SOUTHEAST TURTLE SURVEY

(SETS)

FINAL REPORT TO THE NATIONAL MARINE FISHERIES SERVICE

PELAGIC SURVEYS

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GROTON-NEW LONDON AIRPORT
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GENERAL AND PROJECT OBJECTIVES

Aero-Marine Surveys, Inc. has completed the first year of pelagic surveys for the Southeast Turtle Surveys program (SETS). Four seasonal pelagic surveys were flown from Cape Hatteras, NC to Key West, FL and offshore to the approximate western edge of the Gulf Stream. In addition, one pelagic survey sampled two Gulf Stream areas beyond the regular study areas. The pelagic surveys were designed to provide data for sea turtle population estimates in the Southeast U.S. as well as information on spatial and temporal distribution, behavior, ecological correlates, and sightability.

This report presents an overview of the objectives, methods, calendar, innovations, and preliminary results of the pelagic portion of the SETS program from April 1982 to March 1983. A separate report with different authorship presents the summary of the nesting beach surveys. Although the contract was primarily for data collection, some preliminary data reductions and interpretations were performed and are presented herein. During the course of the surveys insights on future research and methodologies were made and are briefly mentioned. A proposal for further survey and experimentation has been presented separately.

INTRODUCTION

The pelagic aerial survey of sea turtles in the Southeast U.S. waters represents the first comprehensive survey of turtles in this area. Such surveys have been completed in the Northeast under the Cetacean and Turtle Assessment Program (CETAP) and the Gulf of Mexico, both funded by the Bureau of Land Management (BLM). There are five species of sea turtles which occur in this area: the loggerhead (Caretta caretta), leatherback (Dermochelys coriacea), Atlantic green (Chelonia mydas), hawksbill (Eretmochelys imbricata), and Kemp's ridley (Lepidochelys kempi). A survey plan was developed utilizing line transect methodologies to sample these animals in the study area. Specifics on the study area, data collection methodologies, and preliminary results follow.

METHODS

SETS Pelagic Study Area

The study area extends from Cape Hatteras, NC to Key West, FL and offshore to the approximate western edge of the Gulf Stream as depicted on NOAA chart #11009. From Cape Canaveral, FL to Key West, Fl the study area extends from the shore out 25 n.mi. In the southern end of the standard study area, the Gulf Stream is found in approximately 60% of Block 10 and approximately 40% in Block 9. The entire area is approximately

29,086 n.mi. and is divided into ten sampling blocks of nearly equal area (2,900 $n.mi.^2$). Figure 1 depicts the study area and its contiguous blocks. Because of coastal asymmetry and the variable offshore distance of the western edge of the Gulf Stream, each sampling block has a characteristic shape. South of Cape Canaveral, FL, Blocks 9 and 10 where the Gulf Stream is close to shore, a 20 n.mi. wide strip follows the coastal contour. To reduce the effect of glare, transects within a block were flown in a NW-SE axis. The borders of each block are so oriented. In the summer survey (July-August) two extra blocks were added to extend coverage well into the Gulf Stream and are illustrated in Figure 2 as Gulf Stream-North (GN) and Gulf Stream-South (GS). The Gulf Stream coverage included area adjacent to sampling blocks inshore to 10-15 n.mi. beyond the main axis of the Gulf Stream. The Gulf Stream sampling areas were selected to avoid the north and south borders of the study area, in areas of suspected turtle concentrations to determine possible offshore distributional limits, and near logistically manageable bases.

The coordinates of the sampling block borders are given in Figure 3. Under appropriate weather conditions, each block was flown during one day from one of three bases of operation: Titusville, FL (Blocks 6-10), Charleston, SC (Blocks 3-5), and Wilmington, NC (Blocks 1-2). The progression of blocks sampled depended upon weather, offshore military activity, and transit logistics.

The longest survey transects were approximately 82 n.mi. (Block 7) while the shortest transects (Block 1) were approximately 11 n.mi. (not including the Gulf Stream exploratory survey) The farthest point offshore was approximately 65 n.mi. During a standard survey transects were randomly chosen at least 1 n.mi. apart and added to achieve the approximate coverage required.

Because of the curvature of the coastline the NW-SE transects were approximately normal to depth except in the southern areas characterized by shallow plateaus. No bays, harbors, nor estuaries were sampled along the coastline.

Methodology

1. Survey platform. The pelagic aerial survey utilized company owned Beechcraft AT-11's. This type of twin-engined aircraft allows an unobstructed view of the trackline for two observers sitting in the plexiglass nose bubble. Figure 4 illustrates the configuration of the AT-11. Aboard the survey aircraft were a Loran-C navigation computer for instantaneous positions (60' resolution) with way point memory capability, a Barnes PRT-5S radiometer for remotely sensed sea surface temperature, and a voice-activated intercommunications system through which observations were communicated to aft recording personnel. The aircraft, instrumentation, and safety equipment

meet or exceed the requirements outlined for these surveys.

2. Calibration of observation bubble. As required in line transect methodology, each sighting from the observation bubble includes information on distance from the trackline. Rather than recording the angle of each sighting, the bubble was calibrated and marked in intervals to collect right angle or perpendicular distances from the trackline for each sighting. The assumption is made that all animals directly on the trackline are seen.

A separate calibration flight was made from TICO (Titusville-Cocoa, FL) airport for the purpose of marking the distance intervals on the plexiglass of the nose compartment. By flying a series of offsets from a reference airstrip, selected sighting angles, determined with a Suunto PM-5 inclinometer, were marked on each side of the bubble. The survey altitude (and thus the calibration altitude) remained constant at 500 ft. Calibration correction factors for this survey altitude were modeled after similar work by Kenney and Scott for CETAP surveys. Distance from the trackline is given by: D=a tan X where D=perpendicular distance; a=altitude; and X=inclination from the vertical. But, during angle determination, the visual horizon (which at 500' is not exactly 90° from the vertical) was used as the reference by the personnel in the calibration team. The distance to the horizon, $D_h = 1.44(a_f)^{1/2}$ where a_f = altitude in feet. B_a, the angle of inclination to the horizon at altitude a_f is: $B_a = \arctan[(D_h/a_f)(1.646 \times 10^{-4})]$. Thus the perpendicular distance from the trackline utilizing the angle of inclination from the horizon is: a $\tan(B_a - \alpha)$ (Kenney and Scott, 1981).

Five distance intervals on each side were marked in 1/16 n.mi. increments from the trackline such that interval 1= 0-1/16 n.mi.; interval 2= 1/16 - 1/8 n.mi.; interval 3= 1/8 - 3/16 n.mi., etc. Interval data from each sighting can then be used to derive a sighting function with distance from the trackline. Interval distance was chosen on the basis of the suspected effective swath width of 0.334 n.mi. for sea turtles at 500' survey altitude. This swath width figure was utilized in the determination of percent area coverage. Thus, for each of the ten sampling blocks of approximately 2,900 n.mi.^{2}, lineal transect miles flown were designed to approach or surpass 695 n.mi. to achieve the contracted 8% coverage for each block.

3. Flight Plans. The chief observer was responsible for submitting a new set of randomized transects (and way points for those transects) for each survey. Transects were taken from the available 1 n.mi. intervals along a line perpendicular to the direction of flight (315°T to 135°T) in each sampling block. Random numbers within each block range were used and transects added to meet the desired coverage of 8% (using 0.334 n.mi. as effective swath width). Upon completion of the flight the chief observer calculated actual coverage, reviewed formats, and summarized data.

4. Observation Methodology. The observer team was chosen from qualified personnel, all having aerial survey experience and well acquainted with sea turtle morphology and biology (see personnel section below). Each observer was trained in the elements of line transect methodology and was instructed to maintain body posture, visual horizon reference, to report accurate sighting intervals, and to conservatively identify species, assigning reliability codes on each identification. Since observers also recorded data, each was familiar with maintaining notes on environmental conditions. A standard rotation of four observers was followed to reduce observer fatigue. Generally, observer rotation was made for each transect. Position 1 was the right observer (looking left as designed and calibrated), position 2, the left observer (looking right), position 3, observer rest; and position 4, data entry and recording. In blocks where transects were short (e.g.,Block 10), rotations were made every two transects. The two observers in the bubble communicated each sighting via intercom to the recorder. Sightings of all biological, and physical, and human-related events were reported, such as fish schools, shrimping activity, manta rays, tanker traffic, possible species associations, water color changes, turbidity, and any other phenomena. Besides sea turtles, marine mammals were emphasized, particularly the bottlenose dolphins, Tursiops truncatus. Sightings were recorded ~~with~~ from identified observers so that observer variability may be assessed.

5. Manual Recording Methodology. The primary method of data collection and reporting for the spring, summer, and fall was through manual input on data forms. An example of the field recording form is shown in Figure 5. The form was designed for simplicity, rapid entry of data, and to review all information required. Space for notation and comments follow regular data entries. Table 1 accompanies Figure 5 with explanations of "header information", columnar entries, and interpretive codes. Recorders were responsible for accurate entry of positions and radiometer readings on a regular bases (at least every 5 minutes) even when sightings were not reported. Flight logs kept by the co-pilot in the spring and summer surveys offered a redundant system of regular positions and verified waypoints at each end of the transects. During periods of rapid succession of sightings a priority of data input was established such that, at the least, the species, number of animals, sighting interval, and reliability code of the identification were reported. Approximate positions and time could be extrapolated from previous and subsequent entries when not available.

At the end of a survey, data were copied and submitted to NMFS for transcription and entry into the computerized data base. The transcription protocol, developed by NMFS personnel, is listed in Table 2. Table 3 lists species codes and parameter code, and a sample of the transcription form is given in Figure 6.

6. Automated Recording Methodology. For the third and fourth surveys, a Hewlett-Packard Model 85 microprocessing computer was utilized on board the AT-11 to facilitate data recording and to significantly reduce the transcription process after the survey. A substantial effort was made to develop the software to provide an efficient and rapidly responsive program for sightings and survey parameter entry. Because of this important innovation, a separate flight for field testing and operational training was made before Survey 3. The principal investigator and NMFS personnel were aboard this flight to evaluate, observe, and criticize techniques and methods involving the computer use and sighting procedures.

The HP-85 system is interfaced with the Loran-C and radiometer on board and programed such that position and sea surface temperature data are automatically entered each minute (regulated by its own internal clock), and for each sighting. This automated system virtually eliminates human error in position recording and expands the data base by sampling each minute, regardless of sighting activity. The software developed by Aero-Marine Surveys, Inc. provides an interactive self-prompting menu selection (with user-defined keys) for each sighting category (i.e., turtle species, dolphins, number of animals, sighting interval, observer identification, etc.) and for sighting parameter changes (i.e., glare changes, Beaufort sea state, weather, etc.). Information on date, sampling block, transect number, and personnel is entered prior to each transect. The

HP-85 provides a real-time printout of the data (thermographic hard-copy) and data are stored at intervals on its built-in tape system. Software improvements were implemented for the fourth survey to improve response time, add "demand samples" for notes, set priorities of data collection, and allow program interruption to accomodate rapid succession of data entry. Recorders were always prepared to hand record if needed. In fact, for the third survey, a manual record was kept as the official data set in case of computer malfunction. Figure 7 illustrates typical printouts from the computer program and the menu selection categories. In addition to the raw data on the HP-85 tapes, a system was developed by Aero-Marine Surveys, Inc. to edit, review, and transfer the data onto a HP-86 model computer which operates on disc storage and is more compatible with NMFS computer equipment.

7. Sighting and Coverage Variables. Various factors affect sighting conditions and coverage during each survey. The most obvious factor is sea state. A negative relationship between sea turtle sightings and high sea states (3-4) was apparent. A careful monitoring of sea state must be maintained because dramatic changes can occur 1) within a day (e.g., afternoon winds) 2) within a transect (e.g., changes in currents, presence of Gulf Stream bathymetry), 3) during passage of weather fronts, and 4) in local squalls and weather. On occasion, low sea state during a portion of a transect contrasted with unacceptable sea state in another portion. Because of weather variables, availability of the aircraft

was predicated at 2.5 days/sampling block to account for inevitable survey aborts; and for a transect to be counted, at least 65% of its length was required within acceptable sea state limits (0-4).

Sighting curves over time indicate that the time of day influences sightability of turtles (Thompson & Shoop, 1981). During mid-day, turtles seem to "bask" at the surface. This diel behavior may account for a peak in the number of sightings during a sampling day. It is not known if turtle surface behavior is influenced by changes in the weather (i.e., high winds, overcast sky). In any case, experiments to test both the effect of time of day (TOD) and sea state have been proposed for next year.

When possible, each sighting indicated whether the animal was seen at or below the surface. These observations may be correlated with water turbidity estimates.

Other factors affecting sightings and coverage include fog, low sun angle (glare problem), local thunderstorms, airport control zone restrictions (IFR) and active military warning areas (often with live fire). In one case off Block 8, a test firing of an Army missile exploded in the study area on a day otherwise slated for survey.

In an attempt to standardize flight decisions regarding weather and number of days available (25/10 sampling blocks), a decision flow chart was created (Figure 8). Every attempt was made to begin a survey by 0900. A list of personnel is attached as Appendix 1.

RESULTS AND DISCUSSION

This report presents some results but does not represent final analyses since this contract was designed primarily for data collection. The NMFS is responsible for data analysis and interpretation.

1. Survey Calendar. The survey schedule is presented in Appendix 2 as calendars for each of the four seasonal surveys. The first survey began with a calibration flight on 19 April 1982; the last (winter) survey ended 13 February 1983. Two additional flights for the Gulf Stream exploratory were flown in the second (summer) survey and one flight for training personnel and testing the automated data entry system was added to the third (fall) survey. In all, 76 days were required to survey 40.5 sampling blocks for a ratio of 1.88 days/sampling block. In only one case was a sampling block eliminated (Block 1, winter survey) due to weather delays and lack of availability days. The temporal scheme of our surveys represent true seasonal samples since each survey nearly bisected the solstice-equinox intervals. Table 4 lists the inclusive dates for each survey.

2. Survey Coverage. Since each survey required a new set of

randomized transects for each block, the designed coverage per block was not identical. The percent of each block covered was further altered circumstantially by weather, sea states, military zone restrictions, and sightability factors discussed above. Table 5 lists the coverage of each sampling block in each survey. Explanations for reduced coverage for some blocks (indicated in Table 5) are discussed separately in the four seasonal reports to the NMFS. Gulf Stream coverage is indicated by the number of lineal miles flown since sighting methodology was only briefly suspended as observers rotated to maximize coverage by sampling even between standard transects.

3. Distribution of Animals.

a). Distributional maps. Maps of the study area illustrating the distribution of turtles were made from the computerized data bases at NMFS for each survey (Figures 9, 10, 11, 12). An obvious concentration of turtles occurs in Blocks 8 and 9 for the spring and summer surveys and in Block 1 in the fall. A secondary concentration occurred in Blocks 7 and 3 for the spring. An obvious lack of turtles can be seen in Blocks 1-6, 10, and both Gulf Stream blocks during the summer months. The western edge of the Gulf Stream may be a natural offshore border of the normal distribution of sea turtles in the summer since only 17 turtles were encountered in both Gulf Stream sampling blocks. When transects extended shoreward of the Gulf Stream into Blocks 8 and 9, many sea turtles were encountered, further suggesting a distributional limit or natural border. Random distributions within sampling blocks seem apparent although this can be empirically determined.

The numbers of turtles in spring and summer samples account for 81.2% of all turtles in the four seasonal samples. The paucity of sightings is obvious in the fall and winter distributional maps. The minor concentration of animals in Block 1 in the fall sample may represent animals migrating from the area north of Cape Hatteras, NC in advance of winter. The distribution of sea turtles during the winter survey showed a relatively marked occurrence of sea turtles offshore in the northern Blocks (2-6) and is likely a response to the warmer sea temperatures closer to the Gulf Stream.

b) Seasonal Comparisons. Comparisons of sightings by sampling block and species (*Caretta*, *Dermochelys*, unidentified) for each survey has been compiled through histograms seen in Figures 13-15 and scaled equally for easy visual comparison. Total turtle sightings are compared similarly in Figure 16 and can be used to visualize seasonal shifts in distribution and changes in relative abundance. Note that these comparisons are unweighted relative to effort and are useful only as relative comparisons. However, the differences in overall abundance are particularly evident between the spring-summer surveys and the fall-winter surveys. This point is graphically made in Figure 17 through comparisons of percents of sightings by sampling block both within a survey and within the compilation of all turtle sightings for the four surveys. The dashed lines represent percent of all sightings and can be seen as relatively insignificant in both the fall and winter. Monitoring programs in the future, then, could be temporally stratified to fit the seasonal changes in abundance. As seen in Figure 18 approximately 40% of all turtle sightings for all four surveys occurred in Block 8.

As seen in Figure 13, Caretta was numerous throughout the study area in the spring although fewer were found in Blocks 2 and 4-6. There was a strong peak in Block 8 and a secondary peak in Block 3. In the summer, the distribution of Caretta apparently shifted to the south (Blocks 8,9) and numbers were reduced in the rest of the area. Block 1 had a peak in Caretta in the fall, but it is sparse elsewhere. The winter distribution was apparently uniformly sparse. This seasonal distributional pattern is also seen for unidentified turtles (Figure 15). However, there was a greater number of unidentified turtles overall in the spring possibly due to observer experience differences.

Because of low numbers, the distributional shifts noted for Dermochelys are less apparent (Figure 14). There was a strong peak of 31 animals in Block 8 in the summer, more evenly distributed throughout in the spring, and sparse in both the fall and winter. The absolute values for each species by sampling block and season are tabularized in Appendix 3 as submitted in the survey reports.

c) Numbers of turtles. A summary of the sea turtle sightings by season is given in Table 6. Caretta was by far the dominant species representing 2,191 animals or 81.4% of the total number of turtles (2,690). Unidentified turtles were second in frequency of sightings with 389 (14.5%). Only 98 Dermochelys were identified (3.5% of total) and nearly a third of those were seen one day in Block 8, summer survey. The occurrence of Dermochelys seemed spatially clumped.

Only 10 Chelonia, 1 Eretmochelys, and 1 possible Lepidochelys were identified from the grand total of 2,690. These numbers suggest several possibilities; 1) aerial surveys may be inadequate to detect these species, 2) their numbers may represent a true reflection of relative abundance, 3) their behavior may limit surface activity and thus limit their sightability, 4) their size may be prohibitively small for identification from 500' altitude (for hawksbills and ridleys), or 5) their spatial and/or temporal distributions may be very limited and difficult to sample. Chelonia was found in Blocks 3-5, 8, and 10; 1 Eretmochelys in 10, and 1 possible Lepidochelys in 8. In any case, the most benefit of this survey will be from the expansion of biological information on Caretta and Dermochelys as well as information on sightability factors and the use of aerial surveys. Density and population estimates may well be limited to Caretta based on the sample sizes collected.

Many of the unidentified turtles were probably *Caretta* since most turtles seen are of that species.

Notable Concentrations of turtles.

For the spring and summer a vast concentration of turtles (*Caretta*) occurred in blocks 7, 8, and 9 (particularly the northern end of block 9). The area of note extends from just south of Cape Canaveral north to near Brunswick, Georgia. Cape Canaveral has been recognized as a general zoogeographic boundary, and the waters north of this point vary dramatically in the occurrence of marine vertebrates and shrimp, and are obviously more productive. "Outwelling" of nutrients from the coastal marshes increases the productivity of this area and supports great quantities of marine life. Our sightings included hundreds of manta rays, fish schools, cow-nosed rays, shrimping activity, and bottlenose dolphins (*Tursiops truncatus*) in this area. The presence of turtles (particularly *Caretta*) in the Cape Canaveral ship channel is well documented. Because of the predictable numbers of turtles in this area, experiments on sightability variables can be best conducted here to insure presence of animals. A notable drop in the number of animals for this area occurred in the fall; only 12 turtles were sighted in Block 8 versus 461 in the spring, for example.

Determination of Sex/Size.

The sighting methodology attempted to include both size and sex of the animals, however, only occasionally was the large tail characteristic of males evident. Observers also routinely stated whether an animal was particularly large or small. We suspect that counts of smaller and juvenile turtles are negatively biased in our sample due to our survey altitude and speed. Perhaps limits of small size detection can be empirically derived through controlled experiments. Sufficient data to assess size/sex structure are probably not available in the data base.

Sightability Functions

As noted above, each sighting is given with its distance interval from the trackline. When these data are compiled and graphically presented as histograms, various functions can be tested for "goodness of fit". We have produced these histograms for each species for each survey, and they are presented in Appendix 4. Although a few sightings are given in interval 4 (3/16 - 1/4 n.mi. from the trackline), most sightings were limited to interval 3 (1/8 - 3/16 n.mi.) and below. We suspect that with careful analysis, sea state and sightability will be highly correlated, i.e., with increasing sea state, sightings are generally limited to a narrow swath about the trackline. As noted previously in survey reports, the sightability histograms for unidentified turtles show relatively higher values in the outer intervals because the difficulty of identifying turtles corresponds with distance from the trackline.

Environmental Correlates.

As previously stated, environmental conditions were continuously monitored and frequently recorded such that correlations of turtle sightings with 1) sea surface temperature, 2) weather, 3) sea states, 4) species associations, 5) time of day, 6) human activities (i.e., boating, shrimping), and 7) oceanographic features are readily available from the computerized data base. Occurrence of turtles near shipping lanes, proposed oil drilling sites, and active fishing areas may have particular interest. An analysis which partitions the available sightings by sea state may prove illuminating as will a similar analysis with sea surface temperature and depth. There are many analytical combinations and correlations to assess as provided in the data base.

Marine Mammals.

Although the sampling design for the turtle survey was not optimum for marine mammal sighting, many data were collected. Particular emphasis was placed on the most abundant species, *Tursiops truncatus*, the bottlenose dolphin. Table 7 lists the occurrence of marine mammals by season, and the detailed tabularized accounts by survey and sampling block are given in Appendix 5. Approximately 3,403 marine mammals were encountered, and of those 2,260 or 66.4% of the total were identified as

Tursiops truncatus. The next frequent categories were unidentified propoises (752 @ 22.1%), Stenella spp. (312 @ 9.2%), and other marine mammals (79 @ 2.3%). In the winter survey two right whales (Balaena glacialis), a mother calf combination, were seen off Melbourne Beach, FL and photographed for possible inclusion in a program to identify individuals (Dr. Howard E. Winn, University of Rhode Island). Other marine mammals encountered throughout the year included three minke whales (Balaenoptera acutorostrata), grampus (Grampus griseus), pilot whales (Globicephala macrorhynchus), manatees (Trichechus manatus), and several unidentified marine mammals. As an indication of porpoise activity, seasonal comparisons by sampling block were compiled and are presented graphically in Figure 19. The spring and summer distributions look patchy while the fall distribution monotonically decreases from a concentration of animals in Block 1 which probably includes migratory animals from the north. By winter the concentration of the porpoises shifts markedly to the south and ends at Block 9. and Block 10 has a dramatic lack of animals. As expected, no large whales other than the predictable ~~fin and~~ few right whales (both coastal and normal migrants to the area) were encountered. Tursiops was seen during inshore transits within shallow rivers and bays, particularly in South Carolina near Charleston. The relatively high number of unidentified porpoises reflects the difficulty of field identification, the survey altitude (and thus the time available for identification), and the lack of time to circle for identification verification.

CONCLUSIONS

The first year of the pelagic aerial survey for sea turtles in the Southeast has produced much information, particularly on the loggerhead turtle, *Caretta caretta*, the dominant species (81.4% of total) in the study area. An exploratory survey in two sampling blocks in the Gulf Stream produced very few turtles during the summer months. We suspect that our study areas to the Gulf Stream western edge may include the offshore distributional limit of most turtles.

Density and population estimates of turtles can be accomplished through the utilization of sighting functions derived from the line transect methodology. These estimates could be refined with data on sightability correlations, surface behavior of turtles, time of day, and other experimental factors. Aerial methodologies may be inappropriate for ridleys, hawksbills, greens, and juvenile turtles, but extremely effective for *Caretta* and *Dermochelys*. Distributional data provide bases for realistic spatial and temporal strtification schedules for cost/benefit effectiveness. A "hot spot" in Blocks 7-9 requires special attention in the spring and summer, and allocation of effort for future monitoring can now be empirically based.

The survey has provided innovations in automated recording methodology and has produced data on an impressive range of environmental variables. Analyses of the pelagic surveys can later be compared to results of the comprehensive nesting beach survey for distributional correlations.

Table 1. EXPLANATION OF FIELD DATA FORM ENTRIES.

TOP: Observers [L=left; R=right; and observer numerical code ( )]
Recorder [name and/or numerical code]
Crew personnel [pilot/co-pilot]
Survey area [sampling block #]
Date [coded in 6 digits year month day]
Page [sequential for survey day]

Transect number [sequential transect within a sampling block]

Time [2400 hr. designation at time of sighting or data entry]

Number animals + [# of animals seen + variability of estimate; e.g., 20 + 5 dolphins]

Species ID-M,F [coded identification as given in Table 2] M=male, F=female

Sighting Interval [1-5 as designated through distance calibrations]

Reliability code [1=unsure, 2=possible, 3=positive]

S,U [S=animal on surface, U=below surface]

Location; latitude, longitude [position as taken from Loran-C computer display]

Observer number [numerically coded observer responsible for the sighting]

Notes [comments on sighting or additional space for event recording]

Sea State [Beaufort scale 0-5; effective coverage limited to <4]

Glare [right and left observer glare; N=none, S=slight, M=moderate, SV=severe]

Sea T [sea surface temperature taken from radiometer output]

Turbidity [clarity of water C=clear, M=moderately turbid, T=turbid]

Clouds [indicative of weather C=clear, BKM=broken, OC=overcast, % shadow=cloud shadow in swath area]

Visibility [miles of visibility (horizon @ 32 miles with clear visibility @ 500')]

Table 2. Protocol for transcription of SETS pelagic data.

TRANSCRIPTION SOURCE FOR PELAGIC AERIAL SURVEY

Column #	
1	Data source - Survey #1 = 1, Survey #2 = 2, Survey #3 = 3, Survey #4 = 4
2-7	Date - year month day (2 col. each)
8-9	Survey area # = 1-10
10-13	Time - hours minutes (military time/24 hour clock)
14-16	Sighting # - # assigned to keep count of target species (turtles, mammals); assigned by transcriber.
17-20	# animals
21-23	± # animals
24-25	Species - species to be numerically coded, 01-99
26	Sex - to be numerically coded, blank-2
27	Sighting interval = 1-5
28	Reliability of ID 1-3
29-33	Latitude
34-38	Longitude
39	Turtle appearance - sighted above or below water surface, numerically coded, 1-2.
40-41	Observer # - numerically coded (see list)
42-44	Notes - numerically coded 001-999 (see list)
45-47	Sea temperature - measured in nearest tenth °C (entered as integer)
48	Sea state = 1-9
49	Turbidity - numerically coded 1-3
50	Glare - numerically coded 1-4
51	Side - numerically coded 1-2
52	Cloud condition - numerically coded 1-3
53-55	Cloud cover - (%)

Table 2. (continued)

56-57	Visibility - in nautical miles
58-61	Depth - measured in fathoms
62-63	Transect # - dependent on survey area
64	Transect information - numerically coded 1-9
65	Transect made good? - numerically coded blank-1
66-68	Other notes not in previous notes or transect information, numerically coded 1-
69-70	Observer 1 (on left of plane, sights right side) numerically coded (see list)
71-72	Observer 2 (on right of plane, sights left side) numerically coded (see list)
73-74	Recorder - numerically coded (see list)
75-76	Pilot - numerically coded (see list)
77-78	Co-pilot - numerically coded (see list)
79-81	Velocity - (average ground speed from Loran C)
82-84	Altitude - 500 feet
85-87	Mileage per transect (nm) from Loran C
88-90	Mileage in transit (nm) from Loran C
91	Aircraft type - numerically coded

Table 2. (continued)

QUICK REFERENCE: All variables to be entered as integers.
Variables which are reals can be output as reals.
C = numeric coding to be done by transcriber.

I1	Data source	
I6	Date - yr, mo, day	
I2	Survey area	
I4	TIME - hrs, min	
I3	Sighting #	
I4	# animals	
I3	+ # animals	
I2	Species	C
I1	Sex	C
I1	Sighting interval	
I1	Reliability	
I5	Latitude 1	
I5	Longitude	
I1	Turtle appearance	C
I2	Observer #	C
I3	Notes - biological, etc.	C
I3	Sea temp (°C)	
I1	Sea state	
I1	Turbidity	C
I1	Glare	C
I1	Side	C
I1	Cloud condition	C
I3	Cloud cover (%)	
I2	Visibility	
I4	Depth	
I2	Transect	
I1	Transect info: (i.e., beginning, off track, etc.)	C
I1	Transect made good?	C
I2	Other notes - (not in notes of trst info)	C
I2	Observer 1 (on left of plane, sights right side)	C
I2	Observer 2 (on right of plane, sights left side)	C
I2	Recorder	
I2	Pilot	
I2	Co-pilot	
I3	Velocity (avg. ground speed)	
I3	Altitude	
I3	Mileage per trst (nm)	
I3	Mileage in transit (nm)	
I1	Aircraft type	

Table 2. (continued)

QUICK REFERENCE

Turtle Aerial Survey -- Pelagic Coding Information

Sex
F = 1
M = 2
J = 3 (juvenile)
blank = unknown

Turtle Appearance
S = 1
U = 2

Turbidity
C = 1
M = 2
T = 3

Glare
N = 1
S = 2
M = 3
SV = 4

Side
R = 1
L = 2

Clouds
C = 1
BKN = 2
OC = 3

Data Source
1 = dedicated pelagic survey
2 = additional survey

Aircraft type
1 = Beech AT11

Transect info
1 = beginning of track
2 = off track
3 = in transit
4 = survey aborted
8 = transect not completed/end
9 = end of track

Transect made good?
1 = no
blnk = yes

Note Codes:

01) small turtle (any spp. or un.) - juvenile?
02) large turtle (any spp. or un.)
03) possible mating (close association - touching etc.)
04) dead (any spp. or animal)
05) very light coloration (any spp. or un.)
06) very dark coloration (any spp. or un.)
07) apparent tagged animal
08) in association with shrimp boats
09) close to other vessel or human activity such as sportfishing, dredging, etc.
10) apparent feeding (for porpoises, etc.)
11) one observer temporarily indisposed
12) both observers temporarily indisposed
13) sighting verified by non-observers aboard
14) sighting contradicted by non-observers aboard
15) multispecies aggregation, association - stated in notes
16) turtle nesting crawl on beach
17) stranded animal on beach
18) area affected by tidal waters from local inlet or river discharge
19) large freighter or ship in area
20) oil slick evident on surface
21) gulfstream border evident or presumed
22) localized storm - left transect to avoid
23) rain partially obscuring sighting conditions
24) conditions require alternate transect
25) Loran unit -- temporary dysfunction
26) large amount of debris in water
27) weed lines prominent in area
28) color change in water (blue-green)
29) sighting made in transit or between transects
30) sighting made at altitude other than 500 feet
31) radiometer not working
* 32) animal diving actively, possibly in response to aircraft
33) animal at suboptimal orientation relative to aircraft, may affect proper identification
34)
35)
36)
37) fog
38) not observer -- left side
39) not observer -- right side
40) large turtle shaped object
41) mammal appearance, surface
42) mammal appearance, under surface
43) shoaling
44) mission aborted due to excess seq state
46) rain begins
47) rain stops
48) rain squalls in area
49) avoiding storm, modified trackline
50) several/amny/group/lots of
51) reeg area

Note Codes (continued):

52) can see bottom (inbound leg)
53) depth -- becomes deeper (or entering deeper water)
54) depth -- becomes shallower
55) widespread -- in general area (such as # of shrimp boats, etc.)
56) surface disturbance
57) possible mother and calf (marine mammals)
58) probable calf (marine mammals)
59) prominent swells
60) animal apparently on bottom
61) headings for transits
62) fixed fishing gear in area
63) along shoreline -- at beach
64) hazy horizon -- may affect visual horizon regerence
65) military warning area -- acrive, modified brackline
66) *EST
67) *EDT
68) spotted eagle ray
69) notable bird sightings
70) Loran dumped
71) sargassum
72) Change in Water Mass

Table 2. (continued)

TURTLE AERIAL SURVEY - PELAGIC CODING INFORMATION

Participants

1) J. Olsen	2) N. Solomon	3) Hoffman	4) T. Wilson	5) S. Chestnut
6) B. Schroeder	7) G. LeBaron	8) A. McGehee	9) T. Thompson	10) Hoggard
11) Gilman	12) Campbell	13)	14)	15)
16)	17)	18)	19)	20)
21)	22)	23)	24)	25)
26)	27)	28)	29)	30)
31)	32)	33)	34)	35)
36)	37)	38)	39)	40)
41)	42)	43)	44)	45)
46)	47)	48)	49)	50)
51)	52)	53)	54)	55)
56)	57)	58)	59)	60)

1) Olsen (pilot)

2) Solomon (co-pilot)

11) Gilman (co-pilot)

12) Campbell (co-pilot)

Table 3. Species and parameter codes for SETS pelagic surveys

SPECIES CODE

01=Unidentified turtle	UN
02=Caretta caretta	Loggerhead
03=Chelonia mydas	Green
04=Dermochelys coriacea	Leatherback
05=Eretmochelys imbricata	Hawksbill
06=Lepidochelys kempi	Kemp's ridley
07=Trichechus manatus	Manatee
08=Tursiops truncatus	Bottlenose dolphin
09=Unidentified dolphin	UNDO
10=Stenella plagiodon	Spotted dolphin
11=Unidentified marine mammal	UNMM
12=Globicephala macrorhynchus	Pilot whales
13=Kogia spp.	Pygmy or dwarf sperm whale
14=Pseudorca crassodens	False killer whales
15=Balaena glacialis	Right whales
16=Megaptera novaeangliae	Humpback
17=Balaenoptera acutorostrata	Minke whale
18=Balaenoptera edeni	Bryde's whale
19=Balaenoptera physalus	Fin whale
20=Physeter macrocephalus	Sperm whale
21=Stenella coeruleoalba	Striped dolphin
22=Stenella longirostris	Spinner dolphin
23=Steno bredanensis	Rough toothed dolphin
24=Mesoplodon spp.	Beaked whales
25=Ziphius cavirostris	Goosebeaked whale
26=Grampus grisieus	Grampus
27=Stenella spp.	Bridled dolphin
28=Manta birostris	Manta
29=Rhinoptera bonasus	Cow-nosed ray
30=Sphyrna spp.	Hammerhead shark
31=Fish school	
32=Billfish	
33=Unknown shark	
34=Mola mola	Ocean sunfish
35=Cetorhinus maximus	Basking shark
36=Rhincodon typus	Whale shark
37=Unidentified ray	
38=Unidentified animal	

Surface = 1
Below = 2

Sex = 1 = Female
2 = Male
3 = Undetermined

Table 4. Inclusive dates for each survey, number of blocks surveyed, and days required for coverage.

NUMBER	SURVEY	DATES	NUMBER BLOCKS SURVEYED	DAYS/SAMPLE
1	Spring	19 April* - 8 May	10 (+ 1 day calibration)	19/10 = 1.90
2	Summer	19 July - 5 August	12 (2 Gulf Stream blocks)	18/12 = 1.50
3	Fall	18 Oct. - 1 November	10 (+ 1 computer training flight)	14/10 = 1.40
4	Winter	20 Jan.** - 13 Feb.	8.5 (weather aborts)	25/8.5 = 2.94
			ANNUAL	76/40.5 = 1.88

* = 1982 season

** = 1983 season

Table 5. Percent coverage in survey blocks compared by season. (*) Indicates reduced coverage

	% COVERAGE			
BLOCK	SPRING 1982	SUMMER 1982	FALL 1982	WINTER 1983
1	7.85	7.88	7.55*	0% **Survey Abort
2	5.63	6.88	7.43*	4.46 *
3	8.30	6.70	8.34	7.68
4	8.00	8.37	8.11	7.53
5	8.20	8.50	6.0*	7.68
6	8.10	8.65	7.73	6.00*
7	7.29	8.14	8.33	8.02
8	8.10	7.98	7.45*	7.69
9	7.20	7.61	8.00	7.66
10	7.01	7.96	7.73	6.83
GN GS	NA NA	374.4 n.mi. 414.6 n.mi.	NA NA	NA NA

Table 6. Numbers of turtle sightings by season and species. Sightings include all reliability codes; 1 = unsure, 2 = probable, 3 = positive identification.

SEASON	*CARETTA CARETTA*	UNIDENTIFIED TURTLES	*DERMOCHELYS CORIACEA*	*CHELONIA MYDAS*	*ERETMOCHELYS IMBRICATA*	*LEPIDOCHELYS KEMPI*	TOTAL
Spring 1982	882	211	30	4	1	0	1128
Summer + Gulf Stream	892	124	42	6	0	0	1064
Fall	203	23	13	0	0	0	239
Winter * 1983	214	31	13	0	0	1	259
TOTALS	2191	389	98	10	1	1	2690
% of all sightings	81.4%	14.5%	3.6%	0.4%	0.04%	0.04%	

* Block 1 aborted, limited coverage in Block 2.

Table 7. Summary of marine mammal sightings by season and species.

SEASON	*TURSIOPS TRUNCATUS*	UNIDENTIFIED DOLPHINS	*STENELLA* SPP.	OTHERS	TOTAL
Spring 1982	*439	312	171	40	962
Summer	667	164	57	30	918
Fall	637	77	44	1	759
Winter 1983	517	199	40	8	764
TOTALS	2260	752	312	79	3403
% of total	66.4%	22.1%	9.2%	2.3%	

* Numbers represent approximate numbers since schools of porpoises are estimated.

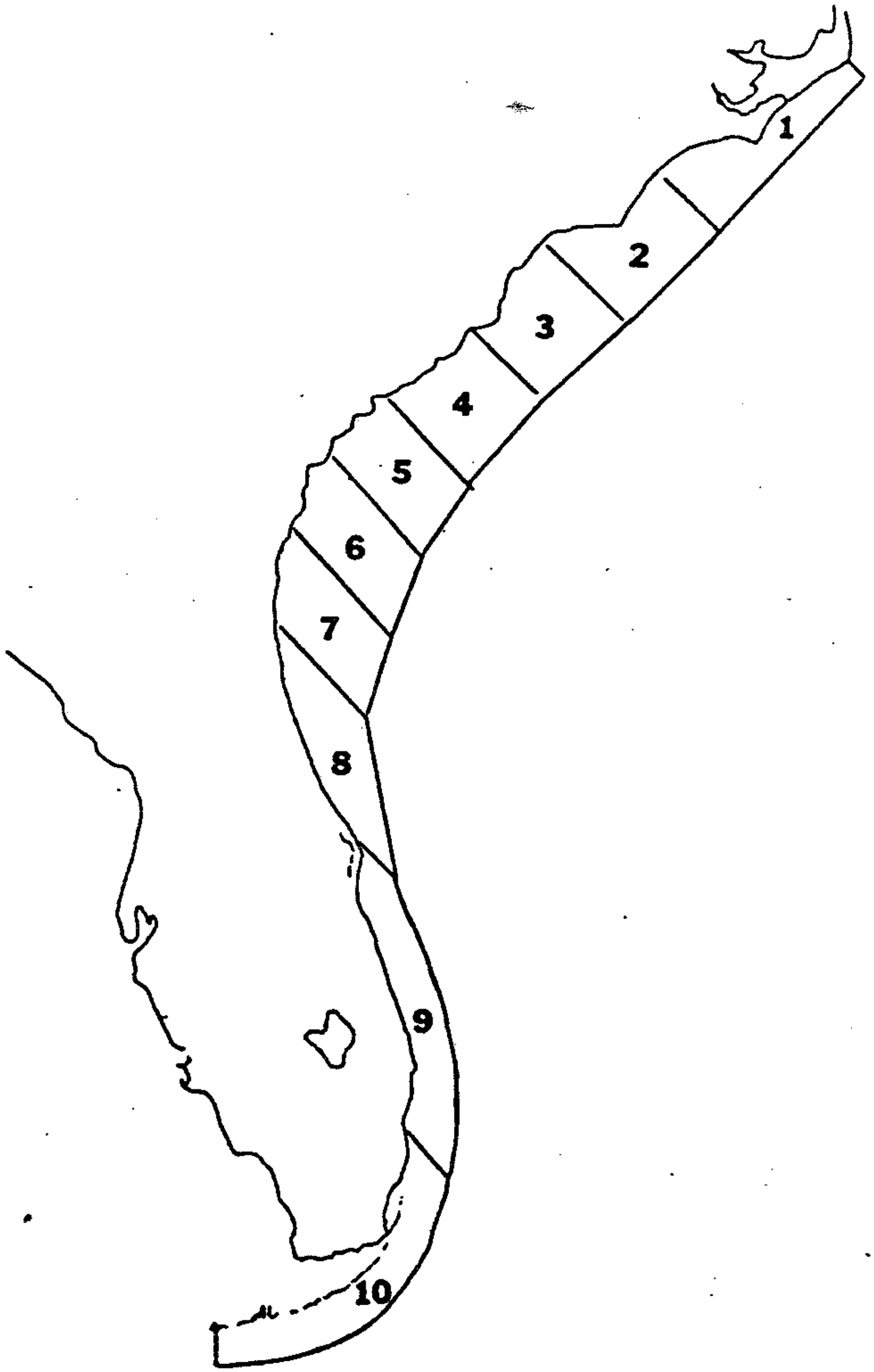


Figure 1. Map of the southeast Atlantic coastline illustrating the ten sampling blocks for the Southeast Turtle Survey.

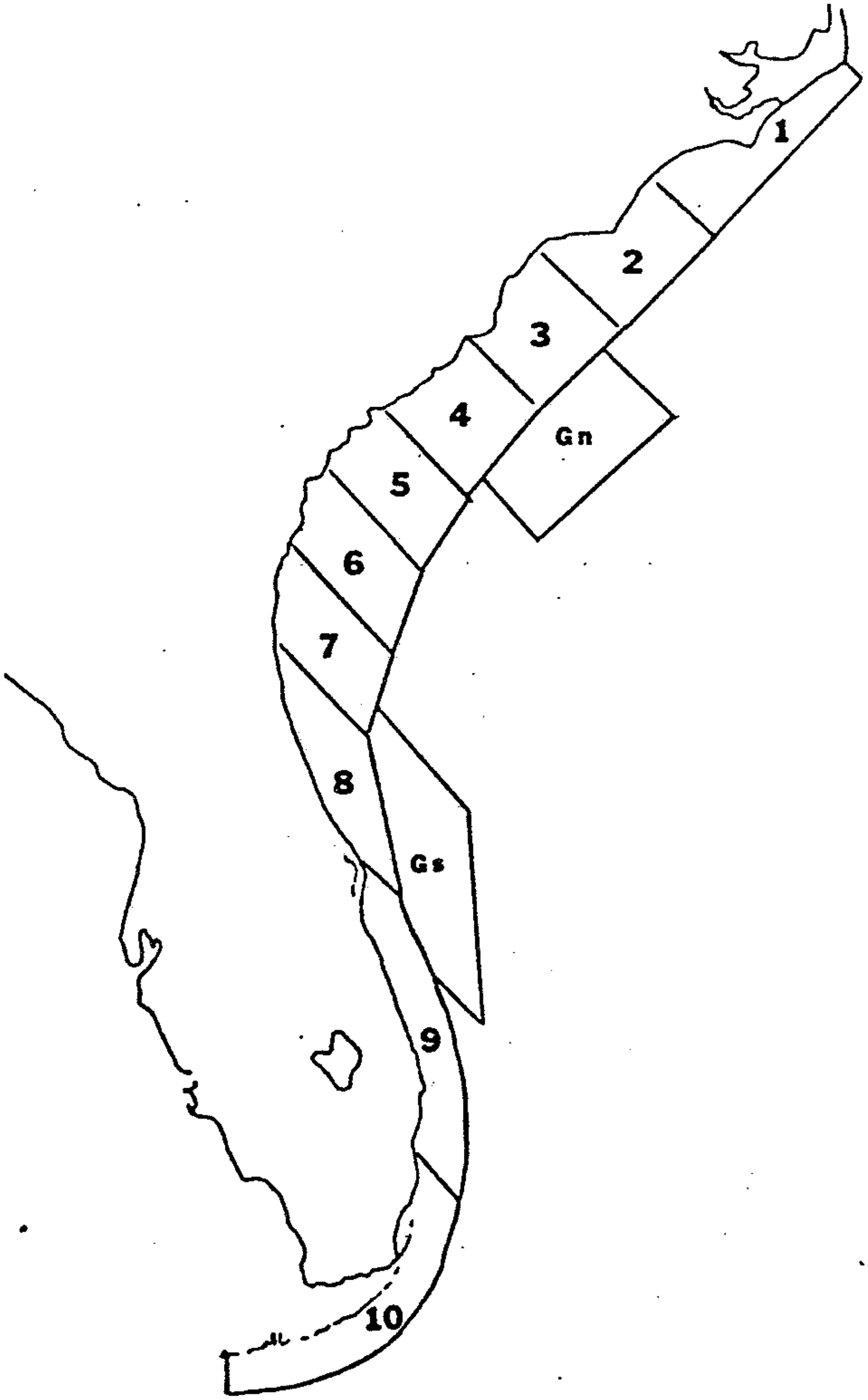


Figure 2. Map of the southeast Atlantic coastline illustrating the ten established sampling blocks and the two sampling blocks in the Gulf Stream. (Gulf Stream-North=GN, and Gulf Stream-South=GS).

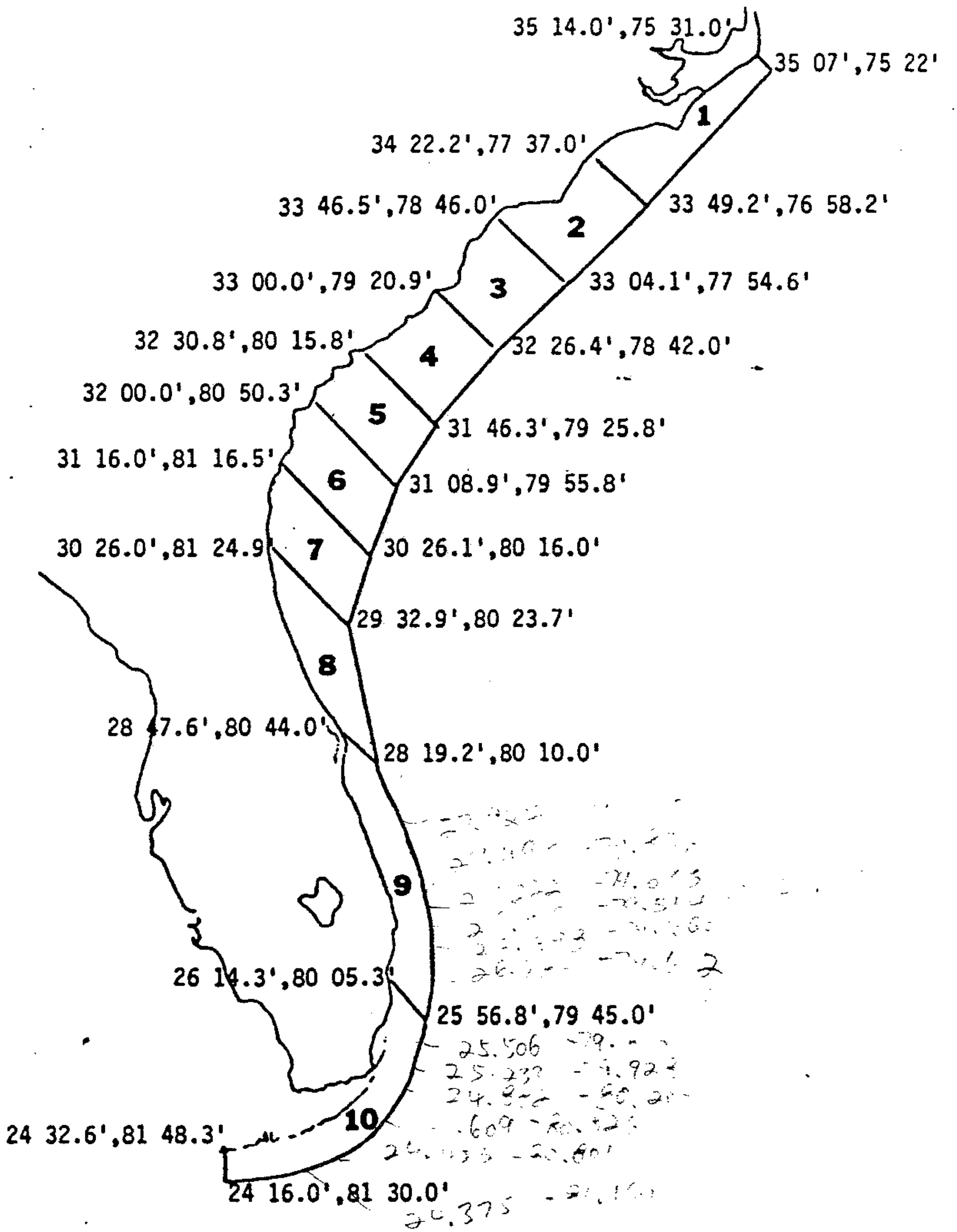


Figure 3. Coordinates of inshore and offshore borders of the ten sampling blocks.

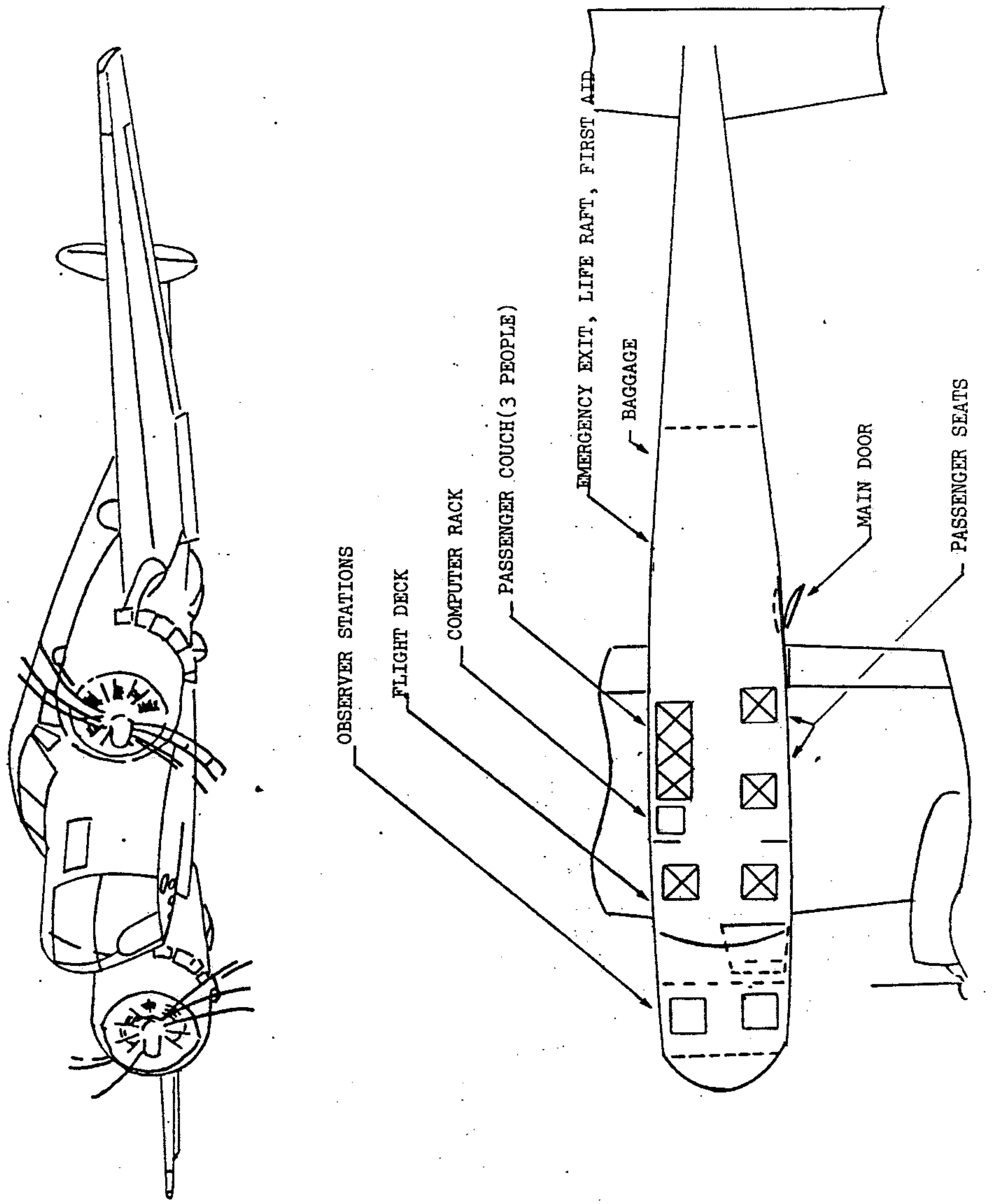


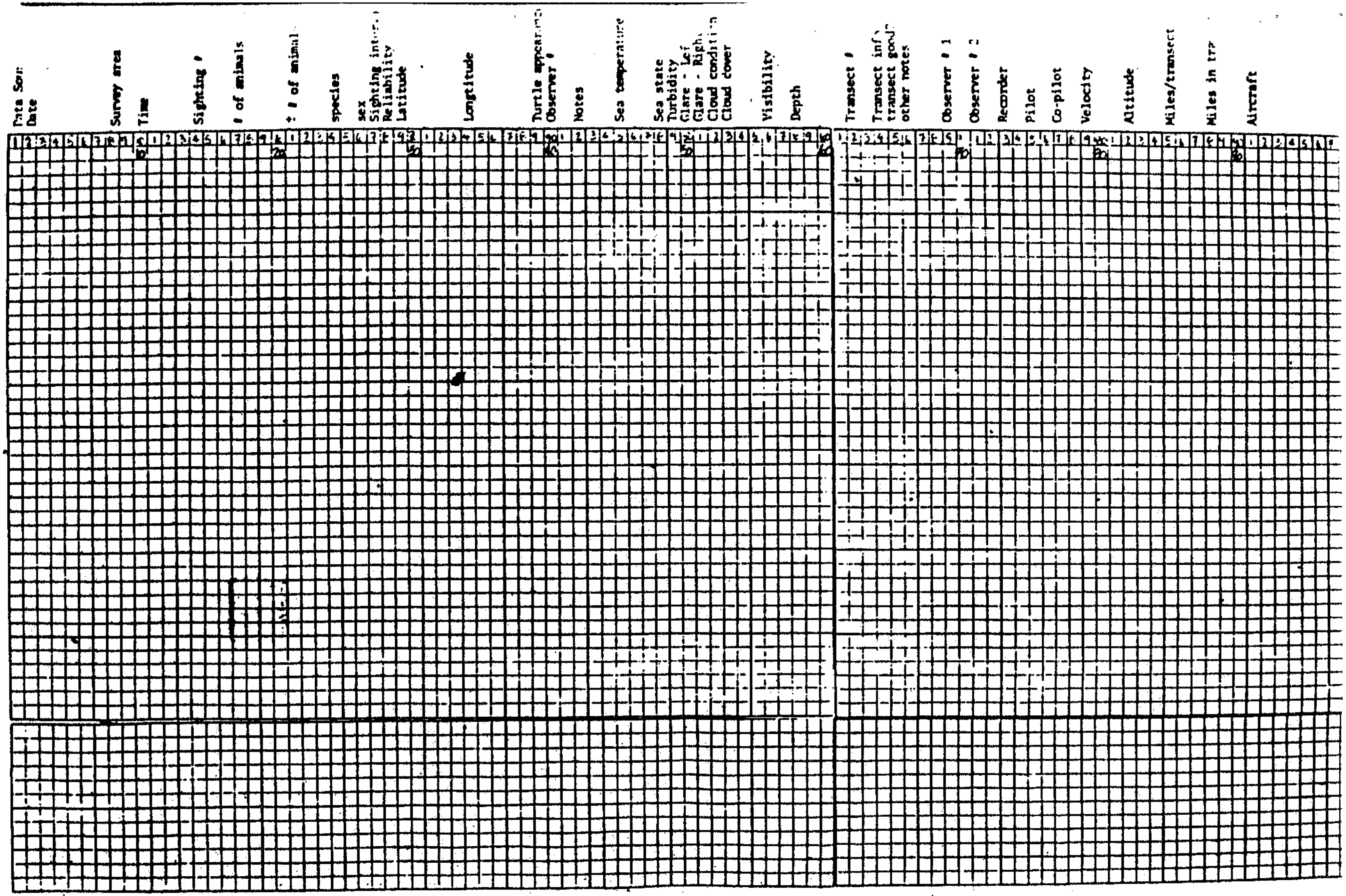
Figure 4. Configuration of AT-11 survey aircraft.

Figure 5. Field data recording forms utilized i.. che pelagic aerial survey.

Observers: L__________( )/ R__________( ) Survey Area # ____ Date ____/____/____ (yr / mo / day) Page ____

Recorder: __________( ) Pilot/Copilot ______/______

Sight# Time	# Animals ±	Species ID/ M,F /	Sighting Interval	Rlblty 1,2,3	S,U	Location Lat.	Location Long.	Obsvr #	NOTES: Behavior, Assoc.animals, vessels, size, heading, Gulfstream, environ. cond., basis of ID, shrimping, photos (roll/frames)	Sea State	Glare n,s,m,ev (R,L)	Sea T°	Turbdty c,m,t	Clouds c,bkn,oc % shadow	Visblty



Columns marked with * are to be duplicated from previous record

Figure 6. Sample transcription form for computer entry of field data.

Figure 7. Examples of printouts from the computer on board with the menu selection categories, sighting inputs, and automatic positional data.

A Sighting Category

```
-------------------------------------------
TURTLE   DOLPHIN-   FISH   WHALE
******   MANATEE    ====   +++++
```

B Species Category

```
CARETTA CARETTA               1
DERMOCHELYS CORIACEA          2
CHELONIA MYDAS                3
ERETMOCHELYS IMBRICATA        4
LEPIDOCHELYS KEMPI            5
Unidentified TURTLE           6

Enter SPECIES #
?
```

C Sighting Input

++indicates Observer and sighting interval

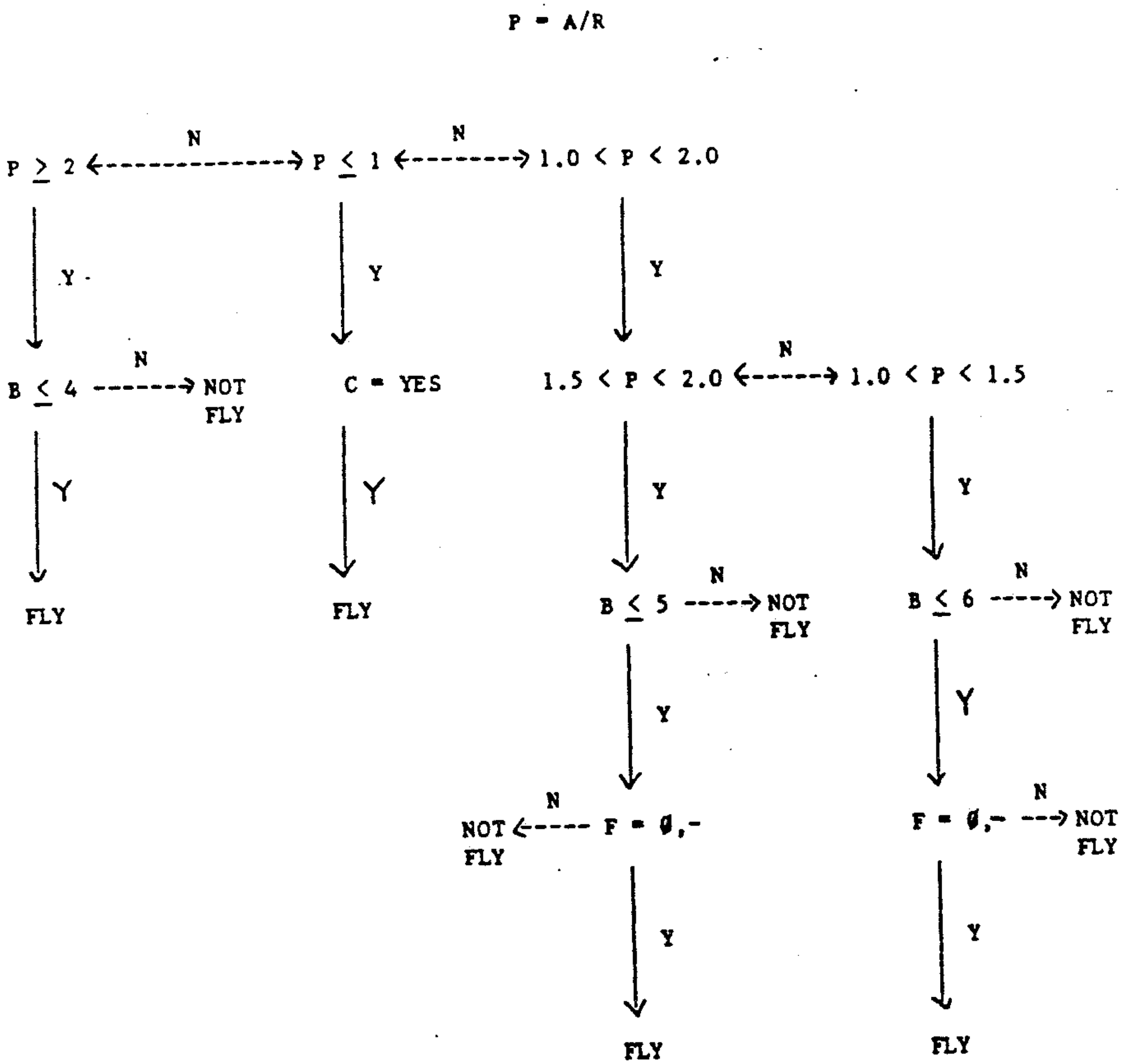
```
09 39 00
283076 0804749 000R1038 000
 10
------------------

TURTLE           1
SPECIES          2      1
QUANTITY         3      2
VARIABILITY      4      0
SEX              5      3
INTERVAL         6      53++
RELIABILITY      7      3
SURFACE/SUB      8      1
NOTE 1           9      1
NOTE 2          10      1

Any changes? Y or N
?
N
```

D One minute positional update

```
Time ——         09 39 06
Position ——     283076 0804749][000R1038 000 —— Heading, tracking information
Temperature —— 10
                ======================
                09 40 00
                283076 0804749 000R1038 000
                 10
                ------------------
```



A = Days Available
R = Days Required
B = Beaufort Sea State
C = Pilot Clearance
F = Forecast, Ø = Unchanged; - = Deteriorating, + = Improving
Y = Yes
N = No

Figure 8. Decision flow chart designed to facilitate mission abort decisions concerning excessive sea states and time available. Pilot clearance is required for all affirmative decisions.

Figure 9. Distributional map of sea turtles; spring 1982.

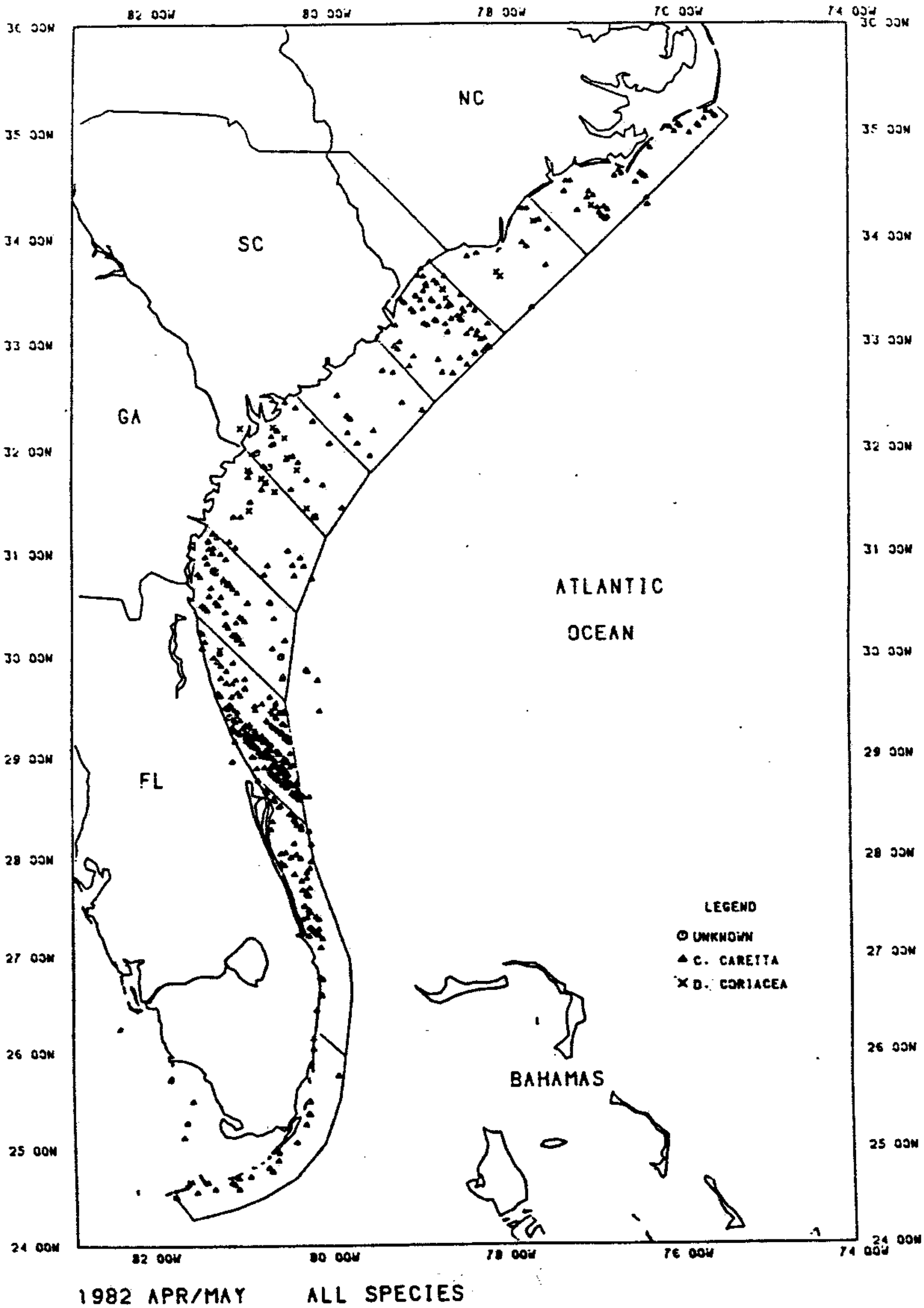
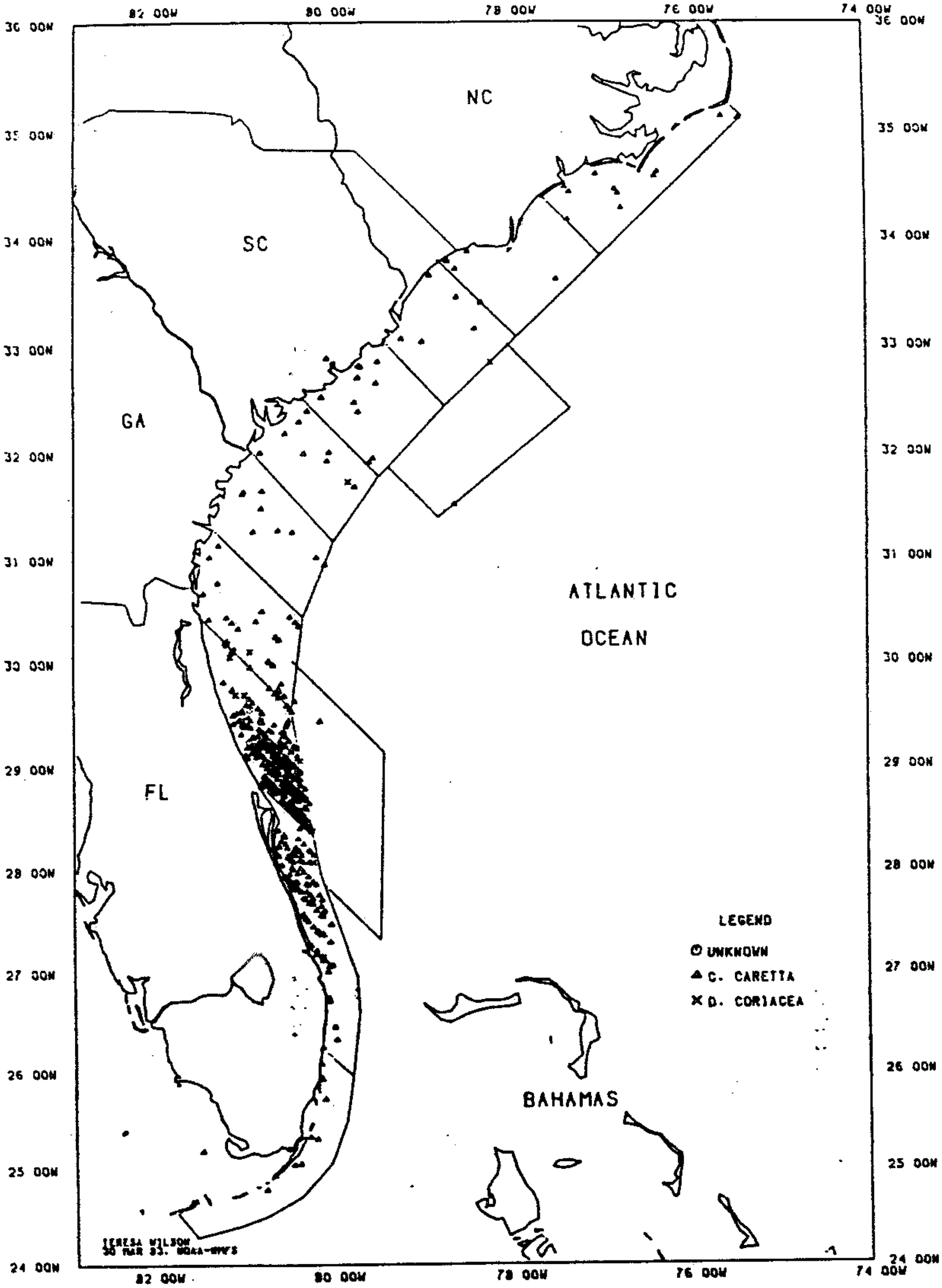


Figure 10. Distributional map of sea turtles; summer 1982



SUMMER 1982

Figure 11. Not Yet Available from NMFS-SEFC

Figure 12. Distributional map of sea turtles; winter 1983.

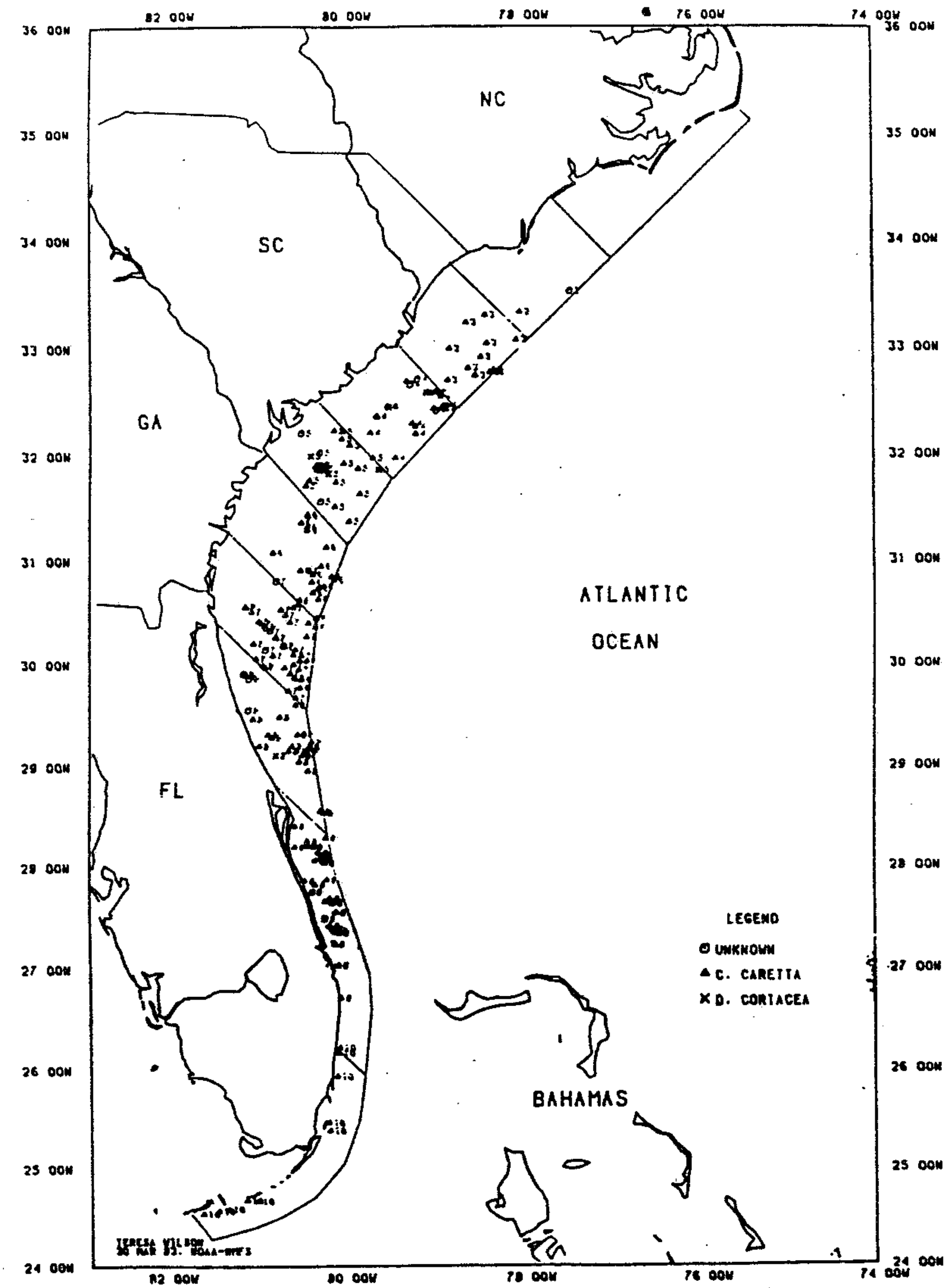


Figure 13. Seasonal comparisons of *Caretta* sightings by sampling block.

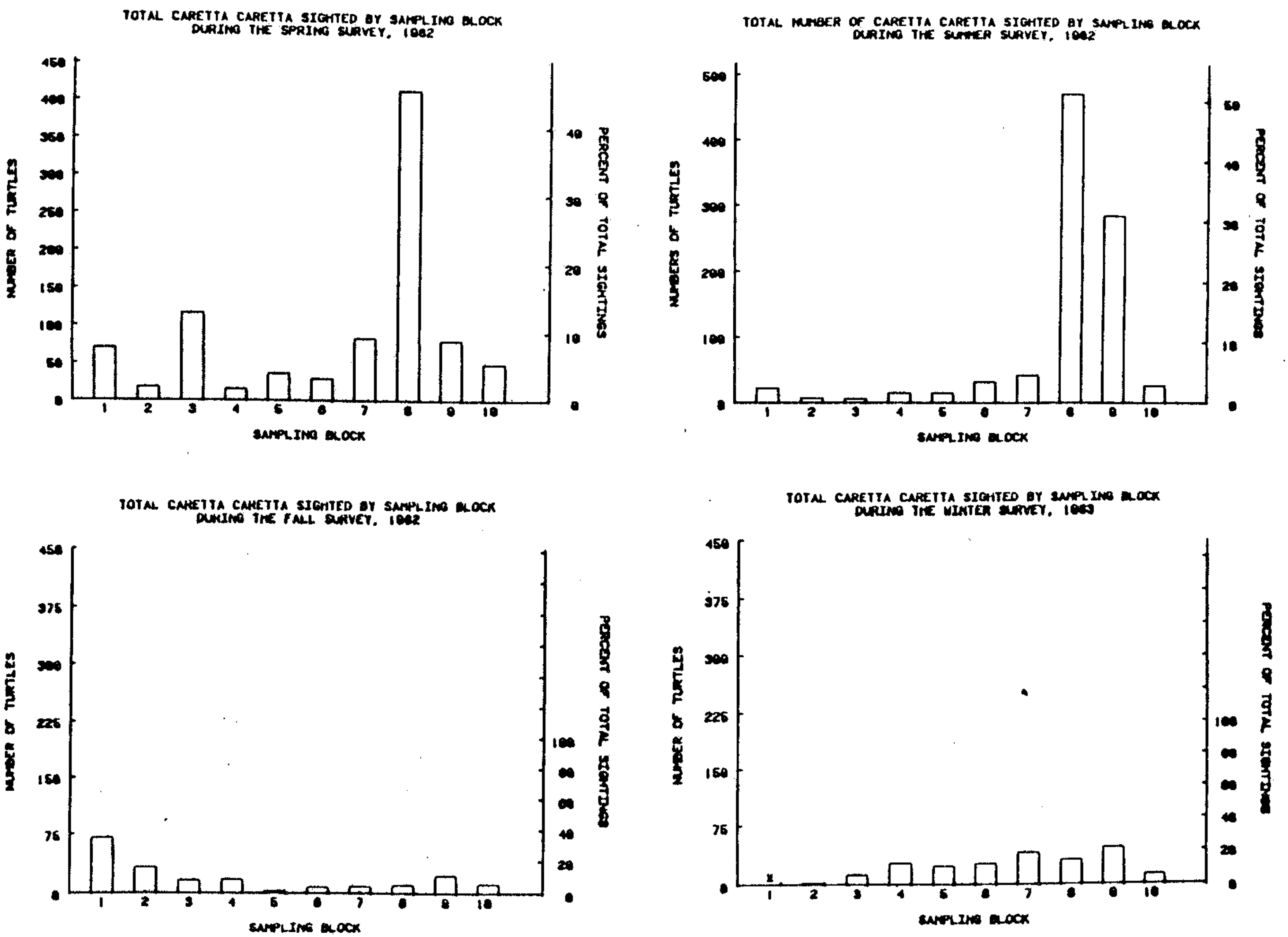


Figure 14. Seasonal comparisons of Dermochelys sightings by sampling block.

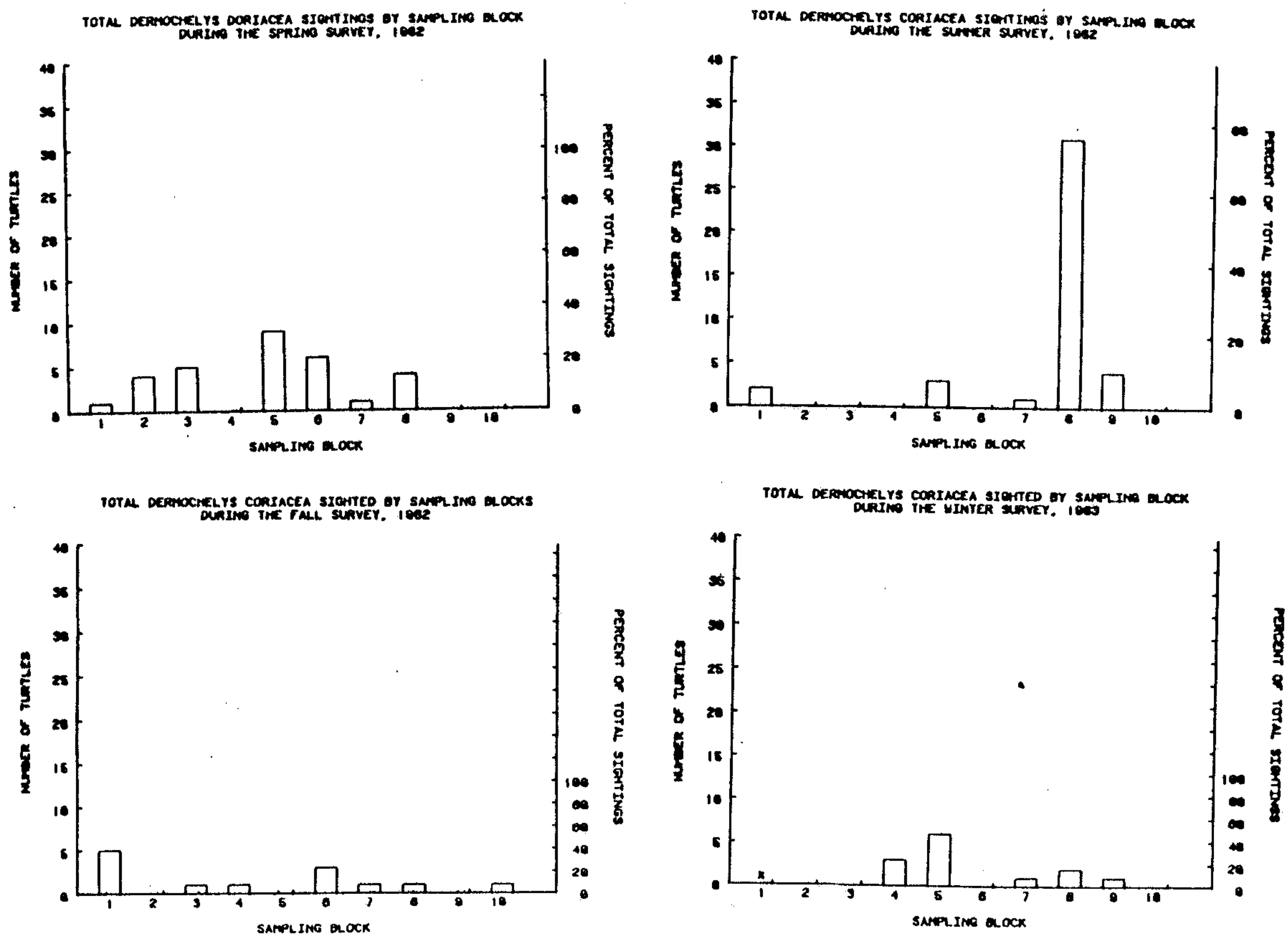


Figure 15. Seasonal comparisons of unidentified turtles by sampling block.

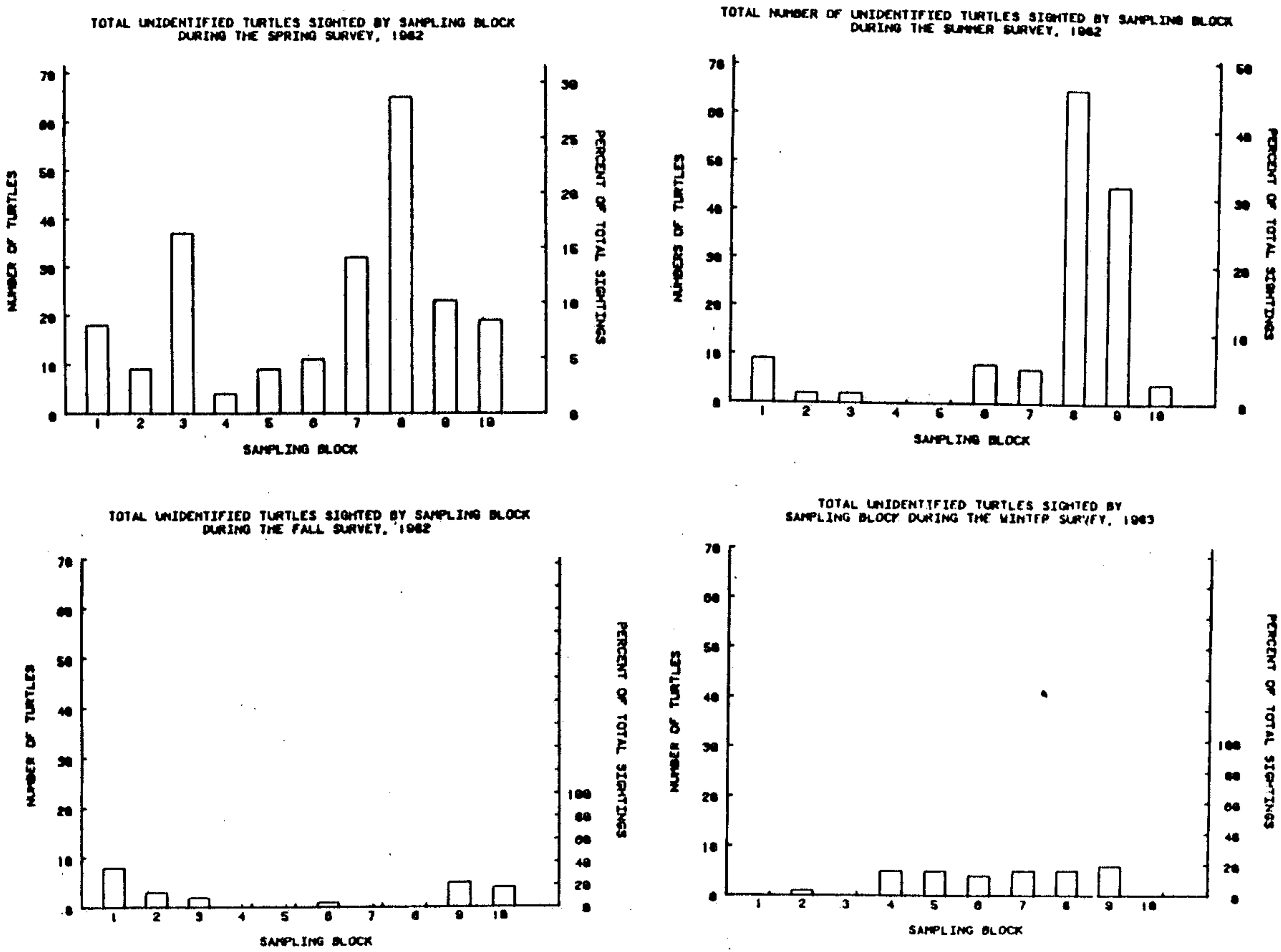
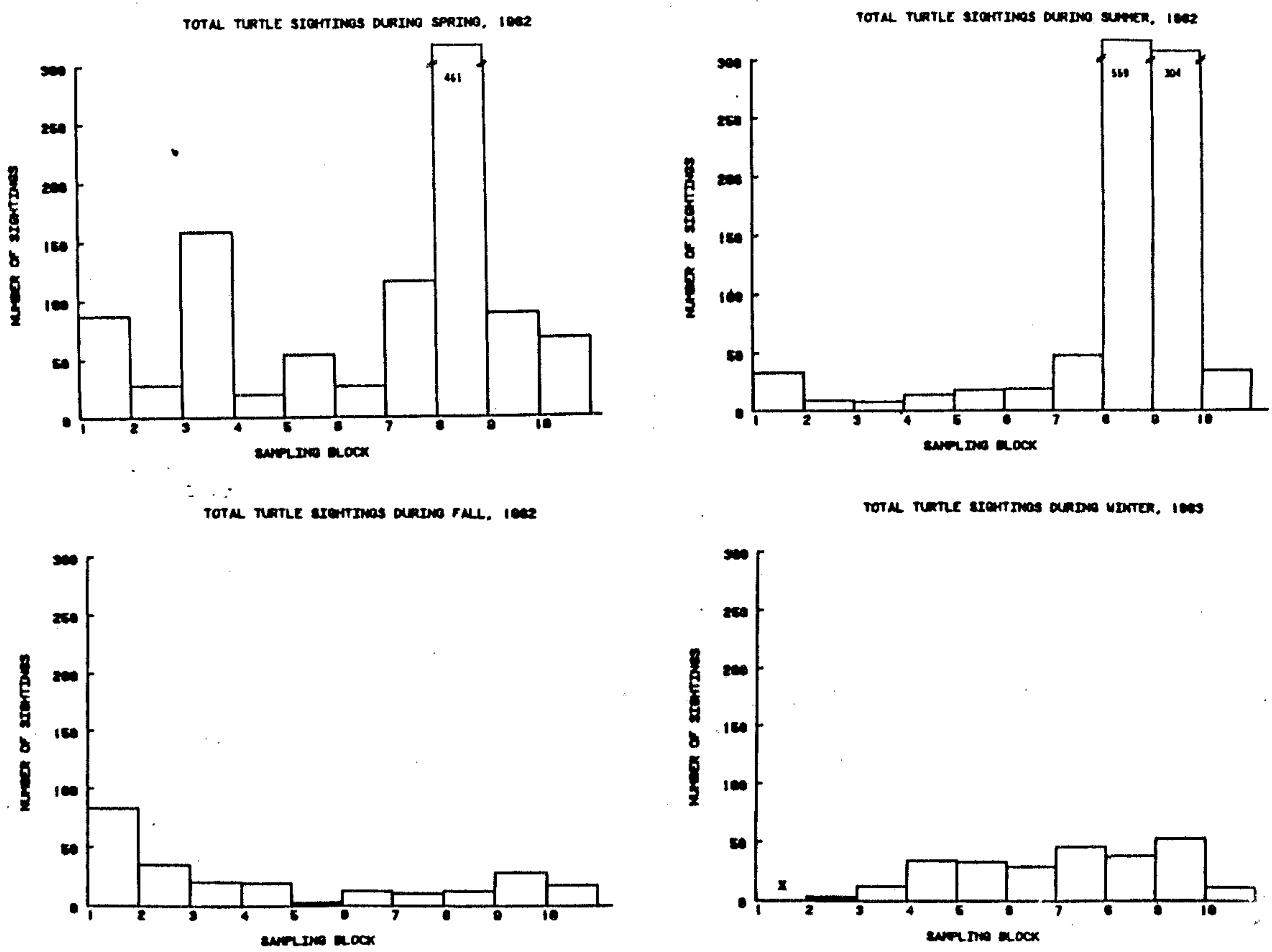


Figure 16. Seasonal comparisons of total turtle sightings by sampling block.



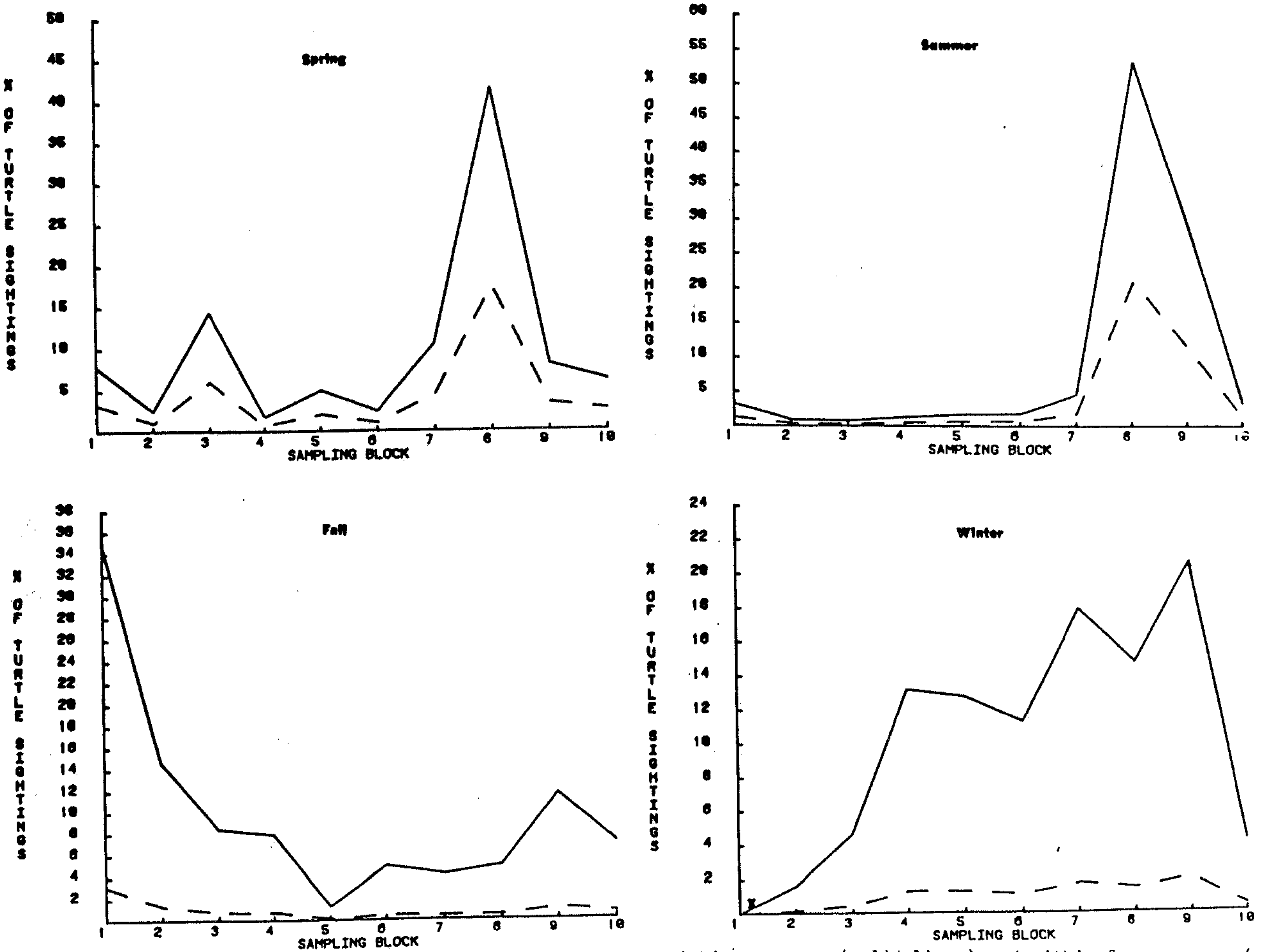


Figure 17. Seasonal comparisons of percent sightings within a survey (solid lines) and within four surveys (---

Fig. 18.

PERCENT OF TOTAL TURTLE SIGHTINGS FOR FOUR SEASONAL SURVEYS BY SAMPLING BLOCK

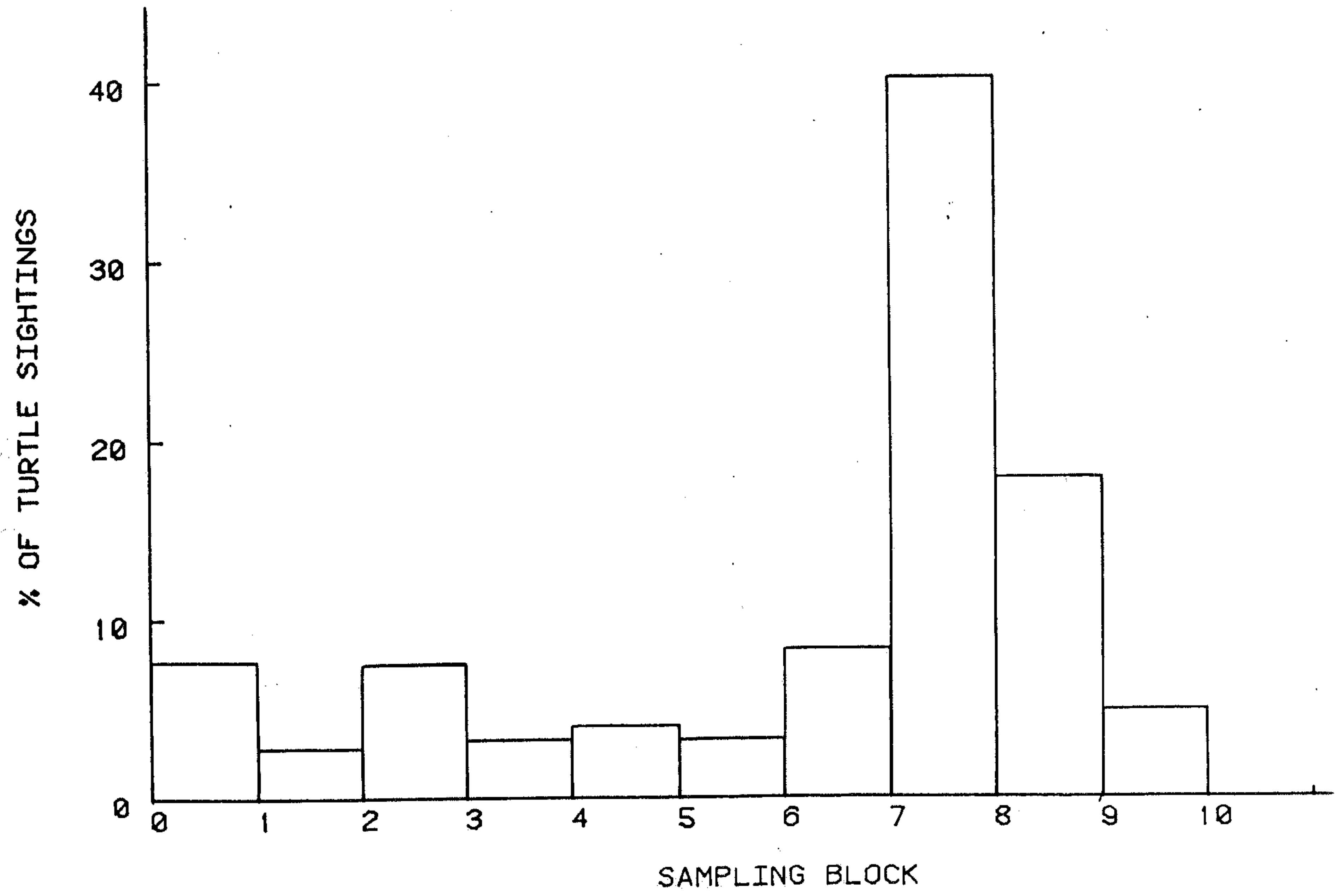
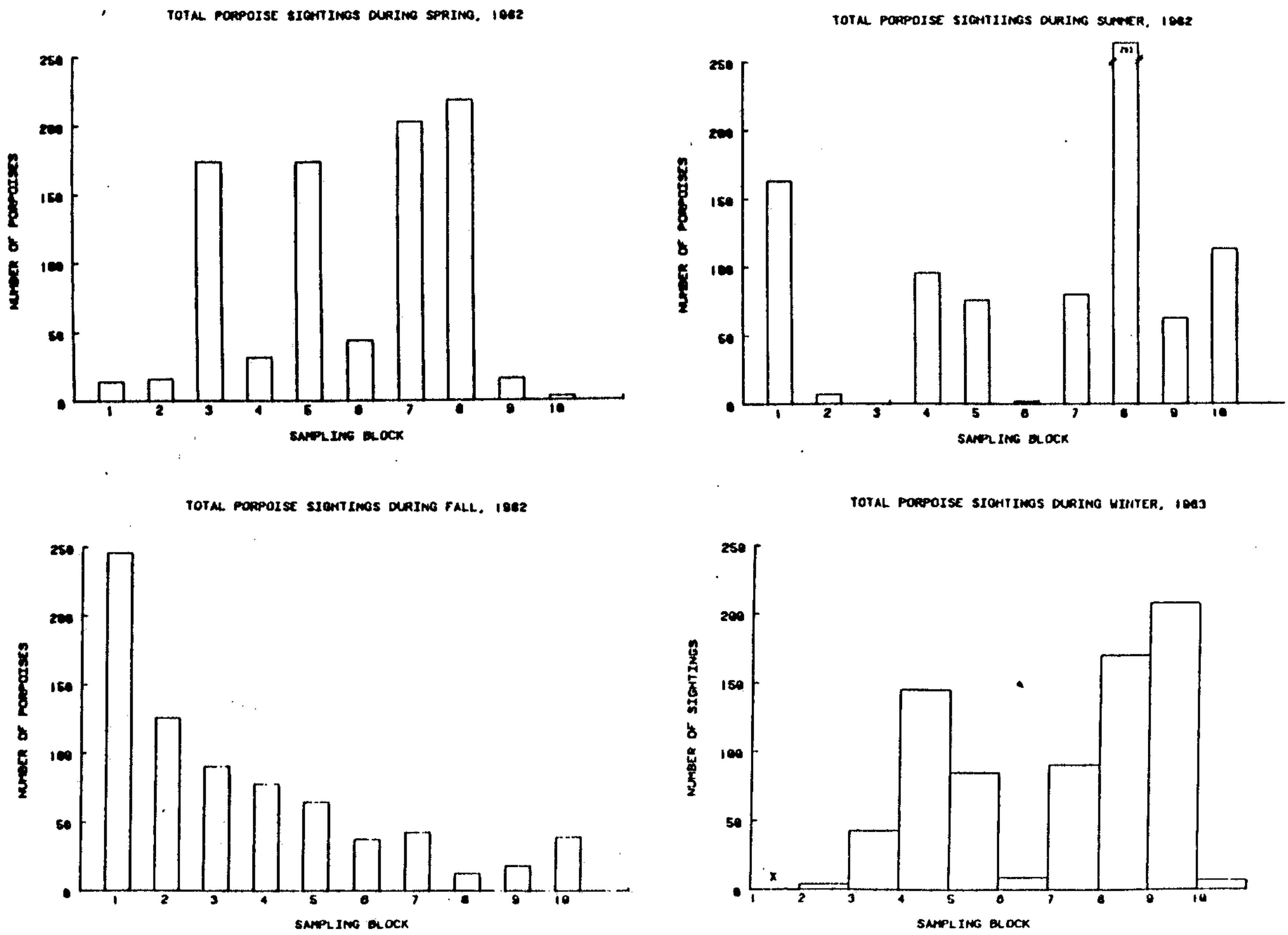


Figure 19. Seasonal comparisons of porpoise sightings by sampling block.



APPENDIX 1

List of Participants

Principal Investigator: Dr. C.Robert Shoop

Pilot: Mr. John Olson

Co-Pilots: Mr Timothy L. Flynn
Mr. Neil Solomon
Mr. Miles Cambell
Mr. Paul Gilman

Calibration Team:
Dr. Nancy B. Thompson, NMFS
Dr. Thomas Thompson, Senior Observer
Mr. Geoffrey LeBaron

Observers:
Dr. Thomas Thompson, Senior Observer
Ms. Barbara Schroeder
Mr. Geoffrey LeBaron
Ms. Stephanie Chestnut
Ms. Angie McGeehee
Mr. Wayne Hoffman
Mr. Wayne Hoggard, NMFS
Ms. Teresa Wilson, NMFS

HP-85/86 Software Development
Mr. Robert Craft
Mr. Timothy Flynn
Hewlett Packard Personnel

Bases of Operation
TICO- Titusville-Cocoa, FL
CHS- Charleston Air Station
ILM- Wilmington, NC

APPENDIX 2. Survey Schedule as Calendars for the Four Seasonal Surveys, 1982-83

Calendar of April - May 1982. Survey showing dates of samples, blocks sampled, and base of operations. (TICO = Titusville, FL.; CHS = Charleston, SC.; ILM = Wilmington, NC.).

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
APRIL	19 Training/ Calibration (TICO)	20 AT-11 Maintenance (TICO)	21 BLOCK 8 (TICO)	22 BLOCK 7 (TICO)	23 Weather Delay (TICO)	24 BLOCK 6 Abort Weather Delay (TICO)
25 Weather Delay (TICO)	26 Weather Delay (TICO)	27 BLOCK 9 (TICO)	28 BLOCK 10 (TICO)	29 BLOCK 6 ABORT Weather Delay (TICO)	30 Weather Delay (TICO)	MAY 1 Weather Delay (TICO)
2 BLOCK 6 (TICO)	3 Transit to Charleston	4 BLOCK 5 (CHS)	5 BLOCK 4 (CHS)	6 BLOCK 3 (CHS) Transit to Wilmington	7 BLOCK 2 (ILM)	8 BLOCK 1 (ILM) END OF SURVEY

Calendar of pelagic aerial survey for summer 1982. Sample blocks, transits, and bases of operations are indicated. (TICO=Titusville, FL.; CHS=Charleston, SC.; ILM=Wilmington, NC.)

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
<u>JULY</u>	19 <u>Block 9</u> (TICO)	20 <u>Block 10</u> (TICO)	21 <u>Block 7</u> (TICO)	22 Abort-active military warning area	23 <u>Block 6</u> (TICO)	24 <u>Block 8</u> (TICO)
25 Transit to ILM	26 Airplane maintenance (ILM)	27 <u>Block 1</u> (ILM)	28 <u>Block 2</u> Transit to (CHS)	29 <u>Block 3</u> (Partial; weather abort) (CHS)	30 <u>Block 3</u> (Partial; weather abort) (CHS)	31 Weather delay (CHS)
<u>AUGUST</u> 1 Weather delay (CHS)	2 <u>Block 4</u> (Late start, weather; completed all but 1 line) (CHS)	3 <u>Block 5</u> (CHS)	4 GN + remaining lines in 3 and 4 Transit to TICO	5 GS modified due to active military warning area (TICO) END OF SURVEY	6	7

Calendar for Survey #3 indicating sampling block, weather delays, aborted missions, maintenance, transit days, and base of operations. (TICO=Titusville-Cocoa; CHS=Charleston; ILM=Wilmington).

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
OCTOBER 17	18 Training Flight TICO	19 BLOCK 7 TICO	20 BLOCK 6 TICO	21 BLOCK 10 TICO	22 BLOCK 9 TICO	23 MAINTENANCE TICO
24 WEATHER DELAY TICO	25 BLOCK 8 TICO TRANSIT TO CHS	26 BLOCK 5 PARTIAL ABORT CHS	27 ABORT (WEATHER) CHS	28 ABORT (WEATHER) CHS	29 BLOCK 4 & 5 CHS	30 BLOCK 3 CHS TRANSIT TO ILM
31 BLOCK 1 ILM	NOVEMBER 1 BLOCK 2 ILM					

Calendar for Survey 4 indicating sampling block, weather delays, aborted missions, maintenance, transit days, and base of operations. (TICO=Titusville-Cocoa; CHS=Charleston; ILM=Wilmington).

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JANUARY 16 /	17 /	18 /	19 /	20 Weather Delay	21 Weather Delay	22 Weather Delay
23 Weather Delay	24 BLOCK 8	25 BLOCK 7	26 BLOCK 9	27 BLOCK 6	28 Weather Delay	29 BLOCK 10
30 TRANSIT TO CHS LINE 8 - AREA 6	-ABORT- 31 a.m. fog Active Military Areas	FEBRUARY 1 BLOCK 5	2 Weather Delay	3 Weather Delay	4 ABORT - Wther BLOCK 3	5 ABORT -Weather BLOCK 3
6 Weather Delay	7 Weather Delay	8 BLOCK 3 CHS	9 BLOCK 4 CHS; TRANSIT TO ILM	10 BLOCK 2 (PARTIAL) ABORT - Wther	11 Weather Delay	12 Weather Delay
13 Weather Delay Survey Abort; Transit to CON	/	/	/	/	/	/

APPENDIX 3. Tabularized Data of Sea Turtle

Sightings by Species, Sampling Block and Season

Four Surveys

Sea turtles sighted in summer 1982 pelagic aerial survey by sampling block and species.

BLOCK	*CARETTA*	UNIDENTIFIED TURTLES	*DERMOCHELYS*	*CHELONIA*	*ERETMOCHELYS*	*LEPIDOCHELYS*	TOTALS
1	21 +4 in transit	10 +1 in transit	2	0	0	0	33
2	7	2	0	0	0	0	9
3	6	2	0	0	0	0	8
4	14 +1 in transit	0	0	0	0	0	14
5	15	0	3	0	0	0	18
6	16 +9 in transit	3 +3 in transit	0	0 1 in transit	0	0	19
7	42	5	1	0	0	0	48
8	470	56	31 +1 in transit	2	0	0	559
9	261 +24 in transit	39 +3 in transit	4	0	0	0	304
10	25 +26 in transit	6	0	4 +1 in transit	0	0	35
TOTALS	877	123	41	6	0	0	1047
GN	1	0	1	0	0	0	2
GS	14	1	0	0	0	0	15
GRAND TOTAL							1064

Sea turtles sighted April - May 1982 survey. Data presented in descending order of frequency of sightings.

BLOCK	CARETTA	UNIDENTIFIED SHELLED TURTLES	DERMOCHELYS	CHELONIA	ERETMOCHELYS	LEPIDOCHELYS	TOTAL
1	69	17	1	-	-	-	87
2	17	7	4	-	-	-	28
3	115	37	5	2	-	-	159
4	15	4	-	1	-	-	20
5	36	8	9	1	-	-	54
6	19	3	5	-	-	-	27
7	85	30	1	-	-	-	116
8	392	65	4	-	-	-	461
9	75	14	-	-	-	-	89
10	48	19	-	-	1	-	68
Abort *6A	5	5	-	-	-	-	10
Abort 6B	6	2	1	-	-	-	9
TOTALS	882	211	30	4	1	-	1128

(* One transect attempted)

Sea turtle sightings in the fall 1982 pelagic aerial survey by sampling block and species.

BLOCK	*CARETTA CARETTA*	UNIDENTIFIED TURTLES	*DERMOCHELYS CORIACEA*	*CHELONIA MYDAS*	*ERETMOCHELYS IMBRICATA*	*LEPIDOCHELYS KEMPI*	TOTALS
1	70	8	5	0	0	0	83
2	32	3	0	0	0	0	35
3	17	2	1	0	0	0	20
4	18	0	1	0	0	0	19
5	3	0	0	0	0	0	3
6	8	1	3	0	0	0	12
7	9	0	1	0	0	0	10
8	11	0	1	0	0	0	12
9	23	5	0	0	0	0	28
10	12	4	1	0	0	0	17
TOTALS	203	23	13	0	0	0	239

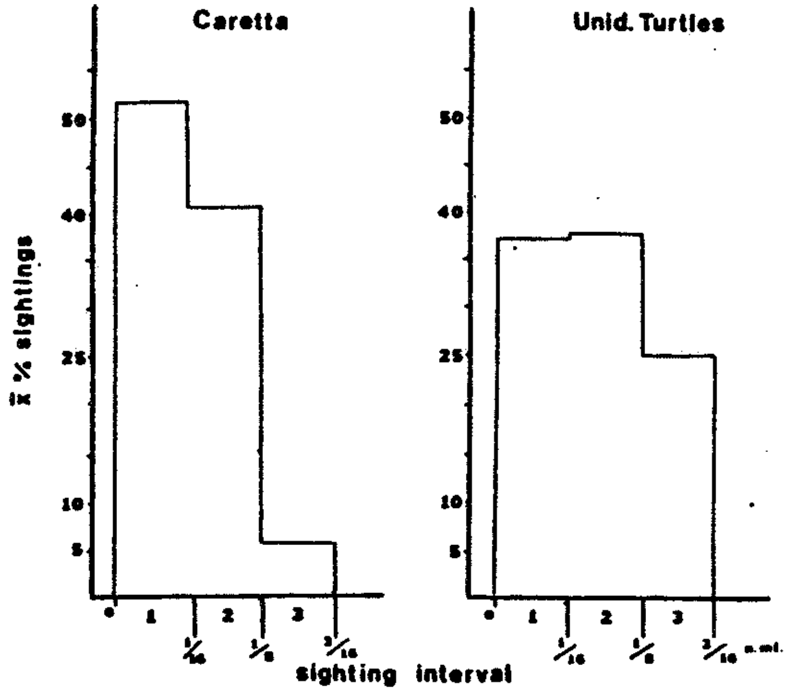
Sea turtle sightings in the winter 1983 pelagic aerial survey by sampling block and species.

Block	*Caretta caretta*	Unidentified turtles	*Dermochelys coriacea*	All turtles
1	SURVEY BLOCK ABORTED---NO COVERAGE	——	——	——
2	2*	1	------	3
3	12	------	------	12
4	26	5	3	34
5	22	5	6	33
6	25	4	------	29
7	40	5	1	46
8	30	5	2	37 (+1**)
9	46	6	1	53
10	11	------	------	11
Totals	214	31	13	259

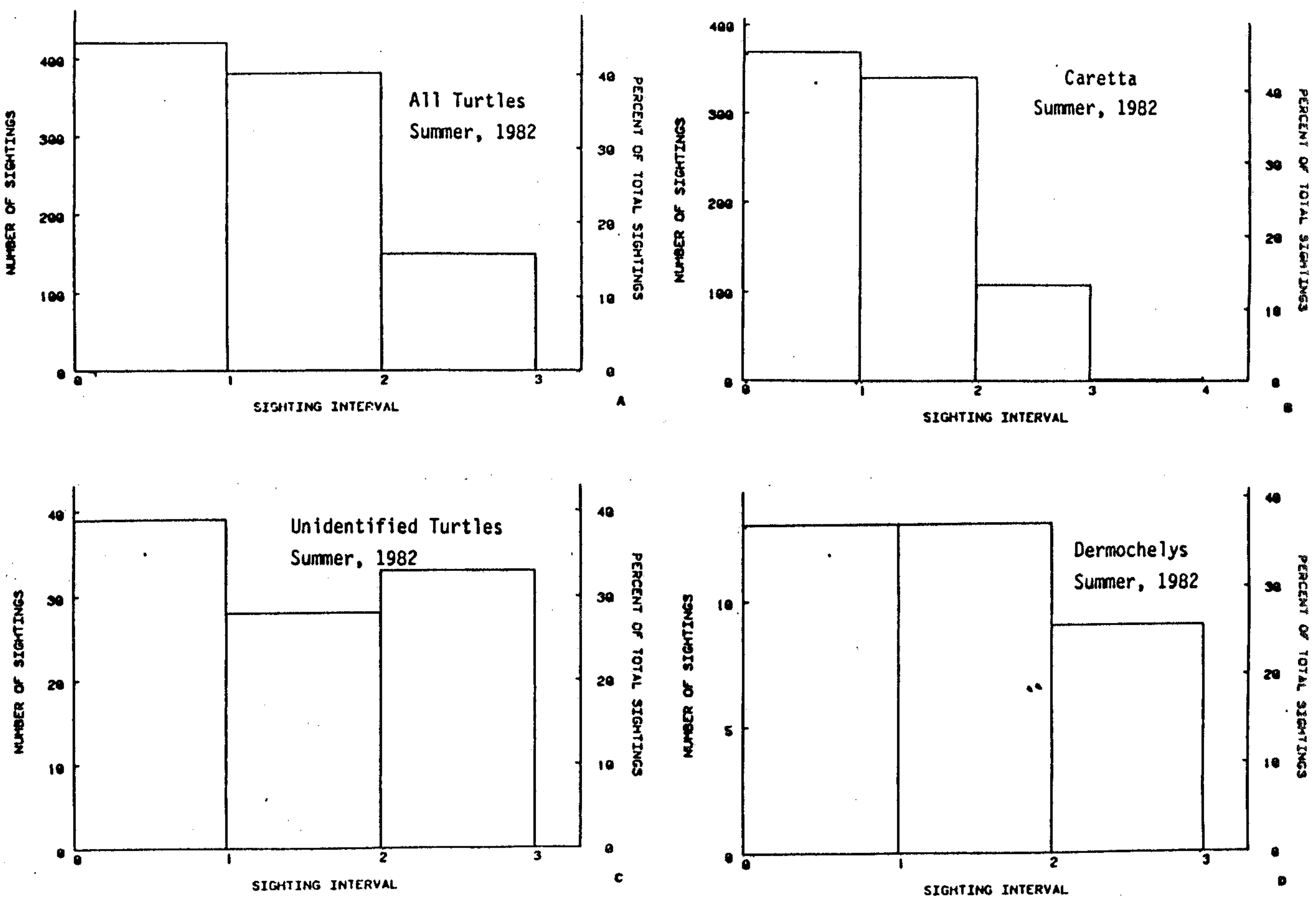
*limited coverage
**1 possible ridley (*Lepidochelys*)

APPENDIX 4. Histograms of Sighting Intervals for Sea Turtle Sightings by Species and Season.

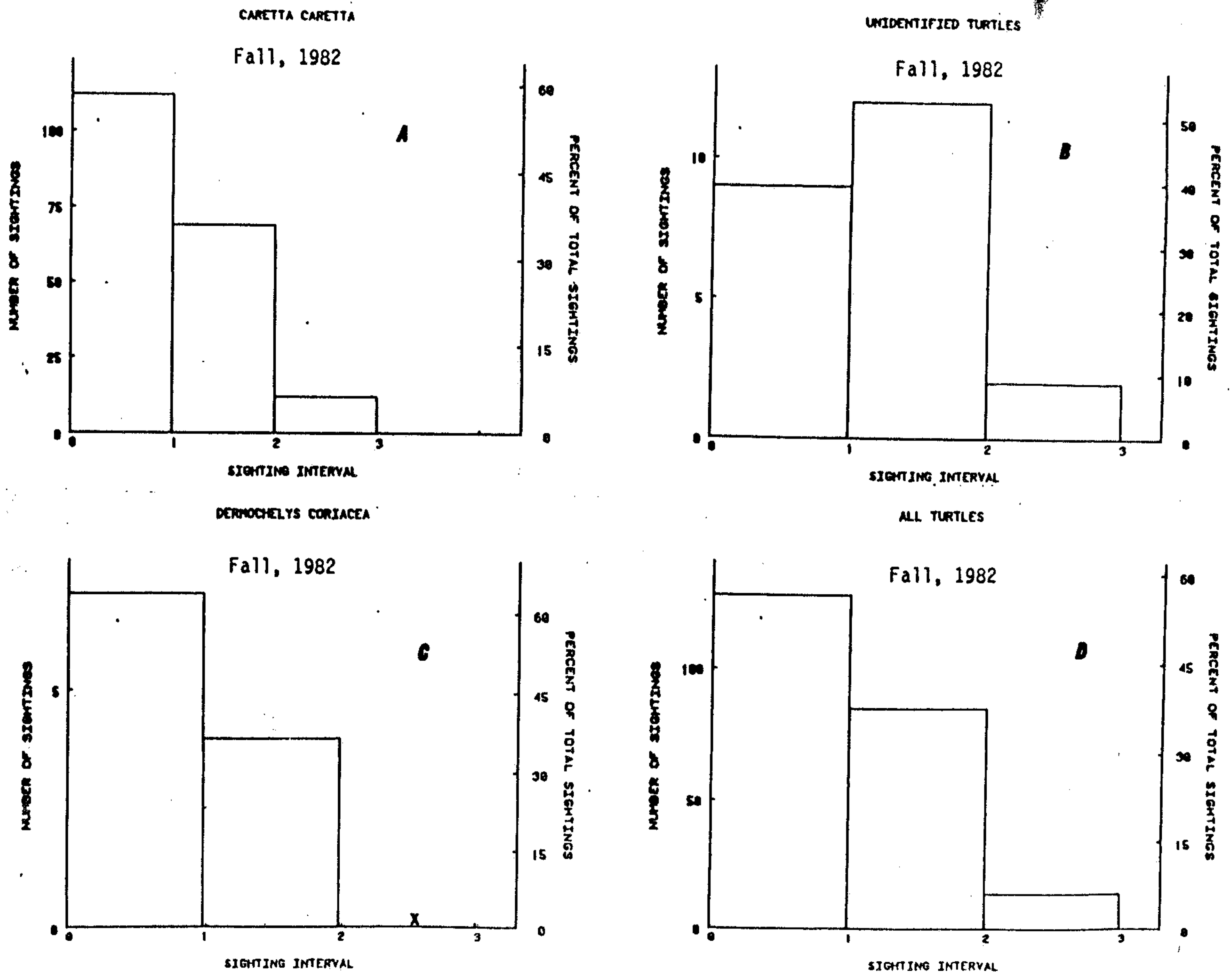
Figure Mean percent sighting by sighting interval, April - May 1982 survey.

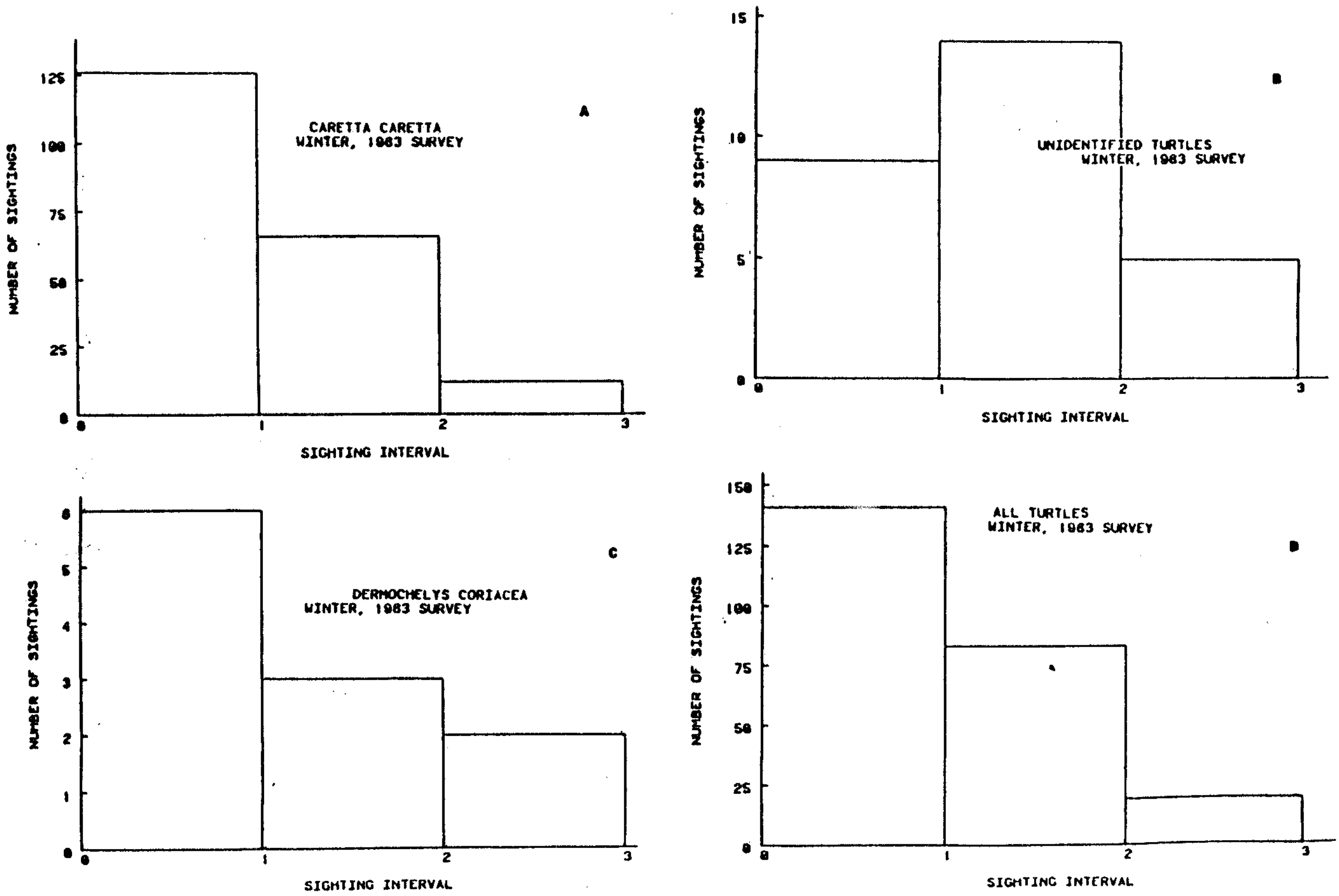


Data on sighting intervals or distance from the trackline are presented for Caretta and Unid. turtles by mean percent of sightings for the spring survey (above), for Caretta, Dermochelys, unidentified turtles, and all turtles by numbers of turtles for the summer, fall, and winter surveys (following pages).



All Turtles
Summer, 1982
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
A
Caretta
Summer, 1982
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
B
Unidentified Turtles
Summer, 1982
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
C
Dermochelys
Summer, 1982
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
D


CARETTA CARETTA
Fall, 1982
A
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
UNIDENTIFIED TURTLES
Fall, 1982
B
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
DERMOCHELYS CORIACEA
Fall, 1982
C
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL
ALL TURTLES
Fall, 1982
D
NUMBER OF SIGHTINGS
PERCENT OF TOTAL SIGHTINGS
SIGHTING INTERVAL


A
CARETTA CARETTA
WINTER, 1983 SURVEY
NUMBER OF SIGHTINGS
SIGHTING INTERVAL
B
UNIDENTIFIED TURTLES
WINTER, 1983 SURVEY
NUMBER OF SIGHTINGS
SIGHTING INTERVAL
C
DERMOCHELYS CORIACEA
WINTER, 1983 SURVEY
NUMBER OF SIGHTINGS
SIGHTING INTERVAL
D
ALL TURTLES
WINTER, 1983 SURVEY
NUMBER OF SIGHTINGS
SIGHTING INTERVAL

APPENDIX 5. Tabularized Data on Marine Mammal Sightings by Species, Sampling Block and Season.

Marine mammals sighted during April - May 1982 survey. Data presented in descending order of frequency of sightings.

BLOCK	TURSIOPS	UNIDENTIFIED PORPOISES	STENELLA PLAGIODON	OTHER MARINE MAMMALS	TOTAL
1	12	2	-	-	14
2	14	1	1	-	16
3	63	78	33	-	174
4	1	11	20	-	32
5	27	103	44	-	174
6	10	16	18	1	45
7	168	35	-	2	205
8	135	54	30	4	223
9	8	8	-	26	42
10	1	2	-	7	10
Abort *6A	-	-	-	25	25
Abort 6B	-	2	-	-	2
TOTALS	439	312	171	40	962

(* One transect attempted)

Marine mammals sighted in summer 1982 pelagic aerial survey by sampling block and species. (un mm = unidentified marine mammal).

BLOCK	*TURSIOPS*	UNIDENTIFIED DOLPHINS	*STENELLA* spp.	OTHERS	TOTALS
1	138*	25	0	0	163
2	3	4 (one dead)	0	5 un mm	12
3	0	0	0	0	0
4	76 ± 10	19	1	6 un mm	102 ± 10
5	58 ± 7	16	2 (10-15 in transit)	0	76 ± 7
6	2	0	0	1 un mm	3
7	80	0	0	0	80
8	208	82	3	0	293
9	35	16	6	4 un mm 2 manatees	63
10	65 ± 10	0	40 ± 10	7 manatees 2 grampus	114 ± 20
GN	0	0	(30 in transit)	2 un mm (1 dead)	2
GS	2	2	5	1 un mm	10
TOTALS	667 ± 27	164	57 ± 10	19 un mm 9 manatees 2 grampus	918 ± 37

Marine mammals sighted in fall 1982 pelagic aerial survey by sampling block and species.

BLOCK	*TURSIOPS*	UNIDENTIFIED DOLPHINS	*STENELLA* SPP.	OTHERS	TOTALS
1	236 ± 38	10	0	-	246 ± 38
2	98 ± 16	28 ± 5	0	-	126 ± 21
3	69 ± 9	22 ± 5	0	-	91 ± 14
4	70 ± 13	3	5 ± 1	-	78 ± 14
5	64 ± 14	1	0	-	65 ± 14
6	34 ± 8	2	2	-	38 ± 8
7	3	5	35 ± 10	-	43 ± 10
8	12	1	0	-	13
9	18 ± 2	1	0	-	19 ± 2
10	33 ± 6	4 ± 2	2 (*S. plagiodon*)	1 Unid. marine mammal	40 ± 8
TOTALS	637 ± 106	77 ± 12	44 ± 11	1	759 ± 129

Marine mammal sightings in the winter 1983 pelagic aerial survey by sampling block and speci

Block	*T. truncatus*	Unid. dolphins	*Stenella* spp.	Others	Totals
1	SURVEY ABORTED---NO COVERAGE		------	------	---------
2	------	4	------	------	4
3	19 ± 3	15 ± 1	9 ± 2	------	43 ± 6
4	86 ± 12	48 ± 5	9	2 unmm*	145 ± 17
5	5	75 ± 10	5	------	85 ± 10
6	5 ± 2	4	------	------	9 ± 2
7	46 ± 7	41 ± 10	4	------	91 ± 17
8	147 ± 15	11	13 ± 2	------	171 ± 17
9	202 ± 34	1	------	2 B.g.** 3 B.a.*** 1 unmm	209 ± 34
10	7	------	------	------	7
Totals	517 ± 73	199 ± 26	40 ± 4	8	764 ± 103

**B.g.=*Balaena glacialis* (right whales)
***B.a.=*Balaenoptera acutorostrata* (minke whales)
*unmm=unid. marine mammal