animals in the water near the hauling site.

Appendix III. Harbor seal counts by ground observers. Counts are given in quarter hour intervals before and after low tide. Upper values are hauled-out animals, lower values are animals in the water near the hauling site.

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1981																						
384	4	91/2	90/2	87/2	97/1	96/0	94/3	95/3	98/0	100/2	103/1	101/2	100/2	90/3	90/0							
384	21						241/6	260/8	267/6	290/3	296/2	300/2	301/3	299/4	290/1	292/1	296/0	292/2	287/2	269/4	261/5	252/7
384	25					233/3	235/5	237/7	241/7	256/6	265/6	261/8	256/6	245/5	240/4	241/3	238/4	240/3	237/5	239/4	240/2	236/6
384	28	278/7	280/4	281/6	283/4	296/5	291/8	293/7	289/7	293/8	298/6	299/10	288/7	293/6	294/5	290/3	288/6	286/6	283/4	279/2	276/2	268/3
June 1981																						
2	21										22/0	23/0	19/0	20/0								
2	22								18/1	22/2	24/0	23/1	24/0	25/1								
2	23									13/2	18/0	17/1	17/0	17/0								
4	22								83/0	83/0	82/0	84/0	84/0	87/0	92/0	92/0						
4	23										70/0	85/0	85/0	86/0	88/0	86/0	86/0	93/0	96/0			
10	22*							25/0	0/5	0/3	0/7	0/13	0/8	0/5	0/7	0/5						

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
June 1981 - Cont'd																						
10	23*									0/7	0/11	0/10	0/5	0/5	0/6	0/3						
10	24*									0/4	0/3	0/2	0/0	0/0	0/1	0/3	0/3	0/4	0/6			
25	23								60/2	56/7	59/2	48/6	53/1	50/0	53/0	52/0	49/2	49/0	47/0	15/5		
142	22					14/0	14/0	17/0	17/0	16/0	16/0	16/0	16/0	14/0	14/0	16/0	14/0	14/0	14/0	16/0		
142	23					17/0	21/0	21/0	21/0	22/0	20/0	21/0	20/0	21/0	23/0	24/0	19/0	24/0	25/0	23/0		
142	24						25/0	28/0	26/0	29/0	29/0	27/0	28/0	31/0	29/0	30/0	30/0	27/0	26/0	24/0		
145	22				8/1	10/0	11/0	11/1	12/0	12/0	12/1	13/0	13/0	13/0	13/0	13/0	13/0					
145	23					10/0	10/0	10/0	10/0	10/0	11/0	11/0	10/0	10/1	10/0	8/0	9/0	9/0	8/1	7/0		
145	24				11/0	12/0	11/0	11/0	11/0	10/1	11/0	11/0	11/0	11/0	11/0	10/0	10/0	10/0				
147	22					10/0		11/0		10/1		14/1		15/1				19/2				
147	23					26/3		29/5		37/6		33/0		36/0		32/3						

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
June 1981 - cont'd																						
147	24						43/1	41/1	42/0	40/1	40/0	41/0	41/0	45/0	42/1	44/0	48/0	48/0				
152	22					35/0	39/0	41/0	40/2	42/0	42/0	40/1	38/0	39/2	36/0	37/2	29/0	26/0				
152	23					39/1	41/0	38/0	39/1	41/0	39/0	39/0	40/0	32/0	29/0	27/0	21/2	19/1				
153	22		16/0		19/0		21/0		21/3		18/0		32/0		28/0	32/0						
153	23			28/0	29/0	33/0	35/0	35/0	33/2	34/0	37/0	37/0	37/1	37/2	36/0	33/0	35/0					
153	24				23/0	22/1	24/1	27/0	24/0	32/1	26/0	28/0	31/0	33/0	29/0	32/0	31/0	34/0				
154	22			25/0		33/0		39/0		37/0		39/0		37/0		32/0						
154	23			22/1	23/0	23/0	24/0	23/0	24/0	25/1	26/0	25/0	22/0	23/0								
154	24					33/0	30/0	37/0	35/1	37/0	33/0	36/0	35/0	37/0								
155	22							40/0	44/0	42/0	42/0	41/0	44/1	34/5	39/1	41/0	42/0	42/0				
155	23				44/0	45/0	44/1	44/0	41/1	35/1	35/0	34/0	34/0	34/0	35/0	35/0	32/0					

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
June 1981 - cont'd																						
155	24					30/0	30/1	31/0	31/0	32/0	32/0	32/2	32/0	33/0	33/0	32/0	32/0	32/0				
157	22					75/1	87/0	97/0	98/0	100/0	108/0	125/0	132/0	122/1	128/0	135/0	132/0					
157	23					131/0	131/2	136/0	135/0	143/1	150/0	147/0	155/0	151/1	144/0	144/0	148/2					
162	22											84/2					78/2					
162	23											86/0		67/7								
162	24									90/1				94/1								
165	22				9/1	9/1	8/0	9/0	9/0	9/1	9/1	9/0	10/0	11/1	11/1	12/1	10/2	10/2	10/2		16/2	
165	23					17/0	21/5	23/0	23/0	23/2	22/2	19/1	19/1	21/1	23/2	22/3	20/2	21/2	22/1	22/1	25/1	15/3
384	18					185/0	208/0	218/0	230/0	236/0	236/0	242/0	241/0	239/0	234/0	246/0						
390	17												30/0	38/0	40/0	39/0	38/0	39/0	34/0	40/0	35/0	38/0
390	18									38/0	39/0	38/0	43/0	41/0	45/0	48/0	46/0	42/0	43/0			

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
June 1981 - cont'd																						
San Clemente Island	June 24																			41/1	45/2	45/2
San Clemente Island	June 25								12/1	25/2	24/0	24/0	28/2	34/0	29/0	28/0	30/0	30/1	35/1	35/1	40/2	39/2
San Nicolas Island	June 24							47/5	51/2	52/1	52/0	54/0	54/0	54/0	54/1							
April 1982																						
1	16					15/0	15/0	16/0	17/0	17/0	17/0	17/0										
1	17*						19/0	19/0	15/0	4/0	6/0	6/0										
1	18*					13/0	13/0	9/2	9/2	8/0	8/1	8/0	7/0	7/0	7/0	7/0	8/0					
2	19*							13/1	14/0	14/0	14/0	4/10										
2	20*						4/0	2/2	4/0	4/0	3/3	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0			
4	15											50/4	54/2	33/6	37/9	40/6	44/6	42/10	46/5	61/0	59/2	62/1
4	16																			29/2	23/7	35/4

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
4	17*					51/2	56/3	57/2	41/5	52/2	59/1	13/16	8/6	21/4	10/4	18/0	20/5	24/3	23/1	22/3	25/0	
4	18*									43/6	36/10	41/7	41/9	16/13	21/8	18/4	21/3	13/1	11/2	3/4		
4	19	44/13	46/11	43/11	40/17																	
5	16*						27/1	30/3	7/5	7/4	6/4	8/6	7/6	8/3	6/4	5/6	4/7	3/5	1/5	0/6		
5	19						15/4	16/5	15/3	14/0	16/0	19/0	19/0	20/0	20/0	21/0	19/3	9/4	6/8			
5	20*							19/1	19/1	17/0	0/7	0/6	0/5	0/7	0/5	0/7	0/5	0/7	0/9	0/5		
6	16							0/0	0/2	4/1	5/4	5/4	12/2	10/2	15/2	12/3	13/2	11/3				
6	19							22/1	18/3	24/1	25/0	17/4	21/1	21/2	23/1	22/1	23/0	23/0	26/0	23/1		
6	20					5/0	10/1	11/0	14/0	18/0	16/2	16/1	20/1	21/0	21/0	19/1	19/0	18/0				
7	16*							29/2	12/5	8/3	6/9	11/4	9/3	6/2	6/2	5/3	4/6	3/5				
7	18							14/7	13/4	13/3	13/4	12/3	14/3	13/3	13/4	10/1						

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
7	19*						24/0	24/1	16/5	20/0	18/1	12/0										
7	20*						20/0	31/0	21/3	21/2	18/2	16/2	16/4	17/3	18/3	17/2	18/3	17/1	16/6			
10	15*						65/0	68/2														
10	16*				13/5	14/6	0/13	0/10	0/15	0/6	0/7	0/6	0/8	0/7	1/9	12/10	22/10					
10	17*					2/11	2/12	3/11	2/11	2/12	2/16	2/14	1/12	2/14	2/16	1/13	2/15	1/17				
10	18*				3/14	12/7	2/15	2/14	2/12	2/14	2/13	2/17	4/12	2/17	2/15	2/14						
10	19*					34/6	41/7	25/6	23/6	9/9	0/6	0/7	0/8	0/8	0/6	0/13	1/13	0/8				
10	20*					0/14	0/12	0/10	0/6	0/14	9/7	15/5	18/5	25/4	35/2	27/8	46/7					
11	16	67/5	81/9	80/13	85/15	110/10	109/7	105/6	117/7	130/11	145/6	141/10	148/10	145/12	163/14	164/9	182/1	199/8	196/4			
11	17														216/0							
11	18					198/0						215/0										

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
11	19								165/12	157/12	161/14	160/20	187/23	208/10	210/9	185/8	194/6	216/5	210/6			
11	20	99/10	116/17	112/16	145/13	158/9	170/12	178/3	183/1	193/5	195/3	181/16	198/4	183/2	205/5	194/3	206/1	223/1	242/1	226/4	233/3	
74	17					20/4	23/2	29/0	30/0	31/1	31/4	30/1	34/0	34/2	35/1	33/9	32/4	32/2				
74	18						32/3	33/1	32/1	38/0	40/0	38/0	35/2	29/3	34/0	32/1	33/0	27/1				
74	19					33/0	26/1	31/1	30/2	26/5	29/0	32/4	31/1	28/0	23/0	20/3	18/2	16/1				
74	20					21/0	24/0	22/1	23/1	24/1	27/0	30/0	27/1	30/0	30/0	26/0	25/0	19/0				
78	17*					42/0	44/0	46/0	43/0	20/0	25/0	28/0	32/0	45/0	45/0	43/0	47/0	40/0				
78	18					14/2	15/3	16/0	17/0	18/0	17/0	22/0	22/0	23/0	27/3	30/0	27/0	27/1				
78	19				50/2	50/0	54/0	50/0	50/0	48/0	47/0	44/0	42/0	40/2	38/0	44/0	45/0	47/0	40/0	36/0	28/2	
78	20								42/0	51/0	48/0	48/0	43/0	43/0	53/0	48/0	46/0	46/0	42/0	35/0	27/0	22/0
79	17					36/0	38/0	30/0	29/0	31/0	30/0	30/0	27/0	29/0	28/0	33/0	31/0	30/0				

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
79	18						37/1	43/0	43/0	40/2	40/0	40/0	42/0	43/0	41/0	38/0	41/0	38/0	41/1			
79	19				39/1	42/0	39/0	38/0	42/0	41/0	34/0	38/0	42/0	42/0	44/0	42/0	41/0	41/0	39/0	37/1	39/0	
79	20							34/0	31/0	31/0	31/0	33/0	25/0	23/0	26/0	25/0	22/0	20/0	17/0	18/0	17/0	
142	18							10/0	12/0	12/0	12/0	12/0	11/0	12/0	12/0	8/0	7/0	8/0	7/0			
142	19						10/0	11/0	11/0	10/0	11/1	11/0	11/0	10/0	10/0	9/0	8/0	7/1				
142	20						10/1	11/0	12/0	12/0	12/2	12/2	12/2	12/0	12/0	11/0	13/0	12/2				
144	17						24/0	25/0	27/0	28/0	28/0	27/1	27/0	28/0	27/1	28/0	28/0	28/0				
145	18										20/3	18/0		18/0		18/2		15/2			10/2	
145	19					17/0	18/1	17/0	19/1	19/0	19/0	21/0	23/0	23/0	23/0	20/1	22/0	18/1				
146	19							3/0	4/0	4/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	4/0			
147	18												22/0		18/1							

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
147	19						20/4	21/3	22/2	23/1	21/3	22/2	22/3	22/2	21/2	19/5	19/5	18/5	18/4	18/5		
148	19							31/1		28/2		36/1		30/2		31/2		30/2		30/4		
152	17					21/0		21/0		21/0		25/0		28/0		26/1		26/0				
152	18*							21/1		22/0		11/2		13/0		14/0		15/1		13/3		
152	19							25/0		26/0		25/0		26/0		27/0		29/0		25/0		27/0
152	20					35/0		29/0		28/0		31/0		30/0		31/0		31/0				
153	17					12/0	12/0	12/0	15/0	15/3	15/0	15/2	14/2	14/2	14/2	14/3	16/2	11/2				
153	18*							16/0		16/0		5/0		5/0		5/0		5/0		7/0		
153	19							13/2		12/1		13/0		14/0		14/3		14/2		8/8		
154	19						12/2	13/2	13/3	14/3	16/3	18/2	18/2	18/3	19/2	19/1	17/2	18/2	16/2			
155	17									45/0		43/0		44/0		43/0		42/0				

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
156	19										39/0	41/0		39/0		42/0		43/0		48/0		45/0
156	20						49/0		53/0		56/0	55/0		54/0	55/0	56/0		63/0	59/0			
157	17					117/0		138/0		130/0		131/0	133/0	129/2		133/0		132/1				
157	18							137/2		140/0		139/1		145/0		143/2	144/0	142/2		124/10		
157	19					141/0		142/0		143/0		143/0		144/1		145/0		142/0		134/8		
157	20							123/2		126/2		127/2		123/0		141/0		131/3				
160	17					27/0		27/0		24/0		26/0		29/0		30/0						
160	18								30/0			30/0		33/0	31/0	32/0		27/0		15/0		
160	19						25/0		25/1		26/0	26/0		27/0		26/0		30/0	27/1	22/0		
160	20					30/0		31/0		27/0		31/0		29/0		20/0		17/4				
161	17						6/0		7/1		11/1	11/1		7/0		5/0						

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
161	18*							0/1		0/0		0/0		0/0		0/0		0/0				
161	19							7/0		7/0		7/0		7/0		4/0						
161	20						7/1		11/0		14/1	15/0					17/0		13/1			
162	17*									90/2	101/0	94/1	101/2	89/5	92/0	88/0	80/0	87/0	88/0	51/0		
162	18										93/0	96/0		97/0		97/0		97/0		96/0		68/0
162	19								97/1		100/5		92/1		72/2							
162	20									69/0		83/0				88/0						
165	19			1/3	1/1	1/2	0/4	0/2	0/1	1/1	0/0	0/2	0/0	0/2	0/1	0/2						
165	20				23/0	25/3	27/1	28/2	29/3	29/0	29/1	28/1	29/0	30/0	31/0	33/0	33/1	33/0	33/1			
165	21						21/2	21/1	21/1	20/0	19/5	17/3	17/2	13/1	13/0	13/1	12/0	11/1	13/0			
165	22						0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0			

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
166	19			68/0	61/0	74/0	67/0	77/0	77/0	77/0	77/0	84/0	85/0	86/0	86/0	85/0						
166	20						1/0	6/0	10/0	13/0	18/0	27/0	29/0	33/0	33/0	37/0	39/0	41/0				
166	21				84/2	84/1	81/2	81/0	82/1	82/2	85/3	84/3	84/4	83/0	84/2	83/2	82/1					
166	22							63/0	62/2	62/1	64/1	62/1	62/0	62/0	56/0	55/1	55/1	56/1	56/2			
169	19				23/0	18/0	31/2							32/1	32/1							
169	20								39/0	39/0												
169	21*						26/0	32/0							0/0							
169	22									23/0	27/0	28/0	25/0	26/0	28/0	27/0	28/0	27/0				
174	19							56/0	57/0				46/0									
174	20											80/0										
174	21*								84/0	53/0	61/0			73/0		51/0	0/0					

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
174	22											86/0	86/0	85/0				81/0	81/0			
175	19									78/0	78/0	80/0										
175	20			39/0	46/0	50/0						70/2	76/2									
175	21											70/0	74/0	74/0								
175	22														81/0	81/0	81/0					
190	19											14/1		15/0		16/0		16/0		16/0		
190	20							8/0	9/0	12/0	13/0	16/0		16/0		16/0						
190	21							3/0		6/0		16/0	18/0			19/0						
190	22		6/0		6/0			7/0	7/0	7/0		8/0		10/0		10/0						
191	19											13/1		13/1	13/1	12/1	12/1	14/1	12/1		13/1	
191	20*					18/0	18/1	16/0	12/1	4/7	5/3	5/2	6/2	8/1	8/1	9/3	9/0	9/1	8/1			

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
191	21						21/0	17/0	13/0	14/0	14/0	14/0	14/0	14/0		11/0	11/0					
191	22					14/0	16/0	17/0	18/0	19/0	19/0	19/2	19/2	16/2								
192	19											23/0	23/0			25/1	24/0	24/0				
192	20				34/0		34/0	27/0	26/0	26/0	26/1	26/1	25/0	26/0		26/2		26/0				
192	21				24/0		19/0	17/0	13/0	11/0		17/0		13/0		15/0						
192	22				15/0		15/0	10/0			10/0	10/0	10/0	10/0	10/0							
194	19							25/0	26/0	26/0	22/0	21/0	21/0	21/0	19/0	18/0	18/0	17/0	17/0	17/0		
194	20				20/0	20/0	20/0	19/0	19/0	16/0	16/0	16/0	16/0	16/0	16/0	15/0	15/0					
215	19		4/3	9/1	10/0	10/1	12/0	11/2	14/0	14/0	12/1	12/1	10/2	11/0	11/0	11/0						
215	20			8/1	9/0	10/1	10/1	10/1	11/0	12/0	12/0	12/0	10/0	12/0	12/1	11/1	11/0	11/0				
215	21			14/0	11/3	14/3	15/3	16/1	17/1	15/5	15/3	15/2	16/3	16/2	16/3	16/2	15/2	9/3	9/4			

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
215	22				4/4	5/1	5/1	5/2	5/4	5/2	2/2	2/5	1/0	2/2	1/3	1/2	1/3					
422	19						40/1	43/1	48/0	51/0	49/0	49/0	40/1	47/0	46/0	47/1	48/1					
422	20								41/0	41/0	44/0	47/1	47/0	44/1	46/0	48/2	48/1	46/2	48/2	45/3	45/3	
422	21					41/0	39/0	45/1	45/0	43/1	46/0	43/0	45/0	40/2	45/0	44/2	44/0	45/0				
422	22				34/1	36/0	36/0	37/0	35/1	37/0	37/1	37/0	37/0	42/2	45/0	47/0	48/0					
221	20*								208/134		266/70					334/131		375/73				
221	21*					211/124				196/154		201/190				200/NC						
221	22						576/0						538/0									
221	23						646/46															
225	20									543/0				500/0				459/0				
225	22										457/0				479/0				467/0			

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
262	17	165/4	157/3	159/3	166/6	169/5	169/4	174/2	170/6	176/4	178/3	178/2	178/3	179/1	184/1	182/1	185/2	190/0	189/1	182/2	183/1	182/1
262	18*	137/4	148/3	147/2	153/1	159/1	164/9	164/5	176/4	182/4	120/0	149/21	134/30	145/23		136/17	141/4	141/8	139/2	144/4	145/4	147/2
262	19			173/4	167/6	168/5	174/4	149/18	158/8	160/9	162/8	167/6	169/6	168/4	169/4	172/2	164/7	160/4	158/4	156/5	157/9	155/6
262	20*	68/3	76/4	88/3	98/3	110/2	114/4	119/4	29/23	55/15	17/20	43/9	50/4	55/3	57/3	59/3	51/6	47/5	23/10	23/10		
262	21*			87/1	107/1	114/1	104/6	109/3	117/1	116/1	92/7	97/0	96/1	96/1	60/0	12/0	9/0	9/0	8/0			
274	22		22/0	22/0	20/1	20/1	20/1	20/1	20/1	21/1	21/0	21/0	17/4	14/5	17/3	17/3	18/3	17/4	17/4	17/2		
384	23**	262/1	266/1	314/2	285/2	275/0	285/0	285/0	290/0	285/0	291/0	290/0										
384	24		309/12	329/0	311/3	315/0	316/0	314/0	318/0	320/0	325/0	320/0										
384	23	75/1	64/0	73/0	78/0	79/0	81/0	78/0	82/0	78/0	81/0	81/0										
384	24		78/0	71/0	77/0	72/0	72/0	75/0	78/0	74/0	73/0											
384-403	23	52/1	44/2	56/0	61/0	58/0	52/8	54/4	63/1	57/3	58/1	63/1	57/0	61/0	47/10							

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
April 1982 - cont'd																						
390	22						8/6	8/6	2/11	2/11	1/7	0/7	0/6	0/7	0/6	0/5	0/7	0/5				
390	23			18/6		29/3	28/3	29/1	27/8	31/5	29/3	30/2	34/0	35/0	34/0	31/2	30/1	33/1				
390	24					30/3	26/4	25/4	27/4	27/2	29/3	31/3	28/4	30/3	31/2							
393	22						11/0	12/0	16/0	16/0	16/0	16/0	17/0	16/0	17/0	16/0	16/0	17/0	20/0	19/0	15/0	
395	21*			12/0	12/0	12/0	9/0	9/0	0/0	0/0	0/0	0/0	0/0	0/0								
395	22*	18/0	17/0	17/0	8/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0								
398-403	21											33/0	44/0	44/0	47/0	46/0	45/0	35/0	30/0	27/0		
398-403	22		30/0	37/1	47/0	48/0	50/1	53/0	56/1	55/1	54/1	52/1	51/1	34/5	41/4	37/4						
May-June 1982																						
3	30						3/0	3/1	3/1	4/1	5/0	5/0	5/0	5/0	5/0	3/0	4/0					
3	31							4/1		5/0		5/0		5/0		6/0		6/0				

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
3	1							2/0		2/0		3/0		3/0		3/0		3/0				
4	1*							66/0		66/0		47/0		43/0		60/0		71/0				
4	2					77/0		76/0				74/0		82/0		84/0						
4	3							85/0		82/0		80/0		84/0		84/0		80/0				
5	30*									0/2		0/2		0/1		0/2						
6	30																10/0		12/0		8/0	
7	30*							7/11		22/6		5/9		11/6		8/5		10/3				
7	31							29/3		39/2		45/2		45/2		40/10		42/0				
10	30*							0/7	0/7	0/13	0/9	0/10	0/10	0/9	0/7	0/14						
10	31*						0/6	0/7	0/5	0/5	0/7	0/8	0/6	0/7	0/10	0/9						
10	1*							0/12		0/20		0/16		0/20		0/22		0/21				

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
11	30							334/0		352/0		360/0		361/1		369/3		373/3		391/2		392/3
11	31							362/4		340/4		361/2		365/3		367/2		372/4		387/3		389/6
11	1					354/4		359/4		370/3		387/4		400/0		402/2		412/2		383/0		
79	31							15/2		18/0		18/0		25/0		32/0		32/0				
79	1							41/0		43/0		47/0		51/0		49/0		40/0				
83	31							33/2		40/2		41/2		48/0		45/0		45/0				
83	1							58/0		52/1		58/0		52/1		57/0		53/0				
152	1							35/0		31/1		39/1		41/1		39/0		42/0				
152	2								31/2	29/0		32/0		33/1		31/0		36/1				
152	3							21/0		24/0		19/3		21/2		22/1		24/0				
154	31							46/0		46/1		48/0		54/0		54/0		58/0				

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
154	1							39/0		40/4		44/2		47/1		47/2		47/2				
154	2							43/0		43/0		42/1		40/3		42/2		41/2				
157	1							137/0		137/0		145/0		138/0		138/0		134/4				
157	2							120/0		121/0		119/4		119/0		119/0		119/0				
157	3									111/1		124/1		137/0		135/1						
160	1											21/0					23/0					
160	2*										35/0				10/0				30/0			
160	3											23/0			22/0		21/0					
161	1											32/0		49/0				49/0				
161	2							34/3				41/1				37/2						
161	3								38/1			39/0		44/0								

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
162	1							124/0		120/0		119/4		129/0		129/3		126/0				
162	2											129/3										
162	3							147/0				147/0				149/3						
164	31*					7/0		5/0		5/0		0/0		0/0		0/0		0/0				
164	1									17/0		17/0		17/0		17/0		17/0				
164	2*							16/0		16/0		16/0		0/0		0/1		0/0				
165	31							2/3	2/3	1/4	4/4	5/3	5/4	5/4	5/4	2/4	3/4	2/4				
165	1							28/1	28/0	23/2	28/0	28/0	22/4	26/0	22/1	21/1	22/0	20/2	21/1			
165	2									47/1	45/0	49/0	49/0	49/0	52/0	52/0	50/0	51/0				
166	31*							95/0		97/1		36/20		59/8		62/3	62/2					
166	1							128/1		133/2		135/1		138/1		138/1						

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide									
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
166	2									138/0		138/0		137/2		137/0		137/1				
168	31											17/1										
168	1											29/0		22/3		26/2		29/1				
169	31											39/0										
169	1									31/3		34/0		34/1		34/2		37/2				
175	31												51/0		53/0							
175	1								50/0		50/0		52/0		52/0		53/0					
188	1							10/0		10/0		10/0	10/0		10/0		10/0		10/0			
188	2							9/0		9/0		9/0		9/0		8/1		9/0				
188	3							8/0		8/0		8/0		8/0		8/0		8/0				
190	1								2/9	16/4	21/0	21/0	21/0	22/0	22/1	23/0	17/1					

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
190	2							29/0		31/0		31/0		30/0		23/5		29/0				
190	3							39/0		38/0		39/0		38/0		38/0		39/0				
192	1									1/0	1/0	1/0	1/0		1/0		1/0		2/0			
192	2							0/0		0/0		0/0		0/0		0/0		0/0				
192	3							0/0		0/0		0/0		0/0		0/0		0/0				
202	1								16/1	23/0	23/4	25/0	25/0	25/0	19/1	23/0	19/2	20/3	23/0	23/0	23/0	
202	2						7/1	14/0	15/3	18/2	16/3	19/3	20/2	23/2	23/1	24/3	23/1	23/2	25/1	26/1		
202	3								26/0	30/2	30/0	30/0	31/0	31/1	29/2	31/0	31/0					
422	1							45/0		48/0		47/0		47/0		50/0		50/0		50/0		49/0
422	2									51/0		51/0		54/0		52/1		51/0		52/1		
422	3									49/0		52/0		54/0		54/1		54/0		54/1		

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
221	31											570 56		570		(about same number)				570		
221	1											450 77					541 NC					
221	2											544 87				541 76				615 64		
225	1							476 0				516 0				461 0						
225	2							445 0				474 0				441 0						
225	3							416 0				407 0				405 0						
274	1		15 0	16 0	16 0	16 0	16 1	16 1	17 2	18 0	18 0	17 1										
274	4	13 1	14 1	15 1	15 0	15 0	15 1	13 2	15 1	15 0	15 0	16 1	16 2	16 1	15 1							
382	2					235 5	261 2	255 0	260 0	271 1	265 1											
382	3*						1 0	26 0	75 0	91 0	112 0	124 0										

Appendix III. - Continued

Site No.	Day	Hours Before Low Tide										Low Tide	Hours After Low Tide								
		2.50	2.25	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
May-June 1982 - cont'd																						
384	4					31/0	34/0	38/0	37/0	37/0	37/0	37/0	37/0	37/0	36/0	36/0						
385	4					158/0	163/0	163/0	168/0	168/0	168/2	169/0	170/0	170/0	170/0	170/0						
385	1					65/2		68/0		68/2		68/1		70/1		71/2						
398-403	2							67/0		68/0		71/1		68/0		71/0		71/1				
398-403	3			61/0		60/0		64/0		66/0		68/0		64/0		66/0		67/0		67/0		67/0
398-403	4	73/0		74/0		75/0		75/0		76/0		76/0		72/0		72/0		72/0		72/0		

*Human disturbance
**Two separate hauling locations in site #384

APPENDIX IV.

Harbor seal census information by hauling site. (*= a minus sign is before low tide, a + sign is after low tide; a ()= replicate count).

APPENDIX IV.

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 18, 1982													
	1-3	1030	-0.75	0.15	-	-	-	19	0	19	19	0	19
	4	1100	-1.00	0.18	23	4	27	38	5	43	38	5	43
	5	1106	-1.13	0.20	0	0	0				0	0	0
	6	1106	-1.13	0.20	8	0	8				10	0	10
	7	1106	-1.13	0.20	13	0	13	12	2	14	12	2	14
	8	1107	-1.13	0.20	0	0	0				0	0	0
	9	1117	-1.15	0.21	-	-	-				-	-	-
	10	1119	-1.15	0.21	0	0	0	9	3	12	9	3	12
	11	1136	-1.07	0.19	Fog	-	-	232	10	242	232	10	242
	12	1146	-0.90	0.16	3	0	3				4	0	4
	13	1146	-0.90	0.16	15	4	19				19	5	24
	14	1150	-0.95	0.17	0	0	0				0	0	0
	15	1152	-0.97	0.18	0	0	0				0	0	0
	16	1152	-0.97	0.18	0	0	0				0	0	0
	17	1153	-0.97	0.18	0	0	0				0	0	0
	18	1203	-0.68	0.12	15	2	17				18	3	21
	19	1204	-0.68	0.12	66	4	70				70	5	75
	20	1205	-0.65	0.12	1	1	2				1	1	2
	21	1208	-0.60	0.11	0	0	0				0	0	0
	22	1214	-0.50	0.09	58	2	60				67	2	69
	23	1214	-0.50	0.09	0	0	0				0	0	0
	24	1225	-0.38	0.07	17	2	19				20	2	22
	(25)	1225	-0.38	0.07	18	0	18				21	0	21
	(26)	1226	-0.38	0.07	51	0	51				58	0	58
	(27)	1227	-0.38	0.07	0	0	0				0	0	0
April 19, 1982													
	25	1157	-1.67	0.33	81	0	81				99	0	99
	26	1157	-1.67	0.33	0	0	0				0	0	0
	27	1159	-1.63	0.33	22	0	22				27	0	27
	28	1158	-1.63	0.33	0	0	0				0	0	0
	29	1159	-1.63	0.33	0	0	0				0	0	0
	30	1200	-1.62	0.33	0	0	0				0	0	0
	31	1205	-1.53	0.31	40	0	40				48	0	48
	32	1205	-1.53	0.31	0	0	0				0	0	0
	33	1205	-1.53	0.31	11	2	13				11	5	16
	34	1206	-1.55	0.31	11	0	11				14	0	14
	35	1206	-1.55	0.31	15	5	20				19	6	25
	36	1206	-1.55	0.31	0	0	0				0	0	0
	37	1207	-1.53	0.31	14	2	16				18	2	20
	38	1207	-1.53	0.31	8	1	9				13	1	14
	39	1207	-1.53	0.31	27	2	29				33	3	36
	40	1208	-1.52	0.31	0	0	0				0	0	0
	41	1210	-1.30	0.26	21	2	23				26	3	29
	42	1211	-1.26	0.26	15	2	17				19	3	22
	43	1211	-1.26	0.26	0	0	0				0	0	0
	44	1213	-1.25	0.26	24	0	24				31	0	31
	45	1215	-1.22	0.24	1	0	1				1	0	1
	46	1218	-1.17	0.23	35	6	41				41	7	48
	47	1223	-1.10	0.22	1	0	1				1	0	1
	48	1223	-1.10	0.22	19	0	19				22	0	22
	49	1223	-1.10	0.22	13	2	15				16	2	18
	50	1223	-1.28	0.26	86	0	86				99	0	99
	51	1226	-1.23	0.25	13	2	15				17	2	19
	52	1226	-1.23	0.25	21	1	23				28	1	29
	53	1226	-1.23	0.25	85	5	90				98	6	104

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
April 19, 1982 (Cont'd)													
	54	1226	-1.23	0.25	0	0	0				0	0	0
	55	1226	-1.23	0.25	0	0	0				0	0	0
	56	1226	-1.23	0.25	23	7	30				29	9	38
	57	1227	-1.22	0.25	46	0	46				54	0	54
	58	1227	-1.22	0.25	0	0	0				0	0	0
	59	1230	-1.17	0.23	3	0	3				4	0	4
	60	1230	-1.17	0.23	10	0	10				13	0	13
	61	1230	-1.17	0.23	0	0	0				0	0	0
	62	1230	-1.17	0.23	0	0	0				0	0	0
	63	1230	-1.17	0.23	5	3	8				6	4	10
	64	1230	-1.17	0.23	25	2	27				32	3	35
	65	1230	-1.17	0.23	29	3	32				34	4	38
	66	1232	-1.13	0.23	14	3	17				18	4	22
	67	1234	-1.26	0.26	8	0	8				10	0	10
	68	1235	-1.20	0.22	0	0	0				0	0	0
	69	1237	-1.07	0.21	9	0	9				11	0	11
	70	1238	-1.05	0.21	18	0	18				23	0	23
	71	1239	-1.00	0.20	23	0	23				29	0	29
	72	1239	-1.00	0.20	64	4	68				71	5	76
	73	1239	-1.00	0.20	8	0	8				10	0	10
	74	1241	-0.97	0.19	27	3	30	28	5	33	28	5	33
	75	1243	-0.97	0.19	17	0	17				22	0	22
	76	1243	-0.97	0.19	71	0	71				80	0	80
	77	1244	-0.95	0.19	5	0	5				5	0	5
	78	1244	-0.95	0.19	51	0	51	53	1	54	53	1	54
	79	1245	-0.93	0.19	40	5	45	38	6	44	39	6	45
	80	1245	-0.93	0.19	12	0	12				15	0	15
	81	1246	-0.92	0.19	0	0	0				0	0	0
	82	1247	-0.92	0.19	0	0	0				0	0	0
	83	1248	-0.92	0.19	0	0	0				0	0	0
	84	1249	-0.92	0.18	0	0	0				0	0	0
	85	1250	-0.92	0.18	67	0	67				75	0	75
	86	1250	-0.92	0.18	25	0	25				31	0	31
	87	1252	-0.88	0.18	80	0	80				88	0	88
	88	1253	-0.88	0.18	0	0	0				0	0	0
	89	1253	-0.88	0.18	0	0	0				0	0	0
	90	1255	-0.87	0.18	0	0	0				0	0	0
	91	1256	-0.88	0.18	0	0	0				0	0	0
	92	1256	-0.88	0.18	0	0	0				0	0	0
	93	1257	-0.87	0.18	0	0	0				0	0	0
	94	1259	-0.77	0.15	0	0	0				0	0	0
	95	1259	-0.77	0.15	1	0	1				1	0	1
	96	1259	-0.77	0.15	0	0	0				0	0	0
	97	1300	-0.75	0.15	22	0	22				28	0	28
	98	1302	-0.72	0.14	19	0	19				24	0	24
	99	1303	-0.70	0.14	0	0	0				0	0	0
	100	1306	-0.65	0.13	0	0	0				0	0	0
	101	1307	-0.63	0.13	14	0	14				18	0	18
	102	1307	-0.63	0.13	20	0	20				24	0	24
	103	1307	-0.63	0.13	0	0	0				0	0	0
	104	1307	-0.63	0.13	0	0	0				0	0	0
	105	1308	-0.63	0.13	0	0	0				0	0	0
	106	1308	-0.63	0.13	0	0	0				0	0	0
	107	1313	-0.53	0.11	29	0	29				35	0	35

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 19, 1982 (Cont'd)													
	108	1315	-0.50	0.10	0	0	0				0	0	0
	109	1315	-0.50	0.10	4	0	4				5	0	5
	110	1316	-0.48	0.10	122	6	128				133	7	140
	111	1317	-0.48	0.09	0	0	0				0	0	0
	112	1318	-0.45	0.09	13	0	13				16	0	16
	113	1318	-0.45	0.09	0	0	0				0	0	0
	114	1318	-0.45	0.09	0	0	0				0	0	0
	115	1320	-0.42	0.08	0	0	0				0	0	0
	116	1321	-0.40	0.08	0	0	0				0	0	0
	117	1322	-0.38	0.08	0	0	0				0	0	0
	118	1324	-0.36	0.07	7	0	7				9	0	9
	119	1323	-0.37	0.08	0	0	0				0	0	0
	120	1324	-0.36	0.07	2	0	2				2	0	2
	121	1324	-0.36	0.07	2	0	2				2	0	2
	122	1325	-0.33	0.07	0	0	0				0	0	0
	123	1325	-0.33	0.07	0	0	0				0	0	0
	124	1327	-0.30	0.06	0	0	0				0	0	0
	125	1327	-0.30	0.06	13	0	13				15	0	15
	126	1328	-0.28	0.06	0	0	0				0	0	0
	127	1329	-0.27	0.05	71	0	71				77	0	77
	128	1330	-0.26	0.05	0	0	0				0	0	0
	129	1332	-0.22	0.04	4	0	4				5	0	5
	130	1335	-0.17	0.03	266	0	266				285	0	285
	131	1338	-0.12	0.02	29	0	29				33	0	33
	132	1338	-0.12	0.02	32	0	32				37	0	37
	133	1338	-0.12	0.02	61	0	61				65	0	65
	134	1342	+0.03	0.01	6	0	6				7	0	7
	135	1344	+0.07	0.01	36	2	38				40	2	42
	136	1345	+0.08	0.02	5	0	5				6	0	6
	137	1349	+0.15	0.03	5	0	5				6	0	6
	138	1349	+0.15	0.03	0	0	0				0	0	0
	139	1349	+0.15	0.03	0	0	0				0	0	0
	140	1349	+0.15	0.03	0	0	0				0	0	0
	141	1351	+0.18	0.04	22	0	22				25	0	25
	142	1353	+0.22	0.04	10	0	10	8	3	11	8	3	11
	143	1353	+0.22	0.04	0	0	0				0	0	0
	144	1354	+0.23	0.04	16	0	16	27	1	28	27	1	28
	145	1357	+0.28	0.06	25	0	25	22	1	23	24	1	25
	146	1357	+0.28	0.05	0	0	0				0	0	0
	147	1358	+0.28	0.02	0	0	0				0	0	0
	148	1400	+0.29	0.05	9	1	10						
	149	1403	+0.30	0.06	18	3	21	29	7	36	29	7	36
	150	1401	+0.29	0.06	49	2	51				54	2	56
	151	1404	+0.32	0.06	36	0	36				40	0	40
	152	1406	+0.43	0.09	20	2	22	26	3	29	26	3	29
	153	1406	+0.43	0.09	23	5	28				25	6	31
	154	1407	+0.45	0.09	0	0	0				0	0	0
	155	1408	+0.47	0.09	0	0	0				0	0	0
	156	1408	+0.47	0.09	9	2	11	9	5	14	9	5	14
	157	1411	+0.43	0.09	138	6	144	138	7	145	138	7	145
	158	1412	+0.45	0.09	2	0	2				2	0	2
	159	1413	+0.47	0.09	6	0	6				6	0	6

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 19, 1982 (Cont'd)													
	160	1415	+0.50	0.10	28	0	28	30	0	30	30	0	30
	161	1416	+0.52	0.10	4	0	4	7	0	7	7	0	7
	162	1416	+1.00	0.20	72	1	73	100	0	100	100	0	100
	163	1417	+1.00	0.20	0	0	0	0	0	0	0	0	0
	164	1240	-1.00	0.24	0	0	0				0	0	0
April 20, 1982													
	165	1248	-0.87	0.19	30	0	30	33	0	33	33	0	33
	166	1250	-0.78	0.17	-	-	-	41	0	41	41	0	41
	167	1252	-0.78	0.17	0	0	0				0	0	0
	168	1252	-0.78	0.17	0	0	0				0	0	0
	169	1258	-0.62	0.14	37	0	37	39	0	39	39	0	39
	170	1258	-0.62	0.14	0	0	0				0	0	0
	171	1258	-0.62	0.14	0	0	0				0	0	0
	172	1258	-0.62	0.14	0	0	0				0	0	0
	173	1304	-0.51	0.11	23	0	23				26	0	26
	174	1304	-0.52	0.11	29	0	29	74	6	80	74	6	80
	175	1306	-0.43	0.10	63	3	66	73	3	76	73	3	76
	176	1314	-0.28	0.06	25	0	25	0	0	0	28	0	28
	177	1312	-0.32	0.07	60	0	60				64	0	64
	178	1315	-0.28	0.06	40	3	43				44	3	47
	179	1315	-0.28	0.06	0	0	0				0	0	0
	180	1316	-0.25	0.06	20	1	21				23	1	24
	181	1317	-0.23	0.06	7	0	7				0	0	0
	182	1317	-0.23	0.06	0	0	0				0	0	0
	183	1317	-0.23	0.06	0	0	0				0	0	0
	184	1317	-0.23	0.06	0	0	0				0	0	0
	185	1317	-0.23	0.06	0	0	0				0	0	0
	186	1320	-0.25	0.06	12	0	12				14	0	14
	187	1321	-0.23	0.06	4	0	4				5	0	5
	188	1322	-0.22	0.05	48	2	50				53	2	55
	189	1322	-0.24	0.05	0	0	0				0	0	0
	190	1323	-0.28	0.06	31	0	31	43	0	43	43	0	43
	191	1323	-0.28	0.06	0	0	0				0	0	0
	192	1323	-0.28	0.06	9	0	9				11	0	11
	193	1324	-0.35	0.08	0	0	0				0	0	0
	194	1324	-0.35	0.08	19	0	19	20	0	20	20	0	20
	195	1418	+0.55	0.12	0	0	0				0	0	0
	196	1421	+0.60	0.13	0	0	0				0	0	0
	197	1422	+0.62	0.14	57	0	57				63	0	63
	198	1423	+0.63	0.14	23	0	23				26	0	26
	199	1423	+0.63	0.14	0	0	0				0	0	0
	200	1423	+0.63	0.14	0	0	0				0	0	0
	201	1423	+0.63	0.14	30	0	30				34	0	34
	202	1426	+0.63	0.14	0	0	0				0	0	0
	203	not covered			-	-	-				-	-	-
	204	(included in 205)			-	-	-				-	-	-
	205	1411			226	57	283	212	61	273	243	62	305
	206	not covered			-	-	-				-	-	-
	207	not covered			-	-	-				-	-	-
	208	not covered			-	-	-				-	-	-
	209	not covered			-	-	-				-	-	-
	210	not covered			-	-	-				-	-	-

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 20, 1982 (Cont'd)													
	211	not covered			-	-	-				-	-	-
	212	not covered			-	-	-				-	-	-
	213	1439			37	3	40				41	3	44
	214	not covered			-	-	-				-	-	-
	215	1452	+0.12	0.03	11	0	11	12	0	12	12	0	12
	216	1452	+0.12	0.03	0	0	0				0	0	0
	217	1500	+0.48	0.10	36	0	36				40	0	40
	218	1502	+0.53	0.12	115	0	115				123	0	123
	219	1504	+0.57	0.13	5	0	5				6	0	6
	220	1507	+0.62	0.14	90	3	93		(Included in 221)				
	221	1509	+0.62	0.14	224	56	280	334	131	465	334	131	465
	222	1509	+0.62	0.14	11	0	11				13	0	13
	223	1512	+0.70	0.15	0	0	0				0	0	0
	224	1513	+0.75	0.15	0	0	0				0	0	0
	225	1517-1523	+1.05	0.23	486	34	520	507	36	543	507	36	543
	226	1528	+1.23	0.27	10	0	10				12	0	12
	227	1528	+1.23	0.17	0	0	0				0	0	0
	228	1528	+1.23	0.27	29	0	29				34	0	34
	229	1528	+1.23	0.27	0	0	0				0	0	0
	230	1529	+1.22	0.27	7	0	7				7	0	7
	231	1529	+1.22	0.27	38	0	38				43	0	43
	232	1530	+1.25	0.27	3	0	3				3	0	3
	233	1530	+1.25	0.27	23	1	24				28	1	28
	234	1530	+1.25	0.27	13	0	13				15	0	15
	235	1530	+1.25	0.27	17	0	17				20	0	20
	236	1539	+1.42	0.31	19	0	19				23	0	23
	237	1539	+1.42	0.31	0	0	0				0	0	0
	238	1539	+1.42	0.31	12	0	12				13	0	13
	239	1539	+1.42	0.31	0	0	0				0	0	0
	240	1541	+1.45	0.32	0	0	0				0	0	0
	241	1541	+1.45	0.32	122	0	122				127	0	127
	242	1541	+1.45	0.32	2	0	2				2	0	2
	243	1542	+1.47	0.31	50	3	53				57	3	60
	244	1542	+1.47	0.32	55	4	59				62	5	67
	245	1545	+1.52	0.33	149	16	165				155	17	172
	246	1542	+1.50	0.32	0	0	0				0	0	0
	247	1542	1.50	0.32	5	0	5				6	0	6
	248	1547-1553	+1.65	0.36	315	23	338				340	25	365
	249	1554	+0.15	0.03	0	0	0				0	0	0
	250	1600	+1.70	0.37	3	0	3				3	0	3
	251	1602	+1.70	0.37	109	0	109				115	0	115
	252	1602	+1.70	0.37	0	0	0				0	0	0
	253	1602	+1.70	0.37	0	0	0				0	0	0
	254	1616	+1.93	0.43	9	0	9				11	0	11
	255	1616	+1.93	0.43	0	0	0				0	0	0
	256	1616	+1.93	0.43	0	0	0				0	0	0
	257	1614	+1.90	0.42	29	0	29				36	0	36
	258	1616	+1.93	0.42	2	0	2				2	0	2
	259	1617	+1.85	0.41	0	0	0				0	0	0
	260	1617	+1.85	0.41	2	0	2				2	0	2
	261	1617	+1.85	0.41	0	0	0				0	0	0
	262	1618	+1.80	0.40	21	0	21	114	5	119	114	5	119
	263	1621	+1.93	0.43	31	0	3				39	0	39
	264	1623	+1.93	0.43	2	0	2				2	0	2
	265	1623	+1.93	0.43	0	0	0				0	0	0
	266	1624	+1.93	0.43	2	0	2				2	0	2

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
April 20, 1982 (Cont'd)													
	267	1624	+1.95	0.43	3	2	5				0	0	0
	268	1625	+1.95	0.43	0	0	0				0	0	0
	269	1626	+1.95	0.43	12	0	12				15	0	15
	270	1626	+1.95	0.43	0	0	0				0	0	0
	271	1626	12.06	0.45	28	0	28				34	0	34
	272	1626	+2.06	0.45	0	0	0				0	0	0
	273	1627	+2.08	0.46	55	0	55				67	0	67
	274	1627	+2.06	0.45	13	0	13				16	0	16
April 21, 1982													
	(245)	1311	-1.68	0.47	96	0	96				117	0	117
	(248)	1319	-1.85	0.51	264	24	288				285	26	311
	(249)	1318	-2.20	0.58	25	2	27				32	2	34
	(251)	1325	-1.53	0.44	106	0	106				183	0	183
	(262)	1332	-1.33	0.39	110	0	110				134	0	134
	(263)	1334	-1.30	0.39	10	0	10				13	0	13
	(266)	1335	-1.28	0.38	2	0	2				2	0	2
	(267)	1336	-1.26	0.38	0	0	0				0	0	0
	(268)	1337	-1.25	0.30	8	0	8				10	0	10
	(269)	1340	-1.22	0.37	6	0	6				8	0	8
	(270)	1340	-1.22	0.37	0	0	0				0	0	0
	(271)	1341	-1.20	0.36	8	0	8				8	0	8
	(272)	1341	-1.20	0.36	1	0	1				1	0	1
	(273)	1341	-1.20	0.36	70	0	70				78	2	80
	(274)	1342	-1.20	0.36	0	0	0				0	0	0
	275	1342	-1.20	0.36	0	0	0				0	0	0
	276	1342	-1.05	0.33	3	0	3				4	0	4
	277	1343	-1.03	0.33	27	0	27				35	0	35
	278	1343	-1.03	0.33	0	0	0				0	0	0
	279	1344	-1.02	0.32	0	0	0				0	0	0
	280	1344	-1.02	0.32	9	0	9				11	0	11
	281	1344	-1.02	0.32	0	0	0				0	0	0
	282	1346	-0.9	0.32	11	0	11				14	0	14
	283	1347	-0.97	0.31	10	0	10				13	0	13
	284	1350	-0.92	0.30	24	0	24				31	0	31
	285	1350	-0.92	0.30	0	0	0				0	0	0
	286	1350	-0.92	0.30	0	0	0				0	0	0
	287	1351	-0.90	0.30	4	0	4				5	0	5
	288	1351	-0.09	0.30	0	0	0				0	0	0
	289	1352	-0.88	0.29	10	0	10				13	0	13
	290	1354	-0.85	0.29	31	0	31				36	0	36
	291	1354	-0.85	0.29	0	0	0				0	0	0
	292	1355	-0.83	0.28	1	0	1				1	0	1
	293	1355	-0.83	0.28	18	0	18				23	0	23
	294	1355	-0.83	0.28	0	0	0				0	0	0
	295	1355	-0.83	0.28	0	0	0				0	0	0
	296	1356	-0.82	0.28	35	0	35				41	0	41
	297	1356	-0.83	0.28	0	0	0				0	0	0
	298	1358	-0.78	0.27	26	0	26				33	0	33
	299	1400	-0.75	0.27	10	0	10				13	0	13
	300	1402	-0.63	0.24	0	0	0				0	0	0
	301	1402	-0.63	0.24	1	0	1				1	0	1
	302	1403	-0.62	0.24	86	1	87				95	1	96
	303	1404	-0.60	0.23	10	0	10				12	0	12
	304	1404	-0.60	0.23	24	2	26				29	2	31
	305	1404	-0.60	0.23	29	0	29				35	0	35
	306	1404	-0.60	0.23	0	0	0				0	0	0
	307	1404	-0.60	0.23	121	10	131				133	10	143

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 21, 1982 (Cont'd)													
	308	1404	-0.60	0.23	0	0	0				0	0	0
	309	1404	-0.60	0.23	18	0	18				22	0	22
	310	1406	-0.57	0.22	3	0	3				3	0	3
	311	1407	-0.55	0.22	8	0	8				9	0	9
	312	1407	-0.55	0.22	6	0	6				7	0	7
	313	1407	-0.55	0.22	27	0	27				32	0	32
	314	1409	-0.52	0.21	4	0	4				5	0	5
	315	1410	-0.50	0.21	39	0	39				45	0	45
	316	1412	-0.47	0.20	27	0	27				32	0	32
	317	1415	-0.43	0.20	11	2	13				14	2	16
	318	1416	-0.42	0.19	6	0	6				7	0	7
	319	1417	-0.47	0.20	5	0	5				6	0	6
	320	1417	-0.47	0.20	41	1	42				47	1	48
	321	1417	-0.45	0.20	0	0	0				0	0	0
	322	1417	-0.47	0.20	0	0	0				0	0	0
	323	1422	-0.47	0.20	25	0	25				30	0	30
	324	1424	-0.63	0.24	36	0	36				42	0	42
	325	1427	-0.58	0.23	0	0	0				0	0	0
	326	1427	-0.58	0.23	63	0	63				69	0	69
	327	1432	-0.50	0.21	33	0	33				38	0	38
	328	1432	-0.50	0.21	20	0	20				24	0	24
	329	1433	-0.48	0.21	2	0	2				2	0	2
	330	1436	-0.46	0.19	25	0	25				30	0	30
	331	1437	-0.43	0.19	0	0	0				0	0	0
	332	1440	-0.37	0.18	33	0	33				38	0	38
	333	1441	-0.35	0.18	35	0	35				40	0	40
	334	1441	-0.35	0.18	19	0	19				22	0	22
	335	1445	-0.30	0.17	0	0	0				0	0	0
	336	1445	-0.30	0.17	12	0	12				12	0	12
	337	1448	-0.23	0.15	33	0	33				38	0	38
	338	1449	-0.22	0.15	9	0	9				10	0	10
	339	1450	-0.20	0.14	26	2	28				30	2	32
	340	1451	-0.18	0.14	0	0	0				0	0	0
	341	1452	-0.17	0.14	36	0	36				40	0	40
	342	1453	-0.15	0.13	29	0	29				33	0	33
	343	1454	-0.13	0.13	11	0	11				13	0	13
	344	1456	-0.10	0.12	17	0	17				20	0	20
	345	1456	-0.10	0.12	0	0	0				0	0	0
	346	1456	-0.10	0.12	0	0	0				0	0	0
	347	1500	-0.05	0.10	0	0	0				0	0	0
	348	1500	-0.05	0.10	0	0	0				0	0	0
	349	1502	-0.02	0.10	42	2	44				47	2	49
	350	1503	0.00	0.10	0	0	0				0	0	0
	351	1504	+0.02	0.10	2	0	2				2	0	2
	352	1504	+0.05	0.11	82	3	85				87	3	90
	353	1513	+0.20	0.14	23	0	23				26	0	26
	354	1513	+0.20	0.14	0	0	0				0	0	0
	355	1518	+0.28	0.16	0	0	0				0	0	0
	356	1521	+0.33	0.17	46	0	46				51	0	51
	357	1522	+0.33	0.17	0	0	0				0	0	0
	358	1523	+0.35	0.18	25	0	25				29	0	29
	359	1525	+0.37	0.18	5	0	5				6	0	6
	360	1532	+0.48	0.21	45	13	58				50	14	64
	361	1532	+0.48	0.21	77	20	97				82	21	103
	362	1532	+0.48	0.21	14	7	21				16	8	24
	363	1535	+0.53	0.22	280	74	354				297	78	375
	364	1535	+0.53	0.22	0	0	0				0	0	0

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
April 21, 1982 (Cont'd)													
	365	1535	+0.53	0.22	0	0	0				0	0	0
	366	1535	+0.53	.22	0	0	0				0	0	0
	367	1535	+0.53	0.22	0	0	0				0	0	0
	368	1552	+0.82	0.28	43	0	43				48	0	48
	369	1557	+0.85	0.29	11	0	11				13	0	13
	370												
	371	1603	+0.88	0.29	25	0	25				29	0	29
	372	1603	+0.88	0.29	3	0	3				4	0	4
	373	1607	+0.95	0.31	96	5	101				103	6	109
	374	1609	+0.90	0.30	27	2	29				31	2	33
	375	1609	+0.90	0.30	7	3	10				7	3	10
	376	1609	+0.90	0.30	1	0	1				1	0	1
	377	1615	+0.85	0.29	4	0	4				5	0	5
	378	1615	+0.85	0.29	5	0	5				6	0	6
	379	1615	+0.85	0.29	1	0	1				1	0	1
	380	1617	+0.83	0.29	15	0	15				17	0	17
	381	1620	+0.93	0.31	32	0	32				37	0	37
	382	1626	+0.45	0.30	323	2	325				349	2	351
	383	1626	+0.45	0.30	0	0	0				0	0	0
	384	1629-1647	-0.02	0.20	339	179	518				366	193	559
	385	1650	-0.17	0.13	114	32	146				123	35	158
April 22, 1982													
	382	1506	-1.38	0.00	176	0	176				192	0	192
	384	1508-1530	-2.00	0.58	287	130	417				313	142	455
	385	1556	-1.57	0.56	78	25	103				85	27	112
	386												
	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				0	0	0
	391				0	0	0				0	0	0
	392				0	0	0				0	0	0
	393				16	0	16	20	0	20	20	0	20
	394				0	0	0				0	0	0
	395				0	0	0				0	0	0
	396				0	0	0				0	0	0
	397				0	0	0				0	0	0
	398				0	0	0				0	0	0
	399				10	0	10				12	0	12
	400				0	0	0				0	0	0
	401				0	0	0				0	0	0
	402				0	0	0				0	0	0
	403				0	0	0				0	0	0
	404				0	0	0				0	0	0
	405				29	1	30	55	1	56	55	1	56
	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				0	0	0
	411				0	0	0				0	0	0
	412				0	0	0				0	0	0
	413				66	0	66				70	0	70

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
April 22, 1982 (Cont'd)													
	414				227	36	263				241	38	279
	415				53	10	63				56	11	67
	416				0	0	0				0	0	0
	417				0	0	0				0	0	0
	418				204	4	208				215	5	220
	419				0	0	0				0	0	0
	420				-	-	-				-	-	-
	421				0	0	0				0	0	0
	422				-	-	-	51	0	51	51	0	51
May 31, 1982													
	1-3	1200	0.00	0.10	-	-	-	6	0	6	6	0	6
	4	1030	-1.53	0.44	78	4	82	79	6	85	79	6	85
	5	1043	-1.32	0.39	0	0	0				0	0	0
	6	1043	-1.32	0.39	0	0	0				0	0	0
	7	1045	-1.28	0.38	53	0	53	45	0	45	59	0	59
	8	1046	-1.27	0.38	0	0	0				0	0	0
	9	1100	+1.30	0.39	-	-	-				-	-	-
	10	1110	-1.33	0.39	0	0	0				0	0	0
	11	1115	-1.42	0.41	284	4	288	346	41	387	346	41	387
	12	1116	-1.40	0.41	33	5	38				37	6	43
	13	1116	-1.40	0.41	9	0	9				12	0	12
	14	1120	+1.40	0.41	0	0	0				0	0	0
	15	1123	-1.35	0.40	24	0	24				31	0	31
	16	1130	+1.35	0.40	0	0	0				0	0	0
	17	1125	-1.35	0.40	39	2	41				46	2	48
	18	1135	-1.15	0.35	18	0	18				23	0	23
	19	1135	-1.15	0.35	0	0	0				0	0	0
	20	1135	-1.15	0.35	18	0	18				23	0	23
	21	1140	+1.12	0.33	0	0	0				0	0	0
	22	1144	-1.00	0.32	46	0	46				80	0	80
	23	1150	+0.95	0.31	0	0	0				0	0	0
	24	1153	-0.90	0.30	0	0	0				0	0	0
	25	1154	-0.88	0.29	138	0	138				153	0	153
	26	1156	+0.93	0.30	0	0	0				0	0	0
	27	1156	-0.93	0.30	29	0	29				37	0	37
	28	1200	+0.85	0.29	0	0	0				0	0	0
	29	1200	+0.85	0.29	0	0	0				0	0	0
	30	1200	+0.85	0.29	0	0	0				0	0	0
	31	1204	-0.80	0.28	67	0	67				74	0	74
	32	1205	-0.80	0.28	1	0	1				1	0	1
	33	1205	-0.80	0.28	0	0	0				0	0	0
	34	1205	-0.80	0.28	0	0	0				0	0	0
	35	1206	-0.78	0.27	57	1	58				66	1	67
	36	1206	-0.78	0.27	22	0	22				28	0	28
	37	1206	-0.78	0.27	60	0	60				70	0	70
	38	1206	-0.78	0.27	0	0	0				0	0	0
	39	1206	-0.78	0.27	132	0	132				145	0	145
	40	1206	+0.78	0.27	0	0	0				0	0	0
	41	1207	-0.77	0.27	57	0	57				66	0	66
	42	1207	-0.77	0.27	9	0	9				11	0	11
	43	1207	-0.77	0.27	21	0	21				26	0	26
	44	1207	-0.77	0.27	0	0	0				0	0	0
	45	1207	-0.77	0.27	0	0	0				0	0	0
	46	1215	-0.65	0.24	26	3	29				32	4	36

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
May 31, 1982 (Cont'd)													
	47	1215	-0.65	0.24	0	0	0				0	0	0
	48	1215	+0.65	0.24	0	0	0				0	0	0
	49	1222	+0.53	0.22	0	0	0				0	0	0
	50	1222	+0.55	0.22	53	0	53				63	0	63
	51	1222	+0.55	0.22	0	0	0				0	0	0
	52	1223	+0.53	0.21	24	0	24				29	0	29
	53	1224	+0.52	0.21	197	0	197				218	0	218
	54	1225	+0.50	0.21	42	0	42				49	0	49
	55	1226	+0.48	0.21	35	0	35				42	0	42
	56	1227	+0.48	0.21	0	0	0				0	0	0
	57	1227	+0.48	0.21	0	0	0				0	0	0
	58	1227	+0.48	0.21	0	0	0				0	0	0
	59	1227	+0.48	0.21	0	0	0				0	0	0
	60	1228	+0.45	0.21	0	0	0				0	0	0
	61	1229	+0.43	0.20	4	0	4				5	0	5
	62	1230	+0.43	0.20	17	0	17				20	0	20
	63	1234	-0.35	0.18	19	0	19				23	0	23
	64	1234	-0.35	0.18	0	0	0				0	0	0
	65	1235	-0.33	0.17	42	0	42				48	0	48
	66	1235	-0.33	0.17	0	0	0				0	0	0
	67	1242	-0.20	0.14	0	0	0				0	0	0
	68	1242	+0.20	0.14	0	0	0				0	0	0
	69	1242	-0.20	0.14	15	0	15				17	0	17
	70	1242	+0.20	0.14	11	0	11				13	0	13
	71	1243	+0.18	0.14	8	0	8				10	0	10
	72	1243	+0.18	0.14	23	0	23				26	0	26
	73	1243	+0.18	0.14	0	0	0				0	0	0
	74	1246	-0.13	0.13	49	1	50				56	1	57
	75	1249	+0.12	0.13	0	0	0				0	0	0
	76	1250	+0.10	0.12	0	0	0				0	0	0
	77	1250	+0.10	0.12	0	0	0				0	0	0
	78	1251	+0.12	0.13	41	0	41				46	0	46
	79	1252	+0.10	0.12	55	0	55	48	0	48	55	0	55
	80	1253	+0.08	0.12	30	3	33				34	3	37
	81	1254	+0.07	0.12	0	0	0				0	0	0
	82	1254	+0.07	0.12	0	0	0				0	0	0
	83	1254	-0.07	0.11	0	0	0				0	0	0
	84	1254	+0.07	0.11	0	0	0				0	0	0
	85	1257	-0.03	0.11	120	2	122				127	2	129
	86	1258	-0.03	0.10	18	0	18				21	0	21
	87	1259	-0.03	0.10	131	7	138				138	8	146
	88	1259	+0.03	0.10	0	0	0				0	0	0
	89	1259	+0.03	0.10	0	0	0				0	0	0
	90	1300	+0.02	0.10	0	0	0				0	0	0
	91	1300	0.00	0.10	0	0	0				0	0	0
	92	1300	0.00	0.10	0	0	0				0	0	0
	93	1305	+0.08	0.12	1	0	1				1	0	1
	94	1307	+0.12	0.13	2	0	2				2	0	2
	95	1309	+0.15	0.13	7	0	7				8	0	8
	96	1310	+0.17	0.14	1	0	1				1	0	1
	97	1310	+0.17	0.14	1	0	1				1	0	1
	98	1311	+0.18	0.14	55	4	59				60	5	65
	99	1312	+0.20	0.14	0	0	0				0	0	0
	100	1314	+0.23	0.15	9	0	9				10	0	10
	101	1315	+0.25	0.16	9	0	9				10	0	10

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
May 31, 1982 (Cont'd)													
	102	1316	+0.27	0.16	44	0	44				48	0	48
	103	1317	+0.28	0.16	1	0	1				1	0	1
	104	1317	+0.28	0.16	7	0	7				8	0	8
	105	1321	+0.35	0.18	6	0	6				7	0	7
	106	1322	+0.37	0.18	1	0	1				1	0	1
	107	1322	+0.37	0.18	34	0	34				37	0	37
	108	1327	+0.45	.20	15	0	15				17	0	17
	109	1325	+0.42	0.19	0	0	0				0	0	0
	110	1329	+0.48	0.21	121	4	125				129	4	133
	111	1329	+0.48	0.21	13	0	13				15	0	15
	112	1329	+0.48	0.21	7	0	7				8	0	8
	113	1329	-0.48	0.21	0	0	0				0	0	0
	114	1330	+0.50	0.21	27	0	27				31	0	31
	115	1330	+0.50	0.21	0	0	0				0	0	0
	116	1330	+0.50	0.21	0	0	0				0	0	0
	117	1331	+0.52	0.21	29	0	29				33	0	33
	118	1334	+0.57	0.22	10	0	10				12	0	12
	119	1331	+0.52	0.21	0	0	0				0	0	0
	120	1334	+0.57	0.22	0	0	0				0	0	0
	121	1334	+0.57	0.22	3	0	3				3	0	3
	122	1335	+0.58	0.23	18	0	18				21	0	21
	123	1336	+0.60	0.23	1	0	1				1	0	1
	124	1336	+0.60	0.23	1	0	1				1	0	1
	125	1336	+0.60	0.23	7	0	7				8	0	8
	126	1337	+0.62	0.24	11	0	11				13	0	13
	127	1339	+0.65	0.24	93	4	97				99	4	103
	128	1339	-0.65	0.24	0	0	0				0	0	0
	129	1342	+0.70	0.25	39	0	39				43	0	43
	130	1344	-0.73	0.26	188	2	190				200	2	202
	131	1346	-0.77	0.27	0	0	0				0	0	0
	132	1346	-0.77	0.27	0	0	0				0	0	0
	133	1346	-0.77	0.27	153	5	158				162	5	167
	134	1346	+0.77	0.27	0	0	0				0	0	0
	135	1351	+0.85	0.29	12	0	12				14	0	14
	136	1353	+0.88	0.29	10	0	10				12	0	12
	137	1353	+0.88	0.29	0	0	0				0	0	0
	138	1355	+0.92	0.30	26	0	26				30	0	30
	(139)	1356	+0.85	0.29	14	0	14				16	0	16
	(140)	1357	+0.87	0.29	7	0	7				10	0	10
	(141)	1358	+0.88	0.29	71	0	71				75	0	75
	(142)	1401	+1.07	0.33	2	0	2				2	0	2
	(143)	1402	+1.05	0.33	0	0	0				0	0	0
	(144)	1404	+1.00	0.32	19	0	19				22	0	22
	(145)	1406	+1.00	0.32	22	2	24				28	2	30
	(146)	1405	+1.08	0.34	0	0	0				0	0	0
	(147)	1405	+1.08	0.34	8	1	9				11	0	11
	(148)	1408	+1.03	0.33	0	0	0				0	0	0
	(149)	1408	+1.03	0.33	0	0	0				0	0	0
	(150)	1408	+1.03	0.33	90	6	96				94	7	101
	(151)	1408	+1.03	0.33	31	2	33				37	2	39
June 1, 1982													
	139	1041	-3.06	0.91	11	0	11				14	0	14
	140	1042	-3.05	0.91	10	0	10				13	0	13
	141	1043	-3.03	0.91	41	2	43				73	3	76

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
June 1, 1982 (Cont'd)													
	142	1045	-2.98	0.90	20	2	22				34	3	37
	143	1046	-2.97	0.90	2	0	2				4	0	4
	144	1047	-2.97	0.89	8	0	8				14	0	14
	145	1048	-2.95	0.89	4	1	5				7	1	8
	146	1048	-2.95	0.89	0	0	0				0	0	0
	147	1048	-2.95	0.89	30	2	32				54	4	58
	148	1053	-2.78	0.86	25	0	25				43	0	43
	149	1053	-2.78	0.86	63	8	71				101	12	113
	150	1055	-2.75	0.85	91	2	93				145	3	148
	151	1056	-2.73	0.85	51	2	53				92	3	95
	152	1058	-2.70	0.84	32	0	32	32	9	41	32	9	41
	153	1100	-2.50	0.80	6	0	6				10	0	10
	154	1100	-2.50	0.80	18	0	18				23	0	23
	155	1100	-2.50	0.80	28	1	29				36	1	37
	156	1101	-2.48	0.80	40	0	40	39	8	47	39	8	47
	157	1104	-2.43	0.79	109	1	110	132	13	145	132	13	145
	158	1104	-2.43	0.79	0	0	0				0	0	0
	159	1104	-2.43	0.79	0	0	0				0	0	0
	160	1106	-2.40	0.78	22	0	22	21	2	23	21	2	23
	161	1109	-2.35	0.77	44	0	44	45	4	49	45	4	49
	162	1109	-2.35	0.77	129	4	133	122	7	129	126	7	133
	163	1110	-2.30	0.77	0	0	0				0	0	0
	164	1115	-2.25	0.75	15	0	15	17	0	17	17	0	17
	165	1126	-1.95	0.69	28	0	28	28	0	28	28	0	28
	166	1132	-1.80	0.66	126	2	128	136	2	138	136	2	138
	167	1134	-1.77	0.65	28	0	28				34	0	34
	168	1136	-1.73	0.65	1	0	1				1	0	1
	169	1138	-1.62	0.62	-	-	-	35	2	37	35	2	37
	170	1140	-1.58	0.62	1	0	1				1	0	1
	171	1141	-1.57	0.61	8	0	8				11	0	11
	172	1142	-1.55	0.61	120	0	120				146	0	146
	173	1143	-1.53	0.61	12	0	12				15	0	15
	174	1143	-1.53	0.61	23	0	23				29	0	29
	175	1148	-1.45	0.59	-	-	-	43	10	53	43	10	53
	176	1156	-1.32	0.56	3	0	3				4	0	4
	177	1150	-1.42	0.58	66	5	71				66	5	71
	178	1156	-1.32	0.56	75	8	83				85	9	94
	179	1156	-1.32	0.56	33	3	36				38	4	42
	180	1158	-1.28	0.56	37	7	44				44	8	52
	181	1159	-1.26	0.55	0	0	0				0	0	0
	182	1200	-1.25	0.55	3	0	3				4	0	4
	183	1202	-1.13	0.52	1	0	1				1	0	1
	184	1203	-1.12	0.52	1	0	1				1	0	1
	185	1203	-1.12	0.52	3	0	3				4	0	4
	186	1203	-1.12	0.52	9	0	9				11	0	11
	187	1204	-1.10	0.52	0	0	0				0	0	0
	188	1204	-1.10	0.52	70	0	70				78	0	79
	189	1205	-1.08	0.52	0	0	0				0	0	0
	190	1206	-1.07	0.51	20	0	20	22	1	23	22	1	23
	191	1206	-1.05	0.51	0	0	0				0	0	0
	192	1207	-1.05	0.51	9	0	9	10	0	10	10	0	10
	193	1207	-1.05	0.51	0	0	0				0	0	0
	194	1207	-1.05	0.51	45	0	45				53	0	53
	195	1214	-1.10	0.52	34	0	34				40	0	40
	196	1215	-1.08	0.52	7	0	7				9	0	9

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
June 1, 1982 (Cont'd)													
	197	1219	-1.02	0.50	104	0	104				116	0	116
	198	1220	-1.00	0.50	118	0	118				132	0	132
	199	1221	-1.98	0.50	0	0	0				0	0	0
	200	1222	-0.97	0.49	7	0	7				9	0	9
	201	1222	-0.97	0.49	0	0	0				0	0	0
	202	1225	-0.92	0.48	21	0	21	24	1	25	24	1	25
June 3, 1982													
	203				0	0	0				0	0	0
	204				-	-	-				-	-	-
	205				195	2	197	-	-	-	210	2	212
	206												
	207				59	1	60	-	-	-	64	1	65
	208				7	0	7	-	-	-	8	0	8
	209				0	0	0	-	-	-	0	0	0
	210												
	211				-	-	-	-	-	-			
	212				0	0	0	-	-	-	0	0	0
	213				6	0	6	75	10	85	75	10	85
	214				-	-	-	8	0	8	8	0	8
June 1, 1982 (Cont'd)													
	215	1236	-0.40	0.38	10	0	10	-	-	-	12	0	12
	216	1239	-0.35	0.37	1	0	1	-	-	-	1	0	1
	217	1245	-0.42	0.38	83	5	88	-	-	-	96	0	96
	218	1248	-0.37	0.37	112	0	112	-	-	-	122	0	122
	219	1251	-0.30	0.36	4	0	4	-	-	-	5	0	5
	220	1258	-0.20	0.34	88	0	88	-	-	-	95	0	95
	221	1302	-0.13	0.32	508	28	536	476	90	566	476	90	566
	222	1303	-0.12	0.32	0	0	0	-	-	-	0	0	0
	223	1303	-0.12	0.32	0	0	0	-	-	-	0	0	0
	224	1311	-0.02	0.30	463	46	509				500	49	549
	225	1313	+0.05	0.31	131	12	143	491	25	516	147	13	160
	226	1320	+0.33	0.37	0	0	0				0	0	0
	227	1321	+0.35	0.37	33	1	34				31	1	37
	228	1321	+0.35	0.37	0	0	0				0	0	0
	229	1321	+0.35	0.37	0	0	0				0	0	0
	230	1322	+0.37	0.37	1	0	1				1	0	1
	231	1322	+0.37	0.37	94	7	101				100	7	107
	232	1323	+0.38	0.38	60	4	64				64	4	68
	233	1325	+0.42	0.38	28	3	31				31	3	34
	234	1325	+0.42	0.38	0	0	0				0	0	0
	235	1325	+0.42	0.38	0	0	0				0	0	0
	236	1334	-0.57	0.41	1	0	1	-	-	-	1	0	1
	237	1334	+0.57	0.41	0	0	0				0	0	0
	238	1334	-0.57	0.41	4	0	4	-	-	-	5	0	5
	239	1335	+0.58	0.42	1	0	1				1	0	1
	240	1335	+0.50	0.42	0	0	0				0	0	0
	241	1335	+0.50	0.42	86	0	86				91	0	91
	242	1336	+0.60	0.42	1	0	1				1	0	1
	243	1336	+0.60	0.42	51	2	53				57	2	59
	244	1336	+0.60	0.42	78	8	86				82	9	91
	245	1339	+0.65	0.43	237	19	256				251	20	271
	246	1337	+0.61	0.42	12	0	12				14	0	14
	247	1336	+0.60	0.42	0	0	0				0	0	0
	248	1341	+0.43	0.39	177	19	196	-	-	-	188	20	208
	249	1343	+0.28	0.35	130	6	136	-	-	-	138	6	144
	250	1351	+0.60	0.42	1	0	1	-	-	-	1	0	1
	251	1355	+0.83	0.47	115	0	115	-	-	-	121	0	121

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	Film Count P	Film Count T	Maximum Ground A	Maximum Ground P	Maximum Ground T	Estimate A	Estimate P	Estimate T
June 1, 1982 (Cont'd)													
	252	1355	+0.83	0.47	0	0	0				0	0	0
	253	1357	+0.87	0.47	11	0	11	-	-	-	13	0	13
	254	1402	+1.03	0.50	1	0	1				1	0	1
	255	1402	+1.03	0.50	6	2	8				8	2	10
	256	1403	+1.05	0.51	8	0	8				10	0	10
	257	1404	+1.07	0.51	45	2	47				50	2	52
	258	1357	+0.87	0.47	0	0	0				0	0	0
	259	1404	+1.07	0.51	0	0	0				0	0	0
	260	1404	+1.07	0.51	0	0	0	-	-	-	0	0	0
	261	1404	+1.07	0.51	0	0	0				0	0	0
	(262)	1407	+1.12	0.52	122	1	123	-	-	-	128	1	129
	(269)	1410	+1.17	0.53	11	2	13	-	-	-	13	2	15
	(271)	1413	+1.30	0.56	7	0	7	-	-	-	9	0	9
	(272)	1413	+1.30	0.56	12	0	12	-	-	-	14	0	14
	(273)	1414	+1.38	0.58	46	0	46	-	-	-	52	0	52
	(274)	1415	+1.35	0.57	16	0	16	18	0	18	18	0	18
June 2, 1982													
	262	1257	-1.78	0.79	127	0	127	-	-	-	163	0	163
	263	1257	-1.78	0.79	0	0	0	-	-	-	0	0	0
	264	1258	-1.77	0.79	0	0	0	-	-	-	0	0	0
	265	1300	-1.67	0.77	0	0	0				0	0	0
	266	1300	-1.67	0.77	6	2	8				8	3	11
	267	1300	-1.67	0.77	0	0	0				0	0	0
	268	1300	-1.67	0.77	0	0	0				0	0	0
	269	1300	-1.67	0.77	0	0	0				0	0	0
	270	1301	-1.60	0.75	0	0	0				0	0	0
	271	1302	-1.57	0.74	8	0	8				11	0	11
	272	1303	-1.55	0.74	12	0	12				15	0	15
	273	1303	-1.55	0.74	49	0	49				59	0	59
	274	1304	-1.53	0.74	16	0	16	-	-	-	20	0	20
	275	1305	-1.52	0.73	20	0	20				25	0	25
	276	1305	-1.52	0.73	0	0	0				0	0	0
	277	1305	-1.52	0.73	48	3	51				57	4	61
	278	1306	-1.50	0.73	0	0	0				0	0	0
	279	1306	-1.50	0.73	1	0	1	-	-	-	1	0	1
	280	1306	-1.50	0.73	0	0	0				0	0	0
	281	1309	-1.45	0.72	21	0	21				26	0	26
	282	1306	-1.50	0.73	0	0	0	-	-	-	0	0	0
	283	1306	-1.50	0.73	0	0	0	-	-	-	0	0	0
	284	1311	-1.42	0.71	29	0	29	-	-	-	37	0	37
	285	1312	-1.47	0.72	0	0	0				0	0	0
	286	1312	-1.47	0.72	0	0	0	-	-	-	0	0	0
	287	1313	-1.45	0.72	58	6	64	-	-	-	71	7	78
	288	1314	-1.43	0.72	2	0	2	-	-	-	3	0	3
	289	1315	-1.42	0.71	9	0	9	-	-	-	12	0	12
	290	1315	-1.42	0.71	0	0	0	-	-	-	0	0	0
	291	1316	-1.40	0.71	1	0	1	-	-	-	1	0	1
	292	1316	-1.40	0.71	0	0	0	-	-	-	0	0	0
	293	1316	-1.40	0.71	0	0	0	-	-	-	0	0	0
	294	1321	-1.32	0.69	4	0	4				5	0	5
	295	1321	-1.32	0.69	40	0	40				48	0	48
	296	1321	-1.32	0.69	48	4	52				56	5	61
	297	1323	-1.28	0.68	2	0	2	-	-	-	2	0	2
	298	1323	-1.28	0.68	0	0	0	-	-	-	0	0	0
	299	1324	-1.27	0.68	24	1	25	-	-	-	31	1	32
	300	1326	-1.23	0.67	1	0	1				1	0	1

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
June 2, 1982 (Cont'd)													
	301	1326	-1.23	0.67	0	0	0				0	0	0
	302	1326	-1.23	0.67	125	0	125				142	0	142
	303	1330	-1.17	0.66	4	0	4				5	0	5
	304	1330	-1.17	0.66	39	0	39				45	0	45
	305	1330	-1.17	0.66	43	2	45				50	2	52
	306	1331	-1.15	0.65	1	0	1				1	0	1
	307	1332	-1.13	0.65	109	0	109				126	0	126
	308	1332	-1.13	0.65	0	0	0				0	0	0
	309	1332	-1.13	0.65	0	0	0				0	0	0
	310-317	not covered											
	318	1454	+0.23	0.45	15	0	15	-	-	-	17	0	17
	319	1454	+0.23	0.45	0	0	0	-	-	-	0	0	0
	320	1456	+0.27	0.46	57	0	57	-	-	-	63	0	63
	321	1456	+0.27	0.46	4	0	4	-	-	-	5	0	5
	322	1456	+0.27	0.46	-	-	-	-	-	-	-	-	-
	323	1456	+0.27	0.46	16		17	-	-	-	18	1	19
	324	1457	+0.28	0.46	0	0	0	-	-	-	0	0	0
	325	1456	-0.28	0.44	0	0	0				0	0	0
	326	1504	+0.32	0.47	81	3	84	-	-	-	86	3	89
	327												
	328												
	329												
	330	1510	+0.42	0.49	29	3	32	-	-	-	32	3	35
	331												
	332	1513	+0.45	0.50	171	5	176	-	-	-	182	5	187
	333	1516	+0.50	0.51	28	5	33	-	-	-	31	5	36
	334	1516	+0.50	0.51	45	0	45	-	-	-	50	0	50
	335	1516	+0.50	0.51	4	0	4	-	-	-	5	0	5
	336	1518	+0.53	0.52	12	0	12	-	-	-	14	0	14
	337	1518	+0.53	0.52	0	0	0	-	-	-	0	0	0
	338	1521	+0.57	0.52	42	6	48	-	-	-	46	7	53
	339	1522	+0.58	0.53	38	0	38	-	-	-	42	0	42
	340	1522	+0.58	0.53	0	0	0	-	-	-	0	0	0
	341	1523-1524	+0.65	0.54	47	2	49	-	-	-	52	2	54
	342	1524	+0.65	0.54	32	0	32	-	-	-	36	0	36
	343	1526	+0.68	0.55	26	1	27	-	-	-	31	1	32
	344	1527	+0.70	0.55	17	1	18	-	-	-	21	1	22
	345	1529	+0.72	0.56	30	1	31	-	-	-	33	1	34
	346	1530	+0.73	0.56	0	0	0				0	0	0
	347	1530	+0.73	0.56	0	0	0				0	0	0
	348	1532	+0.77	0.57	0	0	0				0	0	0
	349	1533	+0.78	0.57	49	2	51	-	-	-	55	2	57
	350	1534	+0.80	0.58	25	2	27	-	-	-	29	0	29
	351	1534	+0.80	0.58	0	0	0	-	-	-	0	0	0
	352	1535	+0.82	0.58	183	0	183	-	-	-	194	0	194
	353	1536	+0.85	0.59	55	0	55	-	-	-	61	0	61
	354	1529	+0.90	0.60	30	0	30	-	-	-	35	0	35
	355	1540	+0.92	0.60	9	0	9	-	-	-	11	0	11
	356	1545	+0.99	0.62	62	5	67				69	6	75
	357	1545	+0.99	0.62	0	0	0				0	0	0
	358	1546	+1.00	0.62	13	0	13	-	-	-	15	0	15
	359	1546	+1.00	0.62	0	0	0	-	-	-	0	0	0
	360	1546	+1.00	0.62	0	0	0	-	-	-	0	0	0
	361	1546	+1.00	0.62	0	0	0	-	-	-	0	0	0
	362	1552	+1.08	0.64	6	1	7	-	-	-	8	1	9

APPENDIX IV. - Continued

Date	Site no.	Time	L.T.* Div. (hr)	Tide Ht. (m)	Film Count A	P	T	Maximum Ground A	P	T	Estimate A	P	T
June 2, 1982 (Cont'd)													
	363	1552	+1.08	0.64	520	63	583	-	-	-	546	66	612
	364	1553	+1.10	0.64	10	3	13	-	-	-	12	4	16
	365	1554	+1.10	0.64	47	5	52	-	-	-	52	6	58
	366	1555	+1.12	0.65	16	0	16	-	-	-	18	0	18
	367	1603	+1.23	0.67	10	0	10	-	-	-	12	0	12
	368	1603	+1.23	0.67	0	0	0	-	-	-	0	0	0
	369	1603	+1.23	0.67	0	0	0	-	-	-	0	0	0
	370	1605	+1.30	0.69	0	0	0				0	0	0
	371	1616	+1.42	0.71	14	0	14	-	-	-	17	0	17
	372	1616	+1.42	0.71	0	0	0	-	-	-	0	0	0
	373	1619	+1.32	0.69	165	7	172	-	-	-	172	7	179
	374	1619	+1.32	0.69	68	8	76	-	-	-	71	8	79
	375	1625	+1.30	0.69	1	0	1	-	-	-	1	0	1
	376	1625	+1.30	0.69	0	0	0	-	-	-	0	0	0
	377	1625	+1.30	0.69	0	0	0	-	-	-	0	0	0
	378	1625	+1.30	0.69	0	0	0				0	0	0
	379	1625	+1.30	0.69	0	0	0				0	0	0
	380	1625	+1.30	0.69	0	0	0				0	0	0
	381	1628	+1.30	0.69	46	0	46	-	-	-	48	0	48
	382	1633	+1.13	0.65	480	3	483	221	44	265	503	4	507
	383	1635	+1.13	0.65	not covered						-	-	-
	384	1638-1641	+0.63	0.54	260	9	269	-	-	-	267	14	281
	385	1645	+0.25	0.46	127	4	131	-	-	-	130	4	134
	386	-	-	-	-	-	-	-	-	-	-	-	-
	387	1435	1.9'1:22	.58	0	0	0						
	388	1436	1.9'1:21	.58	0	0	0						
	389	1436	1.9'1:21	.58	0	0	0						
	390	1437	1.9'1:20	.58	21	0	21						
	391	1438	1.8'1:19	.55	0	0	0						
	392	1438	1.8'1:19	.55	0	0	0						
	393	1440	1.8'1:17	.55	0	0	0						
	394	1440	1.8'1:17	.55	0	0	0						
	395	1444	1.8'1:13	.55	0	0	0						
	396	1446	1.8'1:11	.55	0	0	0						
	397	1449	1.7'1:08	.52	2	0	2						
	398	1450	1.7'1:07	.52	0	0	0						
	399	1450	1.7'1:07	.52	15	0	15						
	400	1450	1.7'1:07	.52	0	0	0						
	401	1450	1.7'1:07	.52	0	0	0						
	402	1450	1.7'1:07	.52	0	0	0						
	403	1450	1.7'1:07	.52	0	0	0						
	404	1450	1.7'1:07	.52	0	0	0						
	405	1451	1.7'1:06	.52	0	0	0						
	406	1454	1.7'1:03	.52	0	0	0						
	407	1456	1.7'1:01	.52	0	0	0						
	408	1458	1.7':59	.52	0	0	0						
	409	1507	1.6':50	.49	0	0	0						
	410	1509	1.5':48	.46	48	0	48						
	411	1509	1.5':48	.46	0	0	0						
	412	1514	1.5':41	.46	35	0	35						
	413	1515	1.5':42	.46	52	0	52						
	414	1517	1.5':40	.46	0	0	0						
	415	1517	1.5':40	.46	0	0	0						
	416	1518	1.5':39	.16	0	0	0						
	417	1520	1.5':37	.46	0	0	0						
	418	1520	1.5':31	.46	129	0	129						
	419				0	0	0						
	420	1523	1.5':34		0	0	0						
	421				0	0	0						
	422	388	1302	0.00	-	-	-	47	3	50	47	3	50