AN OILSPILL RISK ANALYSIS FOR THE SOUTH ATLANTIC

(PROPOSED SALE 56)

OUTER CONTINENTAL SHELF LEASE AREA

By William B. Samuels and Kenneth J. Lanfear

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Abstract

An oilspill risk analysis was conducted to determine the relative environmental hazards of developing oil in different regions of the South Atlantic (Proposed Sale 56) Outer Continental Shelf (OCS) lease area. The probability of spill occurrences, likely movement of oil slicks, and locations of resources vulnerable to spilled oil were analyzed. The times between spill occurrence and contact with various resources were also estimated. The combined results yielded estimates of the overall risks associated with development of the proposed lease area. If all of the 286 proposed tracts are leased, and depending upon the routes chosen to transport any oil which is discovered from OCS platforms to the shore, the leasing of the tracts proposed for OCS Sale 56 will result in an expected 3.0 oilspills. The estimated probability that land will be contacted by one or more oilspills that have been at sea less than 30 days is 0.50.

Introduction

The Federal Government has proposed to offer Outer Continental Shelf (OCS) lands off the South Atlantic coast for oil and gas leasing. The risked mean estimate of oil resources for the proposed 286 tracts is 493 million barrels of crude oil. Risked mean estimates account for the possibility that oil may not be found or, if found, may not be of economically recoverable quantities in some or all of the tracts. Contingent upon actual discovery of oil, production is expected to span a period of 30 years. In addition to the proposed tracts there are 43 existing Federal lease tracts in the study area.

Oilspills are one of the major concerns associated with offshore oil production. An important fact that stands out when one attempts to evaluate the significance of accidental oil spillage is that the problem is fundamentally probabilistic. Uncertainty exists about the amount of oil that will be produced from the leases and the number and size of spills that might occur during the life of production, as well as the wind and current conditions that would exist at the time of a spill occurrence and give direction to the oil slick. While some of the uncertainty reflects incomplete and imperfect data, considerable uncertainty is simply inherent in the problem of describing future events over which complete control cannot be exercised. Since it can not be predicted with certainty that a probabilistic event such as an oilspill will occur, only the likelihood of occurrence can be quantified. It is important to

consider the range of possible effects that could accompany a decision on oil and gas production. It is equally important, in attempting to maintain perspective on the problem, to associate each potential effect with a quantitative estimate of its probability of occurrence.

This report summarizes results of an oilspill risk analysis conducted for the proposed South Atlantic OCS Lease Sale 56. The study had the objective of determining relative risks associated with oil and gas production in different regions of the proposed lease area. The study was undertaken for consideration in the draft environmental impact statement (EIS) for the area prepared by the Bureau of Land Management (BLM), and to facilitate final selection of tracts to be offered for sale. A description of the oilspill trajectory analysis model used in this analysis can be found in a previous paper (Lanfear and others, 1979). The analysis was conducted in three parts corresponding to different aspects of the overall problem. The first part dealt with the probability of oilspill occurrence, and the second with the trajectories of oilspills from potential launch points to various targets. Results of the first two parts of the analysis were ther combined to give estimates of the overall oilspill risk associated with oil and gas production in the lease area.

Decisionmaking Under Risk and Uncertainty

Oilspill impacts result primarily from two events which are probabilistic in nature: oilspill occurrence due to accidents, and oilspill movement by random winds and currents. Although it can not be said with certainty that a probabilistic event, such as an oilspill will occur, the likelihood of occurrence can be quantified. It is possible to estimate the likelihood that oilspills will result from an OCS leasing decision, but whether they will actually occur can only be known after the area is explored and the oil, if any, is produced. This is in contrast to a deterministic situation where a particular action can be depended upon to produce a specific result.

In making decisions under risk and uncertainty, it is important to understand that a choice can have a range of possible outcomes. Generally, a desire to maximize the likelihood of the most favorable outcomes must be tempered by the need to minimize the probability of highly unfavorable outcomes. The USGS Oilspill Trajectory Analysis (OSTA) Model was designed to reflect the range of possible outcomes of leasing decisions by estimating the probability of occurrence for each discrete outcome; specifically, it estimates the likelihood that a particular target will be contacted by 0, 1, 2, ..., N oilspills during the production life of an OCS lease area.

The probability that, if an oilspill occurs at a given launch

point, it will contact a particular target is termed a conditional probability. Such conditional probabilities can be very useful in identifying those launch points at which an oilspill, if it occurs, will pose the highest risks to various targets. Tables of conditional probabilities can help the analyst to select alternatives that will reduce overall risk. However, conditional probabilities do not include the probability of oilspill occurrence. A tract that contains little or no oil is a small risk because, no matter how high the conditional probability of contacting a target may be, the small amount of oil makes it unlikely that an oilspill will occur. Also, conditional probabilities for spills originating at the production platforms do not necessarily reflect the risks of transportation. For these reasons, analysts are cautioned against basing judgments solely upon conditional probabilities.

Summary of the Proposed Action and the Major Alternatives

The proposed action is to lease 286 tracts on the outer continental shelf off the South Atlantic coast. The study area for this analysis includes all of these tracts and extends from latitude 28 degrees N to 37 degrees N, and from longitude 73 degrees W to 81 degrees 40 minutes W. The study area also includes existing lease tracts from OCS Sale 43, held in 1978.

For purposes of this analysis, lease tracts are combined into

tract groups; the proposed tract groups are broken into 13 subdivisions and the existing tract groups into 3 subdivisions. The study area and the proposed tract groups are shown as a Mercator projection in figure 1. The subdivisions of the proposed tract groups are shown in figure 2. The 3 subdivisions of the existing tract groups from OCS Sale 43 are shown in figure 3.

If oil is discovered and the area is developed for oil production, there are a number of ways in which oil can be transported to shore. Possible transportation routes are shown in figure 4. In the most likely transportation scheme, oil from northern tract groups, P1 to P5 will be piped to a central location in tract group P5. From there, it will be piped to an onshore facility at Wilmington, N.C., where it will be shipped in tankers to northern refineries. Oil from the southern tract groups will be piped to a central location in tract group P13. From there, it will also be piped to an onshore facility at Brunswick, Ga., where it will be shipped in tankers to northern refineries. Any oil recovered from existing leases would be transported along these routes. Discovery of an amount of oil greatly different from present estimates could affect the economics of transportation and refining, and result in a different transportation scheme than assumed in this study; there is no way to predict such a change at this time.

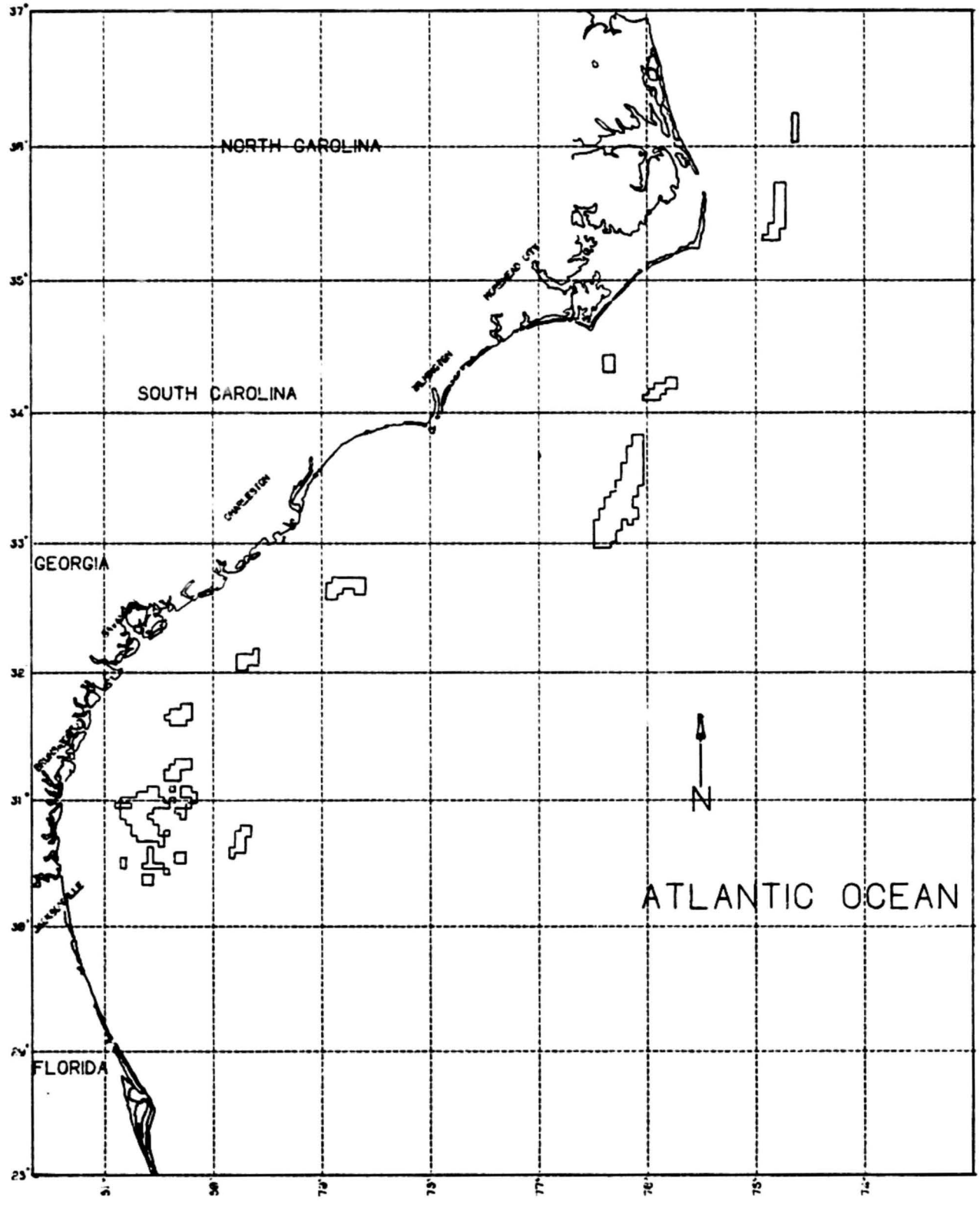

Figure 1.--Map showing the South Atlantic OCS Lease Sale 56 study area and the proposed lease tracts groups.

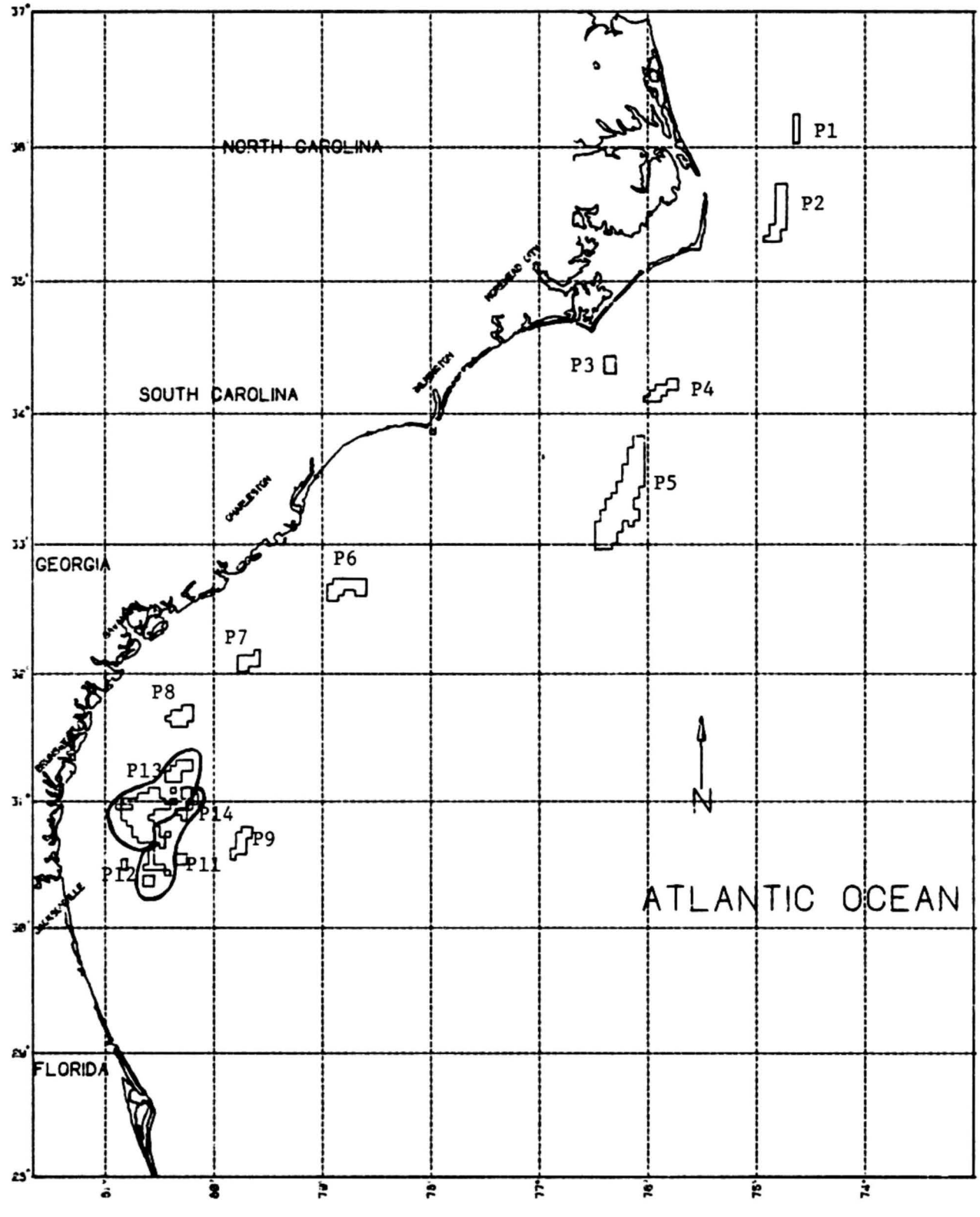

Figure 2.--Map showing the 13 subdivisions of the proposed lease tract groups for South Atlantic OCS Lease Sale 56.

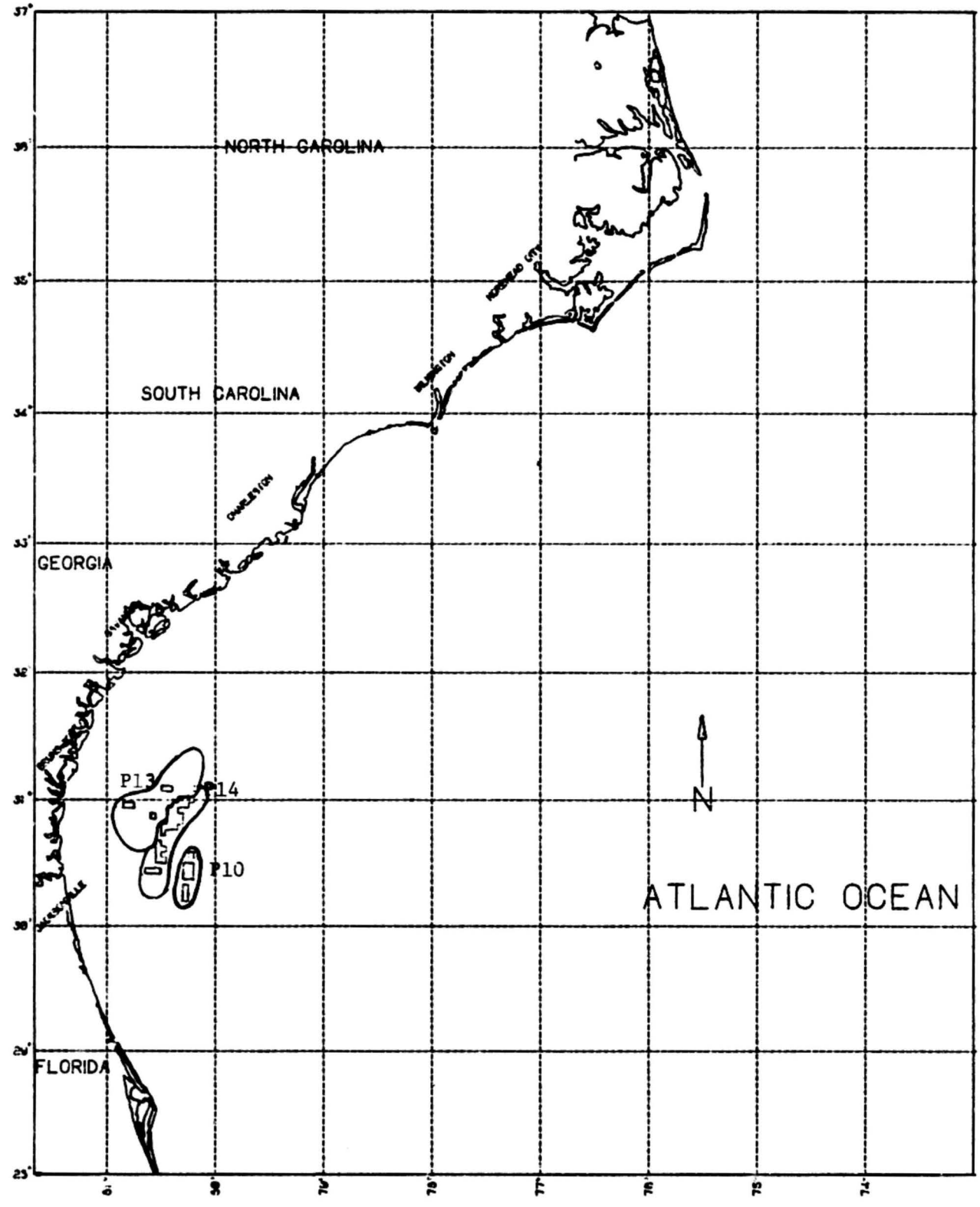

Figure 3.--Map showing the three subdivisions of the existing lease tract groups in the study area.

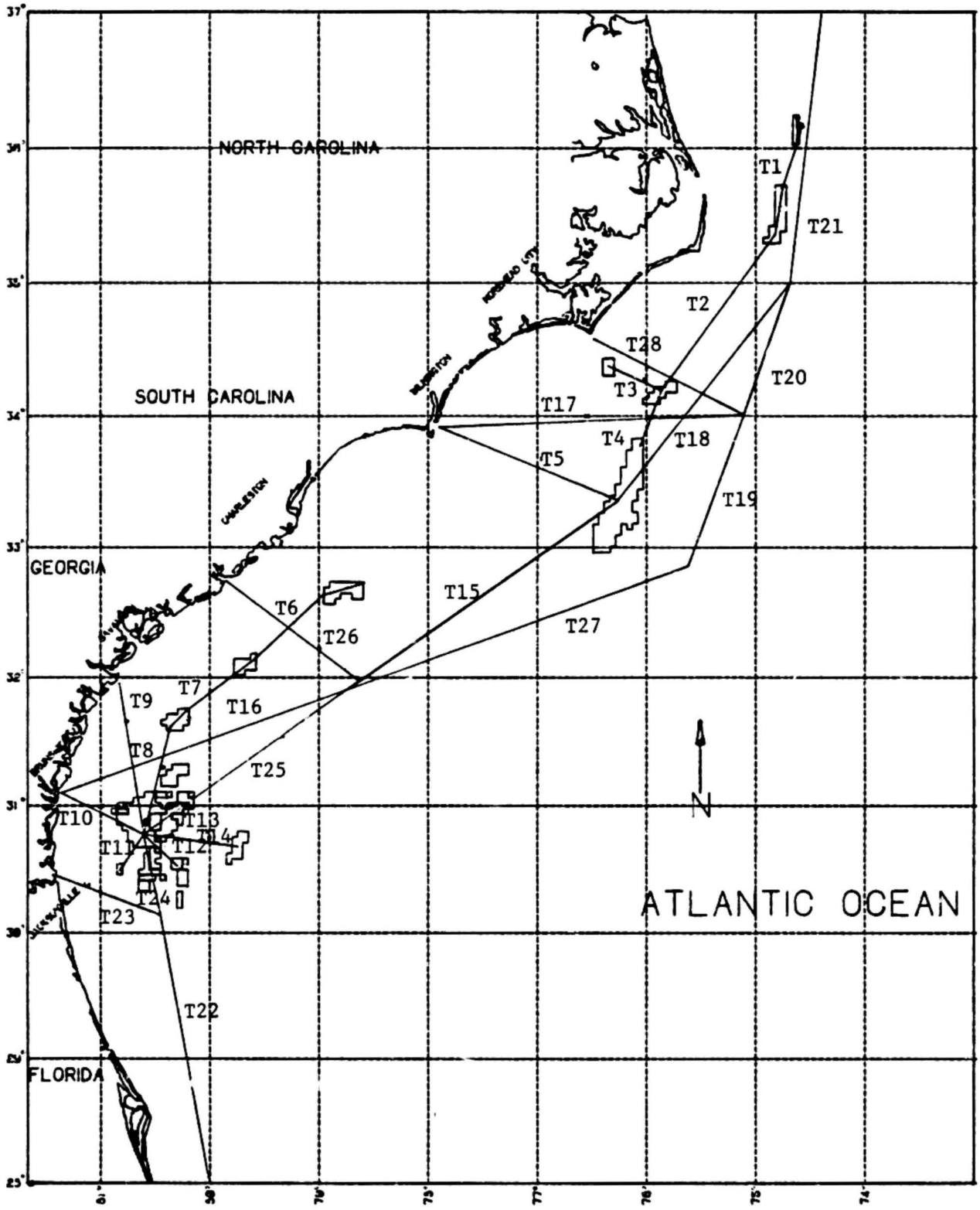

Figure 4.--Map showing the transportation route segments (T1 to T28); polygons represent proposed and existing lease tract groups.

Environmental Resources

The locations of 20 categories of biological, recreational, and other resources (or targets, as they are designated in this paper) were digitized in the same coordinate system, or base map, as that used in trajectory simulations. Maps showing the digitized targets are shown in appendix A, figures A-1 to A-19. The monthly sensitivity of these targets was also recorded so that, for example, a target such as migrating birds could be contacted by simulated oilspills only when the birds would be present in the area. Federal and State Parks have two different sensitivity periods within the same areal extent; therefore this target is shown only once in appendix A. The targets are listed below:

Brown Pelican Rookeries (Vulnerable all year)

Marine Turtle Nesting Habitat (Vulnerable May through October)

Onslow Bay Live Bottom Area (Vulnerable all year)

Federal and State Wildlife Conservation
Areas (Vulnerable all year)

Federal and State Parks (Vulnerable May through October)

Federal and State Parks (Vulnerable November through April)

Blackbeard, Sapelo, and Wolf Islands (Vulnerable all year)

Gray's Reef (Vulnerable all year)

Cape Romain National Wilderness (Vulnerable all year)

Monitor Marine Sanctuary (Vulnerable all year)

Tourist Beaches, N.C.
(Vulnerable May through October)

Tourist Beaches, S.C.

(Vulnerable May through October)

Tourist Beaches, Ga.

(Vulnerable May through October)

Tourist Beaches, Fla.

(Vulnerable April through November)

Coastal Inlets, N.C. (Vulnerable all year)

Coastal Inlets, S.C. (Vulnerable all year)

Coastal Inlets, Ga. (Vulnerable all year)

Coastal Inlets, Fla. (Vulnerable all year)

Historic Sites (Vulnerable all year)

Prehistoric Sites (Vulnerable all year)

Because the trajectory model simulates an oilspill as a point, most targets have been given an areal extent slightly greater than they actually occupy. For example, some shoreline targets extend a short distance offshore; this allows the model to simulate a spill that approaches land, makes partial contact, withdraws, and continues on its way.

To provide a more detailed analysis for land or land-based targets, the model includes a feature that allows subdividing the coastline into land segments. Figure 5 shows the coastline divided into segments of approximately equal length; this is designated as set 1. Figure 6 shows the coastline divided into segments selected by BLM analysts; this is designated as set 2.

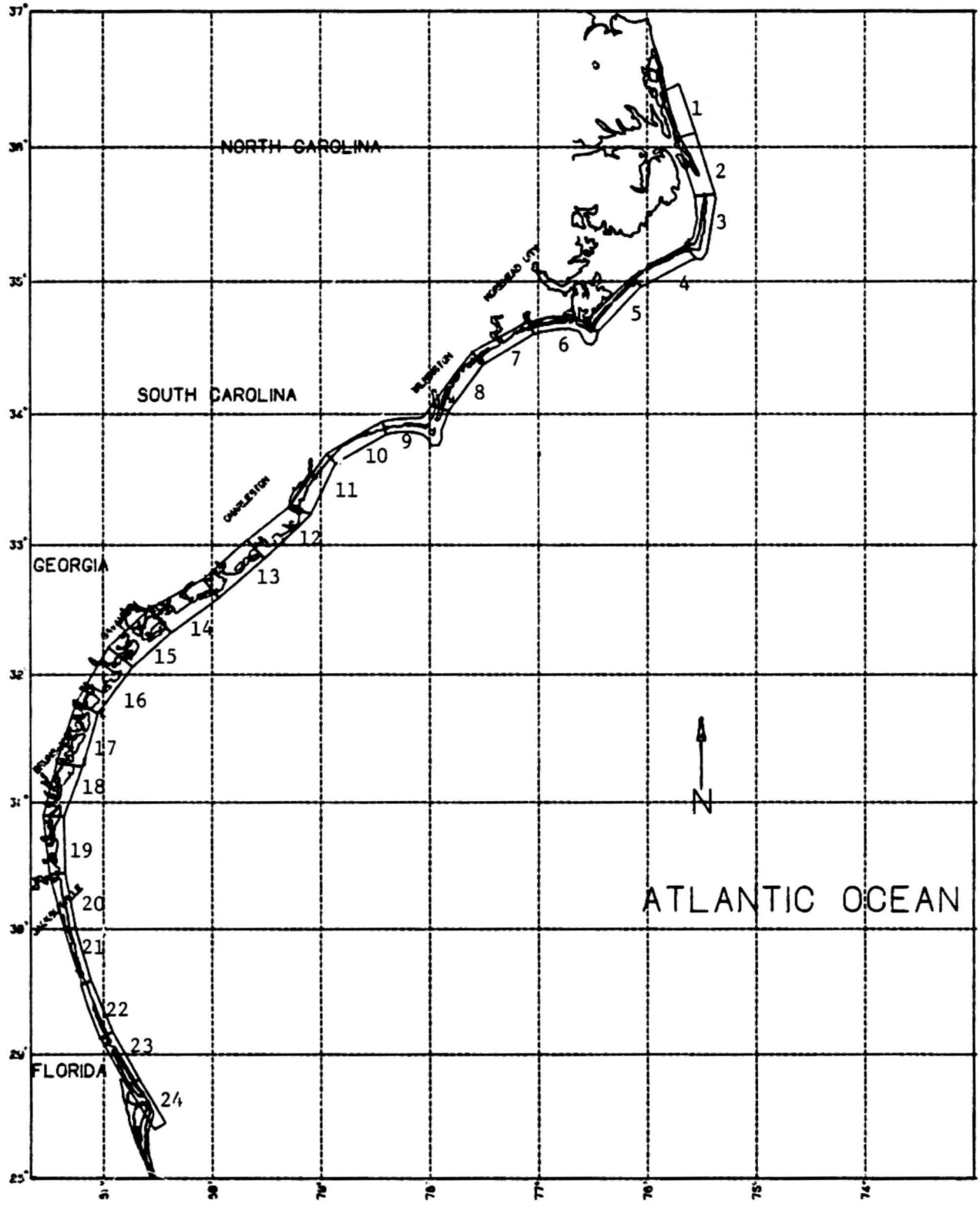

Figure 5.--Map showing the division of the South Atlantic shoreline into segments of approximately equal length (set 1).

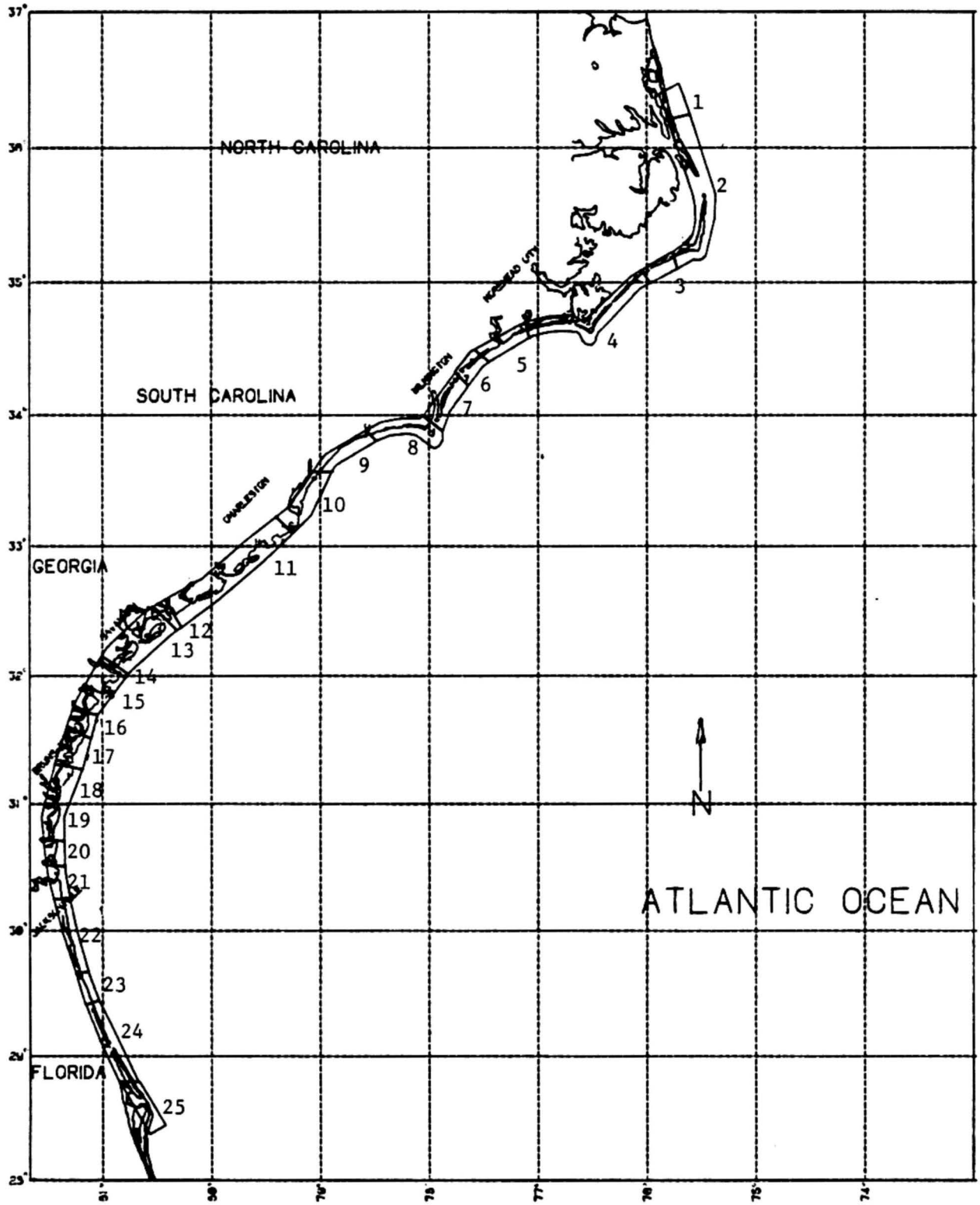

Figure 6.--Map showing the division of the South Atlantic shoreline into segments selected by BLM (set 2).

Estimated Quantity of Oil Resources

Considerable uncertainty exists in estimating the volume of oil that will be discovered and produced as a result of an OCS lease sale. There is a question of whether oilspill risk calculations should be based upon a single estimate of volume, or should consider volume to be a random variable and include some probability distribution for volume in computing oilspill occurrence probabilities. The choice may depend upon how the results are to be incorporated into benefit/risk analysis.

Benefits and risks (as well as many environmental impacts), are functions of the volume of oil, and are not independent of each other. Greater risks are associated with greater volumes of oil and greater economic benefits. If benefits are evaluated by assuming production of a specific amount of oil, then the corresponding risks should be stated in a conditional form such as, "the risks are ..., given that the volume is ..." If benefits are evaluated for a number of discrete volumes, then risks should likewise be calculated for the same volumes. Any statements about the likelihood of the presence of a particular volume of oil apply equally well to the likelihood of the corresponding benefits and risks.

The estimated oil resources used for oilspill risk calculations

in this report correspond to those used by BLM in preparing the draft EIS for the area. They are "risked mean estimates," the amount of oil expected to result from the proposed sale. Risked mean estimates account for the possibility that oil may not be found or if found, may not be of economically recoverable quantities in some or all of the tracts. For oilspill calculations, the lease area was divided into smaller subareas than those used by BLM; the individual oil volume estimates for each of these subareas are considered proprietary information. For the entire proposed leasing area, the risked mean estimate of oil resources is 493 million barrels. Over the 30-year expected life of the Sale 56 leases, BLM estimates that 1.6 billion barrels of oil from other sources, such as imports, will be transported by tankers through the study area.

Probability of Oilspills Occurring

Statistical distributions for estimating probabilities of oilspill occurrence were taken from Devanney and Stewart (1974) and Stewart (1975), and from USGS files of offshore platform accidents. Besides the fundamental assumption that realistic estimates of future spill frequencies can be based on past OCS experience, use of these distributions requires the further assumptions that spills occur independently of each other (as a Poisson process), and that spill rate is dependent on volume of oil produced and handled. The first assumption -- that past spill rates are indicative of future

spill rates -- might be modified either by assuming a decrease in future spill rates due to experience and improved standards, or by assuming an increase because of unknown conditions in new territory. The assumption that spills occur independently of each other could be modified by assuming a positive correlation (if a spill occurs, conditions are such that more will follow shortly) or by assuming a negative correlation (if a spill occurs, extra precautions are taken). This analysis takes the middle ground between these two assumptions by using the historic spill rates. The final assumption -- that the spill rate is a function of the volume of oil handled -- might be modified on the basis of size, extent, frequency, or duration of the handling. In the case of tanker transport, for example, the number of port calls and the number of tanker-years have been contemplated (Stewart, 1976, and Stewart and Kennedy, 1978). This analysis uses volume of oil handled, since all other estimates must ultimately be derived from this quantity.

Spill frequency estimates for oilspills greater than 1,000 barrels in size were calculated for production and transportation of oil from Sale 56, from Sale 43, and for existing transportation of oil by tankers within the study area. Table 1 shows the expected number of spills and the most likely number of spills that will occur during the expected production life of the lease area. figure 7 shows the probability that 0, 1, 2, ..., N spills will occur.

Table 1. -- Oilspill probability estimates for spills greater than 1,000 barrels resulting from OCS Lease Sale 56, from existing Federal leases, or from existing oil transportation in the South Atlantic area.

	Expected number of spills (mean).	Most likely number of spills (mode).	Probability of one or more spills.
Sale 56	3.0	2	0.95
Sale 43 (existing)	0.05	0	0.05
Sales 56 and 43	3.0	2	0.95
Existing transportation	3.1	3	0.96
Sales 56 and 43 plus existing transportation	6.2	6	0.99+

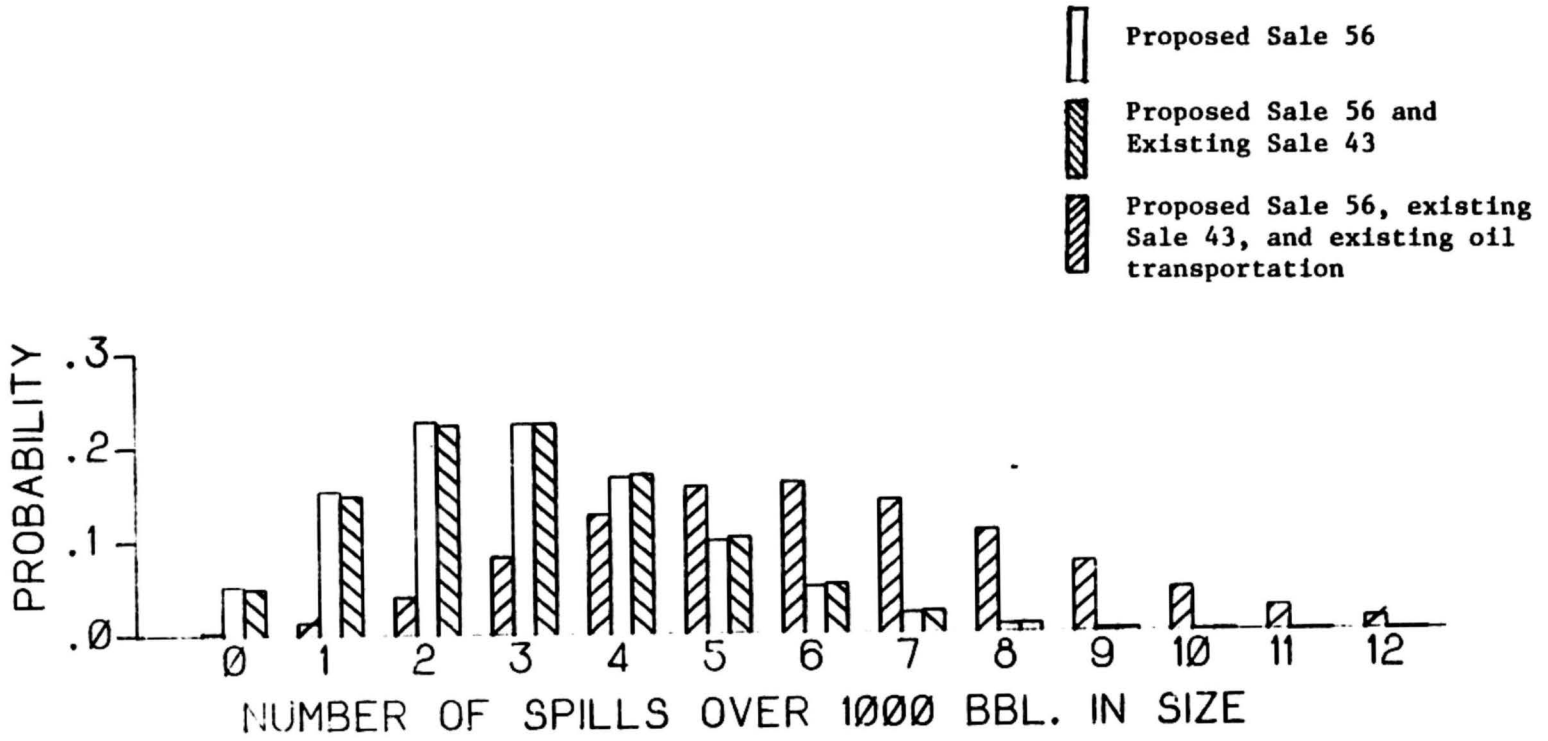

Figure 7.--Estimated frequency distribution for oilspills greater than 1000 barrels occurring during the production life of the proposed lease area for South Atlantic OCS Lease Sale 56.

Oilspill Trajectory Simulations

The trajectory simulation portion of the model consists of a large number of hypothetical oilspill trajectories that, collectively represent both the general trend and the variability of winds and currents, and which can be described in statistical terms. Representations of the monthly surface water velocity field were based on 3 years of satellite observations supplied by NASA to BLM. Data for each year were used for one-third of the trajectory simulations to provide a stochastic representation of the currents. Short-term patterns in wind variability were characterized by probability matrices for successive 3-hour velocity transitions. A first-order Markov process with 41 wind velocity states (eight compass directions by five wind speed classes, and a calm condition) was assumed. Wind transition matrices were calculated from the U.S. Weather Service records from Charleston, S.C. (station number 13880), Savannah, Ga. (station number 3822), and Cape Kennedy, Fla. (station number 12868). The study area was divided into zones that a simulated oilspill would, depending upon its location, be directed by the matrix of the appropriate wind station. JAYCOR (1979) compared winds observed at Charleston, S.C., with winds observed about 200 km offshore to the east on a National Data Buoy Office meteorological data buoy over a 1-year period. They found that offshore wind speed averaged 1.8 times the coastal wind speed. This factor was applied to the Charleston and

Savannah wind speeds; the Cape Kennedy wind data did not appear to require this adjustment.

Five hundred hypothetical oilspill trajectories were simulated in Monte-Carlo fashion for each of the four seasons from 13 potential oilspill locations in the proposed lease areas, 3 locations in the existing lease areas, and from 28 locations along the transportation network. Each potential spill source was represented as either a single point (e.g., a small portion of the lease area), or as a straight line with the potential spills uniformly distributed along the line (e.g., a transportation route). Surface transport of the oil slick for each spill was simulated as a series of straight-line displacements of a point under the joint influence of winds and currents for a 3-hour period. The wind transition probability matrix was randomly sampled each period for a new wind speed and direction, and the current velocity was updated as the spill changed location or the simulated month changed. The wind drift factor was taken to be 0.035 with a drift angle of 20 degrees clockwise. As the simulated oilspill was moved, any contacts with targets were recorded. Spill movement continued until the spill hit land, moved off of the map, or aged more than 30 days.

It should be emphasized that the trajectories simulated by the model represent only hypothetical pathways of oil slicks and do not involve any direct consideration of cleanup, dispersion, or weathering processes which could determine the quantity or quality

of oil that might eventually come in contact with targets. An implicit analysis of weathering and decay can be considered by noting the age of simulated oilspills when they contact targets. For this analysis, three time periods were selected: 3 days, to represent diminished toxicity of the spill; 10 days, to allow for deployment of cleanup equipment; and 30 days, to represent the difficulty of tracking or loacting spills after this time.

Each entry in tables 2, 3, and 4 represents the probability (expressed as percent chance) that, if a spill starts from a certain location, it will contact a particular target within 3, 10, or 30 days, respectively. Tables 5 to 10 present similar probabilities for land segments (set 1 and 2). These conditional probabilities allow for the possibility that the targets may not be vulnerable to oilspills for the entire year: a target which is vulnerable for only 1 month, for example, could have a conditional probability no higher than about 1/12.

Combined Analysis of Oilspill Occurrence and Oilspill Trajectory Simulations

Data in figure 7 indicates the probabilities of different numbers of oilspills occurring. Tables 2 to 10 indicate the probabilities that targets or land segments will be contacted, given that an oilspill occurs. Combining these two sets of probabilities yields the chances that oilspills will occur and

Table 2. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 3 days.

Target	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
Land	n	n	2	2	n	n	n	n	n	n	n	n	n	n	n	1	2	1	5	n	n
Brown Pelican	n	n	n	n	n	n	1	n	n	n	n	1	n	n	n	n	n	n	12	n	n
Marine Turtle	n	n	2	2	n	n	n	n	n	n	n	n	n	n	n	1	1	1	n	n	n
Onslow Bay Live Bot.	n	n	57	n	2	4	n	n	n	n	n	n	n	n	n	n	15	n	58	n	n
Wildlife Conser.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Parks (May-Oct)	n	n	2	2	n	n	n	n	n	n	n	n	n	n	n	1	1	1	5	n	n
Parks (Nov-Apr)	n	n	3	2	n	n	n	n	n	n	n	n	n	n	n	1	3	2	4	n	n
Blkbrd, Sapelo, Wolf	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gray's Reef	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Cape Romain Wild.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Monitor	n	n	n	12	2	n	n	n	n	n	n	n	n	n	n	12	7	7	n	n	n
Tourist Beaches, NC	n	n	1	2	n	n	n	n	n	n	n	n	n	n	n	1	1	1	3	n	n
Tourist Beaches, SC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Tourist Beaches, GA	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Tourist Beaches, FL	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Inlets, NC	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	1	1	1	9	n	n
Coastal Inlets, SC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Inlets, GA	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Inlets, FL	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Historic Sites	n	n	1	9	1	n	n	n	n	n	n	n	n	n	n	7	6	6	5	n	n
Prehistoric Sites	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
Land	n	8	14	n	n	n	n	n	2	3	n	n	n	n	1	13	n	n	9	n	4
Brown Pelican	n	4	31	1	n	n	n	n	8	6	n	n	n	n	1	n	n	n	11	n	n
Marine Turtle	n	4	11	n	n	n	n	n	2	1	n	n	n	n	n	10	n	n	2	n	5
Onslow Bay Live Bot.	n	n	n	n	n	n	n	3	1	44	n	n	n	n	n	n	n	n	n	1	7
Wildlife Conser.	n	13	1	n	n	n	n	n	n	n	n	n	n	n	1	17	n	n	7	n	n
Parks (May-Oct)	n	n	5	n	n	n	n	n	n	3	n	n	n	n	n	10	n	n	6	n	5
Parks (Nov-Apr)	n	n	4	n	n	n	n	n	n	3	n	n	n	n	n	9	n	n	5	n	5
Blkbrd, Sapelo, Wolf	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
Gray's Reef	1	7	1	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Cape Romain Wild.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
Monitor	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	7
Tourist Beaches, NC	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	4
Tourist Beaches, SC	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n
Tourist Beaches, GA	n	2	12	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
Tourist Beaches, FL	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13	n	n	n	n	n
Coastal Inlets, NC	n	n	n	n	n	n	n	n	n	6	n	n	n	n	n	n	n	n	n	n	7
Coastal Inlets, SC	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13	n	n
Coastal Inlets, GA	n	13	21	n	n	n	n	n	4	n	n	n	n	n	n	n	n	n	n	n	n
Coastal Inlets, FL	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	16	n	n	n	n	n
Historic Sites	n	2	7	n	n	n	n	n	1	4	1	n	n	n	n	12	n	n	8	n	7
Prehistoric Sites	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: n = less than 0.5 percent

Table 3. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain target within 10 days.

Target	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
Land	1	2	18	11	4	3	3	7	n	2	1	9	4	3	1	7	13	9	13	2	5
Brown Pelican	n	n	1	1	n	1	7	8	1	2	2	6	6	3	n	n	1	1	13	6	7
Marine Turtle	n	n	15	8	3	1	2	4	n	1	1	6	3	2	n	5	9	6	4	2	3
Onslow Bay Live Bot.	n	n	65	2	5	18	n	n	6	2	3	1	1	1	n	1	25	2	64	4	n
Wildlife Conser.	1	1	n	n	n	1	3	5	n	1	1	5	2	2	1	n	n	n	n	3	4
Parks (May-Oct)	n	1	15	10	3	2	1	1	n	1	1	4	2	1	n	7	11	7	9	1	1
Parks (Nov-Apr)	1	1	11	6	3	1	1	1	n	1	1	3	1	1	1	4	9	5	8	n	1
Blkbrd, Sapelo, Wolf	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1
Gray's Reef	n	n	n	n	n	n	n	6	n	n	n	2	2	1	n	n	n	n	n	n	2
Cape Romain Wild.	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n
Monitor	n	n	10	19	7	2	n	n	2	1	1	n	n	n	n	18	17	12	4	n	n
Tourist Beaches, NC	n	1	14	9	3	1	n	n	n	n	n	n	n	n	n	6	10	6	7	n	n
Tourist Beaches, SC	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	1	2
Tourist Beaches, GA	n	n	n	n	n	n	n	2	n	1	1	3	3	1	n	n	n	n	n	n	n
Tourist Beaches, FL	n	n	n	n	n	n	n	n	n	n	n	3	1	1	n	n	n	n	n	n	n
Coastal Inlets, NC	n	1	15	7	3	2	n	n	n	n	n	n	n	n	1	3	10	5	16	n	n
Coastal Inlets, SC	n	n	n	n	n	1	5	3	n	1	n	n	n	n	n	n	n	n	n	4	5
Coastal Inlets, GA	n	n	n	n	n	n	n	6	n	1	1	5	4	2	n	n	n	n	n	n	2
Coastal Inlets, FL	n	n	n	n	n	n	n	n	n	n	n	3	1	1	n	n	n	n	n	n	n
Historic Sites	1	1	16	18	7	2	1	1	2	1	1	4	2	1	1	15	20	12	10	1	2
Prehistoric Sites	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1

	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
Land	5	23	29	6	3	3	1	2	6	10	3	1	1	1	6	25	4	1	17	1	15
Brown Pelican	8	13	38	6	3	3	1	1	11	8	n	n	n	n	9	3	3	1	18	n	1
Marine Turtle	3	12	20	4	2	2	1	2	4	4	2	n	n	n	5	16	2	1	6	n	11
Onslow Bay Live Bot.	1	n	n	1	1	1	3	12	5	48	n	n	n	n	1	1	1	5	4	7	11
Wildlife Conser.	3	2	8	4	1	1	1	n	2	n	1	n	n	n	6	21	1	n	15	n	n
Parks (May-Oct)	1	2	9	3	1	2	1	1	1	7	2	n	1	n	2	14	1	n	7	1	12
Parks (Nov-Apr)	1	1	8	3	1	1	1	1	2	6	2	1	1	n	2	12	1	n	6	1	10
Blkbrd, Sapelo, Wolf	1	4	2	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
Gray's Reef	5	13	6	1	n	1	n	n	3	n	n	n	n	n	n	1	1	n	n	n	n
Cape Romain Wild.	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n
Monitor	n	n	n	n	n	n	1	3	2	4	5	1	1	n	n	n	n	1	1	3	14
Tourist Beaches, NC	n	n	n	n	n	n	n	1	n	5	2	n	1	n	n	n	n	n	n	1	11
Tourist Beaches, SC	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
Tourist Beaches, GA	2	6	18	3	1	2	n	n	3	n	n	n	n	n	n	1	2	n	n	n	n
Tourist Beaches, FL	n	n	1	2	n	1	n	n	n	n	n	n	n	n	3	17	1	n	n	n	n
Coastal Inlets, NC	n	n	n	n	n	n	n	1	1	12	1	n	n	n	n	n	n	n	n	1	13
Coastal Inlets, SC	1	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n
Coastal Inlets, GA	5	26	32	5	2	2	n	n	7	n	n	n	n	n	n	3	2	1	n	n	n
Coastal Inlets, FL	n	n	1	2	1	1	n	n	n	n	n	n	n	n	1	20	1	n	n	n	n
Historic Sites	2	6	14	4	1	1	1	3	4	8	5	1	1	n	2	16	2	1	10	2	19
Prehistoric Sites	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	1	n	n

Note: n = less than 0.5 percent

Table 4. -- Probabilities (expressed as. percent chance) that an oilspill starting at a particular location will contact a certain target within 30 days.

Target	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
Land	5	5	38	20	10	16	25	33	9	15	16	25	23	19	5	15	29	15	35	19	29
Brown Pelican	n	n	6	2	1	7	23	28	4	9	9	16	17	12	n	1	4	1	17	15	25
Marine Turtle	1	1	24	13	6	8	14	19	5	6	9	16	15	12	1	9	17	9	15	11	16
Onslow Bay Live Bot.	n	n	66	5	7	28	7	4	14	9	9	6	4	7	n	3	28	4	66	13	5
Wildlife Conser.	3	3	1	1	1	3	17	19	4	7	7	11	11	8	3	2	1	1	2	13	20
Parks (May-Oct)	1	2	27	15	7	10	6	7	5	6	6	10	8	7	1	11	20	10	22	7	6
Parks (Nov-Apr)	2	1	16	9	4	5	4	4	3	4	5	6	6	5	2	7	14	7	14	4	4
Blkbrd, Sapelo, Wolf	n	n	n	n	n	n	1	4	n	n	n	2	2	1	n	n	n	n	n	1	3
Gray's Reef	n	n	n	n	n	n	2	10	n	1	1	5	6	3	n	n	n	n	n	1	5
Cape Romain Wild.	n	n	n	n	n	1	4	1	1	1	1	1	1	1	n	n	n	n	n	4	4
Monitor	n	n	15	23	9	6	2	1	5	3	3	2	2	3	1	20	23	14	9	3	1
Tourist Beaches, NC	2	2	25	14	7	7	1	n	3	2	3	1	1	2	1	11	19	10	18	2	n
Tourist Beaches, SC	n	n	n	n	n	n	7	8	1	1	1	1	2	1	n	n	n	n	n	4	9
Tourist Beaches, GA	n	n	n	n	n	n	2	7	1	2	3	8	9	5	n	n	n	n	n	1	3
Tourist Beaches, FL	n	n	n	n	n	n	n	n	1	1	1	5	2	2	n	n	n	n	n	n	n
Coastal Inlets, NC	2	2	28	12	6	10	1	1	4	2	3	1	1	2	3	8	20	8	32	4	1
Coastal Inlets, SC	n	n	n	n	n	3	21	19	2	4	4	3	5	4	n	n	n	n	1	15	22
Coastal Inlets, GA	n	n	n	n	n	n	7	17	2	5	5	13	15	9	n	n	n	n	n	3	10
Coastal Inlets, FL	n	n	n	n	n	n	n	n	1	2	2	4	1	2	n	n	n	n	n	n	n
Historic Sites	2	3	28	23	11	9	8	9	6	8	8	11	11	8	3	18	29	16	21	8	8
Prehistoric Sites	n	n	n	n	n	n	3	3	n	1	1	1	1	1	n	n	n	n	1	2	4

	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
Land	27	44	46	25	19	18	13	13	15	27	7	1	3	4	22	37	17	13	29	6	26
Brown Pelican	20	25	44	15	13	13	7	5	14	11	n	n	n	n	21	9	9	7	23	1	3
Marine Turtle	17	24	29	16	12	12	7	8	8	13	4	n	1	1	13	23	11	8	12	4	15
Onslow Bay Live Bot.	5	3	2	5	7	6	10	18	8	50	1	n	n	n	7	4	6	11	10	10	13
Wildlife Conser.	14	31	16	11	8	8	6	3	5	2	1	n	1	2	15	26	7	5	21	n	1
Parks (May-Oct)	9	8	14	10	8	8	5	8	4	18	5	n	1	1	8	19	8	6	11	5	17
Parks (Nov-Apr)	6	5	12	7	5	4	4	5	4	11	3	1	1	2	6	15	5	4	8	2	14
Blkbrd, Sapelo, Wolf	2	6	4	2	1	1	n	n	1	n	n	n	n	n	n	1	1	n	n	n	n
Gray's Reef	9	16	10	4	3	4	1	n	3	n	n	n	n	n	1	2	2	1	n	n	n
Cape Romain Wild.	1	1	n	1	1	1	1	n	1	n	n	n	n	n	1	n	n	1	6	n	n
Monitor	2	1	1	2	3	2	3	6	3	8	7	1	2	n	3	2	2	4	2	4	17
Tourist Beaches, NC	1	1	1	2	2	2	3	6	2	14	5	n	1	1	1	1	2	4	2	4	16
Tourist Beaches, SC	3	5	1	1	1	1	1	1	1	n	n	n	n	n	1	1	1	1	6	n	n
Tourist Beaches, GA	8	12	24	9	5	7	2	1	4	n	n	n	n	n	1	6	5	2	1	n	n
Tourist Beaches, FL	2	1	3	4	2	2	1	n	n	n	n	n	n	n	8	17	2	1	n	n	n
Coastal Inlets, NC	1	1	1	1	2	1	3	7	3	25	3	n	1	1	2	1	2	4	4	4	19
Coastal Inlets, SC	7	12	3	3	4	3	4	2	3	n	n	n	n	n	2	2	2	3	25	n	n
Coastal Inlets, GA	18	37	42	15	9	11	4	2	9	n	n	n	n	n	1	9	8	4	2	n	n
Coastal Inlets, FL	1	1	3	4	2	2	1	n	n	n	n	n	n	n	3	22	3	1	n	n	n
Historic Sites	12	14	21	11	9	8	7	9	8	18	8	1	2	2	7	21	9	8	15	5	24
Prehistoric Sites	1	4	1	1	1	n	1	n	1	n	n	n	n	n	3	1	1	n	2	n	n

Note: n = less than 0.5 percent

Table 5. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 1) within 3 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
3	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
4	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	1	1	1	n	n	n
5	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
6	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n
13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2
8	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n
9	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	8	n	n
16	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	13	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n
20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

Table 6. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 1) within 10 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
2	1	1	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
3	n	1	1	4	1	n	n	n	n	n	n	n	n	n	1	4	2	3	n	n	n
4	n	n	3	6	3	n	n	n	n	n	n	n	n	n	n	3	7	5	1	n	n
5	n	n	6	1	n	n	n	n	n	n	n	n	n	n	n	n	2	1	1	n	n
6	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	1	n	n
7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
8	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n
9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	2	1
14	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	1
15	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1
16	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1
17	n	n	n	n	n	n	n	3	n	n	n	n	1	n	n	n	n	n	n	n	1
18	n	n	n	n	n	n	n	1	n	1	n	2	2	1	n	n	n	n	n	n	n
19	n	n	n	n	n	n	n	n	n	n	n	2	1	1	n	n	n	n	n	n	n
20	n	n	n	n	n	n	n	n	n	n	1	4	n	1	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
3	n	n	n	n	n	n	n	n	n	1	1	n	1	n	n	n	n	n	n	n	3
4	n	n	n	n	n	n	n	1	n	2	1	n	n	n	n	n	n	n	n	1	5
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
6	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	3
7	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n
9	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n
12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n
13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	13	n	n
14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
15	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	1	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	1	7	2	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
18	2	3	19	2	1	1	n	n	4	n	n	n	n	n	n	1	2	n	n	n	n
19	1	1	7	2	1	1	n	n	n	n	n	n	n	n	n	6	1	n	n	n	n
20	n	n	1	2	n	n	n	n	n	n	n	n	n	n	1	16	1	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

Table 7. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 1) within 30 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
1	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
2	4	3	n	1	1	n	n	n	n	n	n	n	n	n	3	2	1	1	n	n	n
3	1	1	4	6	3	2	n	n	1	1	1	n	1	n	2	6	5	4	2	1	n
4	n	n	8	10	5	2	1	n	1	1	1	1	n	1	n	6	12	7	4	1	n
5	n	n	10	2	1	1	n	n	n	n	n	n	n	n	n	1	5	2	3	n	n
6	n	n	10	1	n	2	n	n	1	1	1	n	n	1	n	n	3	1	7	1	n
7	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n
8	n	n	3	n	n	2	n	n	1	n	n	n	n	n	n	n	1	n	7	n	n
9	n	n	1	n	n	2	n	n	n	n	n	n	n	n	n	n	1	n	7	n	n
10	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
12	n	n	n	n	n	1	2	1	n	1	1	n	1	1	n	n	n	n	n	3	3
13	n	n	n	n	n	1	6	5	1	2	1	1	1	1	n	n	n	n	n	4	5
14	n	n	n	n	n	n	4	4	n	1	1	1	1	1	n	n	n	n	n	2	6
15	n	n	n	n	n	n	2	4	n	n	n	1	1	n	n	n	n	n	n	1	3
16	n	n	n	n	n	n	4	4	n	n	1	1	1	1	n	n	n	n	n	2	4
17	n	n	n	n	n	n	3	7	n	1	1	3	3	2	n	n	n	n	n	1	4
18	n	n	n	n	n	n	1	5	1	3	2	6	7	4	n	n	n	n	n	n	2
19	n	n	n	n	n	n	1	2	1	1	2	5	5	4	n	n	n	n	n	n	1
20	n	n	n	n	n	n	n	n	n	1	2	6	1	3	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	2	1	1	n	1	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
1	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n
2	n	n	n	n	n	n	n	n	n	n	1	1	1	3	n	n	n	n	n	n	1
3	n	n	n	1	1	n	1	2	1	2	3	1	1	1	1	n	1	1	n	1	5
4	1	n	n	1	1	1	1	3	1	4	2	n	1	n	1	1	1	1	1	2	9
5	n	n	n	n	n	n	n	1	n	2	n	n	n	n	n	n	n	n	n	1	6
6	n	n	n	1	n	n	1	2	1	5	n	n	n	n	n	n	1	1	1	1	3
7	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	1
8	n	n	n	n	n	n	n	1	1	6	n	n	n	n	n	n	n	1	n	1	1
9	n	n	n	n	n	n	n	1	n	4	n	n	n	n	n	n	n	n	1	n	n
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
12	1	n	n	n	1	n	1	n	n	n	n	n	n	n	n	n	n	1	4	n	n
13	1	1	1	1	1	1	1	1	1	n	n	n	n	n	1	1	1	1	15	n	n
14	2	2	n	1	1	n	1	n	1	n	n	n	n	n	n	n	n	n	2	n	n
15	2	4	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	1	n	n
16	2	12	1	1	1	1	1	n	1	n	n	n	n	n	n	1	1	n	2	n	n
17	4	10	5	2	1	1	1	n	2	n	n	n	n	n	n	1	1	1	1	n	n
18	7	8	24	7	5	6	2	1	5	n	n	n	n	n	1	5	4	2	n	n	n
19	6	4	11	6	3	4	2	1	1	n	n	n	n	n	1	8	3	2	n	n	n
20	1	1	2	4	2	2	1	n	n	n	n	n	n	n	1	17	2	1	n	n	n
21	n	n	n	n	1	n	n	n	n	n	n	n	n	n	2	2	2	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

Table 8. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 2) within 3 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
2	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	1	1	1	n	n	n
3	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n
4	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
7	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4
7	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	n	n
13	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	10	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n
19	n	n	4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

Table 9. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 2) within 10 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
2	1	2	2	5	2	n	n	n	n	n	n	n	n	n	1	5	4	5	1	n	n
3	n	n	2	4	2	n	n	n	n	n	n	n	n	n	n	1	5	3	1	n	n
4	n	n	13	1	n	n	n	n	n	n	n	n	n	n	n	1	4	1	1	n	n
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
7	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
8	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n
11	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	2	2
13	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1
14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n	n	1
16	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1
17	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n
18	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n
19	n	n	n	n	n	n	n	n	n	1	n	2	1	1	n	n	n	n	n	n	n
20	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	2	n	1	n	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
2	n	n	n	n	n	n	n	1	n	1	2	n	1	1	n	n	n	n	n	1	4
3	n	n	n	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	1	3
4	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	7
5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
6	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n
7	n	n	n	n	n	n	n	n	n	4	n	n	n	n	n	n	n	n	n	n	n
8	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n
11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	16	n	n
13	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
14	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
16	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	1	3	2	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
18	1	2	15	1	1	1	n	n	3	n	n	n	n	n	n	1	1	n	n	n	n
19	1	1	9	2	1	1	n	n	1	n	n	n	n	n	n	1	1	n	n	n	n
20	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n
21	n	n	1	2	n	1	n	n	n	n	n	n	n	n	n	15	1	n	n	n	n
22	n	n	n	1	n	n	n	n	n	n	n	n	n	n	1	6	1	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

Table 10. -- Probabilities (expressed as percent chance) that an oilspill starting at a particular location will contact a certain land segment (set 2) within 30 days.

Land Segment	Hypothetical Spill Location																			
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	T1	T2	T3	T4	T5	T6	T7
2	5	4	7	9	6	2	1	n	2	1	1	1	1	1	5	10	9	8	4	2	1
3	n	n	5	7	3	2	n	n	1	1	n	n	n	n	n	3	8	4	2	1	n
4	n	n	20	3	1	4	n	n	1	1	1	n	n	1	n	2	9	2	10	1	n
5	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n
6	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n
7	n	n	4	n	1	3	n	n	1	n	n	n	n	n	n	n	1	n	9	n	n
8	n	n	1	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n
9	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
10	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	1	1	1
11	n	n	n	n	n	1	12	9	1	3	2	2	3	2	n	n	n	n	n	8	11
12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1
13	n	n	n	n	n	n	3	5	n	n	n	1	1	n	n	n	n	n	n	2	5
14	n	n	n	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	n	n
15	n	n	n	n	n	n	2	3	n	n	1	1	1	1	n	n	n	n	n	1	3
16	n	n	n	n	n	n	1	2	n	n	n	1	1	n	n	n	n	n	n	1	2
17	n	n	n	n	n	n	2	4	n	n	n	2	2	1	n	n	n	n	n	1	2
18	n	n	n	n	n	n	1	4	1	2	2	4	5	3	n	n	n	n	n	n	2
19	n	n	n	n	n	n	1	3	1	2	2	5	5	3	n	n	n	n	n	n	1
20	n	n	n	n	n	n	n	n	n	n	n	2	2	1	n	n	n	n	n	n	n
21	n	n	n	n	n	n	n	n	n	n	1	3	1	1	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	3	2	4	n	3	n	n	n	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Land Segment	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21	T22	T23	T24	T25	T26	T27	T28
2	n	n	1	1	1	1	1	3	2	4	5	1	2	4	1	1	1	2	1	2	8
3	n	n	n	n	1	n	1	2	1	2	2	n	n	n	n	n	1	1	1	1	6
4	1	n	n	1	1	1	1	3	1	8	n	n	n	n	1	1	1	1	1	2	10
5	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	1
6	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	n	n	n
7	n	n	n	n	n	n	n	1	1	7	n	n	n	n	n	n	n	n	1	1	1
8	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	1	n	n
9	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
11	3	4	1	2	2	2	3	1	1	n	n	n	n	n	1	1	1	2	20	n	n
12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
13	2	5	1	n	n	n	1	n	1	n	n	n	n	n	n	n	n	n	2	n	n
14	n	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
15	2	10	1	1	1	1	n	n	1	n	n	n	n	n	n	1	n	n	1	n	n
16	1	5	2	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
17	2	5	4	2	1	1	n	n	1	n	n	n	n	n	n	1	1	n	n	n	n
18	5	6	18	5	3	4	1	1	4	n	n	n	n	n	1	3	3	1	n	n	n
19	6	4	13	6	4	4	2	1	1	n	n	n	n	n	1	3	3	1	n	n	n
20	2	2	4	2	1	1	1	n	n	n	n	n	n	n	n	2	1	1	n	n	n
21	1	1	2	3	1	2	1	n	n	n	n	n	n	n	n	16	1	1	n	n	n
22	n	n	1	2	2	1	1	n	n	n	n	n	n	n	3	7	3	n	n	n	n
23	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n
25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7	n	n	n	n	n	n

Note: n = less than 0.5 percent.
Land segments for which all probabilities are less than 0.5 percent are not shown.

contact targets or land segments.

There is a critical difference between the conditional probabilities calculated in the previous section and the overall probabilities calculated in this section. Conditional probabilities depend only on the winds and currents in the study area -- elements over which the decisionmaker has no control. Overall probabilities, on the other hand, will depend not only on the physical conditions, but also on the course of action chosen by the decisionmaker, e. g. choosing to sell or not to sell the lease tracts.

Table 11 shows the probabilities (expressed as percent chance) of one or more oilspills, the most likely number of oilspills, and the expected number of oilspills occurring and contacting targets within periods of 3, 10, and 30 days, over the expected production life of the lease area. Tables 12 and 13 show similar probabilities for land segments. Only the impact of Federal oil and gas leasing is shown in tables 11 to 13. Tables of probabilities which show the effects of existing oil transportation combined with existing and proposed leasing are presented in appendix D. Calculating oilspill probabilities for the proposed sale and then for the proposed sale along with existing sources of oilspills allows for a cumulative analysis of oilspill risks. A cumulative analysis places the proposed action in context with the present circumstances. This allows for a quantitative comparison of oilspill risks from different sources.

Table 11. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode) and the expected number of spills (mean) occurring and contacting targets over the production life of the lease area.

Target	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing and Proposed			Proposed			Existing and Proposed			Proposed			Existing and Proposed		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
Land	11	0	0.1	11	0	0.1	26	0	0.3	27	0	0.3	50	0	0.7	51	0	0.7
Brown Pelican	23	0	0.3	23	0	0.3	30	0	0.4	31	0	0.4	40	0	0.5	40	0	0.5
Marine Turtle	8	0	0.1	8	0	0.1	17	0	0.2	17	0	0.2	33	0	0.4	33	0	0.4
Onslow Bay Live Bot.	21	0	0.2	21	0	0.2	26	0	0.3	26	0	0.3	31	0	0.4	31	0	0.4
Wildlife Conser.	1	0	0.0	1	0	0.0	7	0	0.1	7	0	0.1	19	0	0.2	20	0	0.2
Parks (May-Oct)	5	0	0.0	5	0	0.0	11	0	0.1	12	0	0.1	24	0	0.3	24	0	0.3
Parks (Nov-Apr)	4	0	0.0	4	0	0.0	10	0	0.1	10	0	0.1	19	0	0.2	19	0	0.2
Blkbrd, Sapelo, Wolf	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
Gray's Reef	1	0	0.0	1	0	0.0	6	0	0.1	6	0	0.1	10	0	0.1	10	0	0.1
Cape Romain Wild.	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
Monitor	1	0	0.0	1	0	0.0	5	0	0.1	5	0	0.1	10	0	0.1	10	0	0.1
Tourist Beaches, NC	1	0	0.0	1	0	0.0	4	0	0.0	4	0	0.0	12	0	0.1	12	0	0.1
Tourist Beaches, SC	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
Tourist Beaches, GA	8	0	0.1	8	0	0.1	13	0	0.1	13	0	0.1	19	0	0.2	19	0	0.2
Tourist Beaches, FL	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	3	0	0.0
Coastal Inlets, NC	4	0	0.0	4	0	0.0	7	0	0.1	7	0	0.1	16	0	0.2	16	0	0.2
Coastal Inlets, SC	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	7	0	0.1	8	0	0.1
Coastal Inlets, GA	13	0	0.1	14	0	0.1	22	0	0.2	22	0	0.3	32	0	0.4	33	0	0.4
Coastal Inlets, FL	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	3	0	0.0
Historic Sites	7	0	0.1	7	0	0.1	17	0	0.2	17	0	0.2	31	0	0.4	31	0	0.4
Prehistoric Sites	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0

Note: n = less than 0.5 percent.

Table 12. -- Probabilities (expressed in percent chance) of one or more spills, the most likely number of spills (mode) and the expected number of spills (mean) occurring and contacting land segments (set 1) over the production life of the proposed lease area.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing and Proposed			Proposed			Existing and Proposed			Proposed			Existing and Proposed		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
3	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	3	0	0.0
4	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
5	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	3	0	0.0
7	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
8	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	3	0	0.0
9	1	0	0.0	1	0	0.0	2	0	0.0	2	0	0.0	3	0	0.0	3	0	0.0
12	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
13	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
14	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
15	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
16	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
17	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	6	0	0.1	6	0	0.1
18	8	0	0.1	8	0	0.1	13	0	0.1	14	0	0.2	18	0	0.2	19	0	0.2
19	1	0	0.0	1	0	0.0	5	0	0.0	5	0	0.0	10	0	0.1	10	0	0.1
20	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0	2	0	0.0

Note: n = less than 0.5 percent. Those land segments for which all probabilities of one or more spills are less than 0.5 percent are not shown.

Table 13. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments (set 2) over the production life of the lease area.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing and Proposed			Proposed			Existing and Proposed			Proposed			Existing and Proposed		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	6	0	0.1	7	0	0.1
3	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	3	0	0.0
4	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	5	0	0.0	5	0	0.0
5	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0
7	1	0	0.0	1	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
8	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0
11	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	4	0	0.0	4	0	0.0
13	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
15	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
16	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0
17	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	4	0	0.0
18	7	0	0.1	7	0	0.1	10	0	0.1	10	0	0.1	14	0	0.2	14	0	0.2
19	3	0	0.0	3	0	0.0	7	0	0.1	7	0	0.1	11	0	0.1	11	0	0.1
20	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	3	0	0.0	3	0	0.0
21	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0	2	0	0.0
22	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0

Note: n = less than 0.5 percent. Those land segments for which all probabilities of one or more spills are less than 0.5 percent are not shown.

The overall probabilities are also shown graphically in appendices B and C. Figures B-1 through B-9 are histograms which show probabilities of 1, 2, ... N spills occurring and contacting specific targets after periods of 3, 10, and 30 days. Figure C-1 indicates, through circles superimposed on maps of the coastline, the probabilities of one or more spills occurring and contacting land segments (set 1) within 3, 10, and 30 days.

Discussion of Results

Sale of the proposed leases will result in a 0.5 probability of one or more oilspills occurring and contacting land within 30 days. Since the same probability for 3 days is only 0.11, it can be concluded that any oil washing ashore will, most likely, have undergone a substantial amount of weathering. Oilspill risks are present along the entire coast of the study area, reflecting the wide distribution of tracts. Detailed analysis indicates that most of the risk to N.C. is caused by the northern tract groups P1 to P5, and that risks to the other states are caused by the southern tracts. The Brunswick, Ga., to Jacksonville, Fla., coastline has the highest risk of being contacted by an oilspill, because a greater number of transportation routes converge offshore from this area.

The probability that one or more spills will occur and contact a

Brown Pelican rookery within 3 days is 0.23, somewhat higher than that of contacting land. This is because the target has been extended seaward to represent the range of foraging activity. Most (though not all) of the risk to the Brown Pelican arises from spills originating in the southern tracts.

Existing tanker transportation of oil presents a risk about equal to that of the proposed leases, but the nature of tanker operations tends to spread the risks more evenly along the coast. To the extent that oil from the proposed sale tends to displace some of the existing transportation, the risks of production will be offset by reductions in tanker traffic; this analysis, however, has not made this assumption.

A stochastic oilspill model, such as that presented in this paper, can not be verified by observing an individual oilspill. A number of spills must be observed in order to draw statistical inferences; such a data base rarely exists for a given study area. The Cape Hatteras area of North Carolina, however, was the site of intense submarine warfare during World War II, and tanker sinkings during that period provide a data base for verifying the model. Campbell and others (1977) examined tanker sinkings by submarine activity in the first 6 months of 1942, and were able to identify 15 sinkings of laden tankers just south of Cape Hatteras, between latitudes 33 degrees N and 35 degrees 10 minutes N. During that same period, at least one oilspill was confirmed to have washed ashore on the Outer Banks south of Cape Hatteras, (Campbell and

others, 1977) and it is believed that as many as three oilspills may have come ashore on this portion of coastline. The locations of the 15 tanker sinkings were matched to lease tract group P3, and transportation routes T2, and T5, and the model's results were used to predict how many of the slicks were likely to come ashore on the Outer Banks (land segments 3, 4, or 5 of set 1). Of the 15 spills, the model estimated that there was only a 0.09 probability that none would come ashore, but that there was a 0.75 probability that between 1 and 3 oilspills would contact the Outer Banks. This is in good agreement with the observations of Campbell and others, 1977.

Conclusions

This analysis indicates that OCS Lease Sale 56 will result in an expected 3.0 oilspills occurring off the South Atlantic coast. The probability that one or more oilspills will occur and contact land within 3 days is 0.11; for contacts within 30 days, the probability increases to 0.50.

Risks to land are distributed along the coastline, with most of the risks to N.C. due to the northernmost tracts, and the risks to other States due to the southern tracts.

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tanker/pipeline controversy: Report to the U. S. Department of the Interior, Washington, D. C., 69 p.

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Appendix A

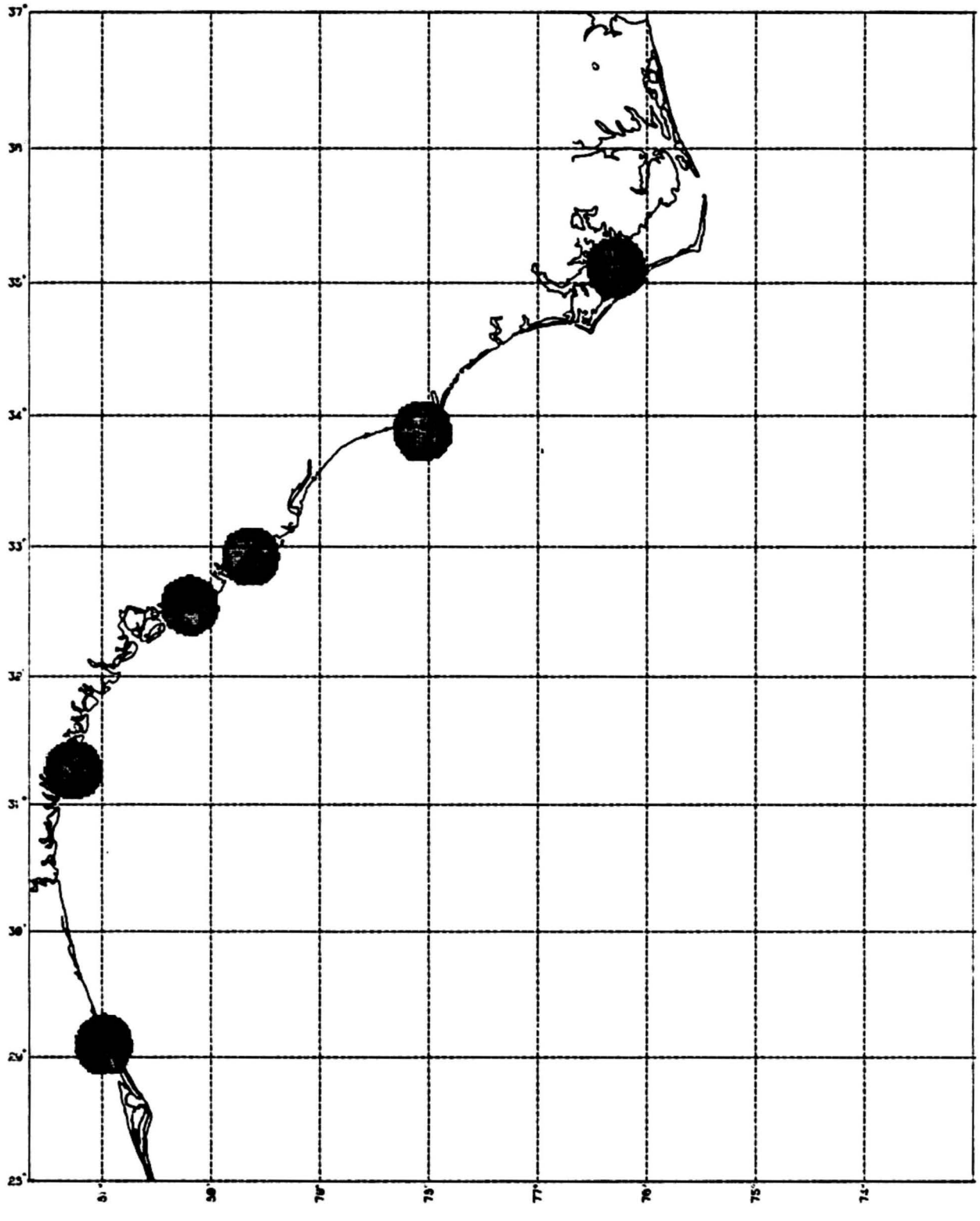

Figure A-1.--Map showing the location of Brown pelican rookeries, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

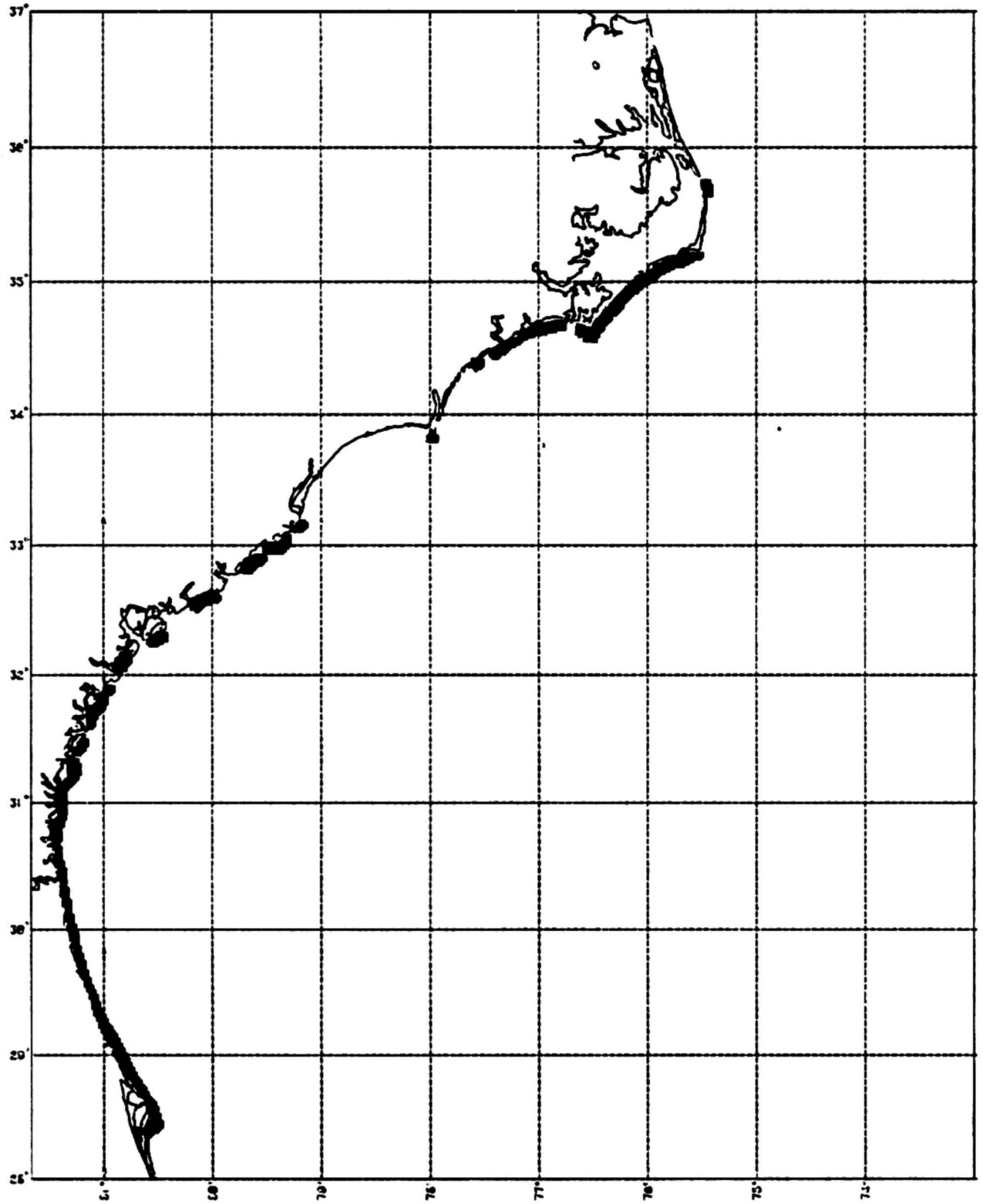

Figure A-2.--Map showing the location of marine turtle nesting habitat, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

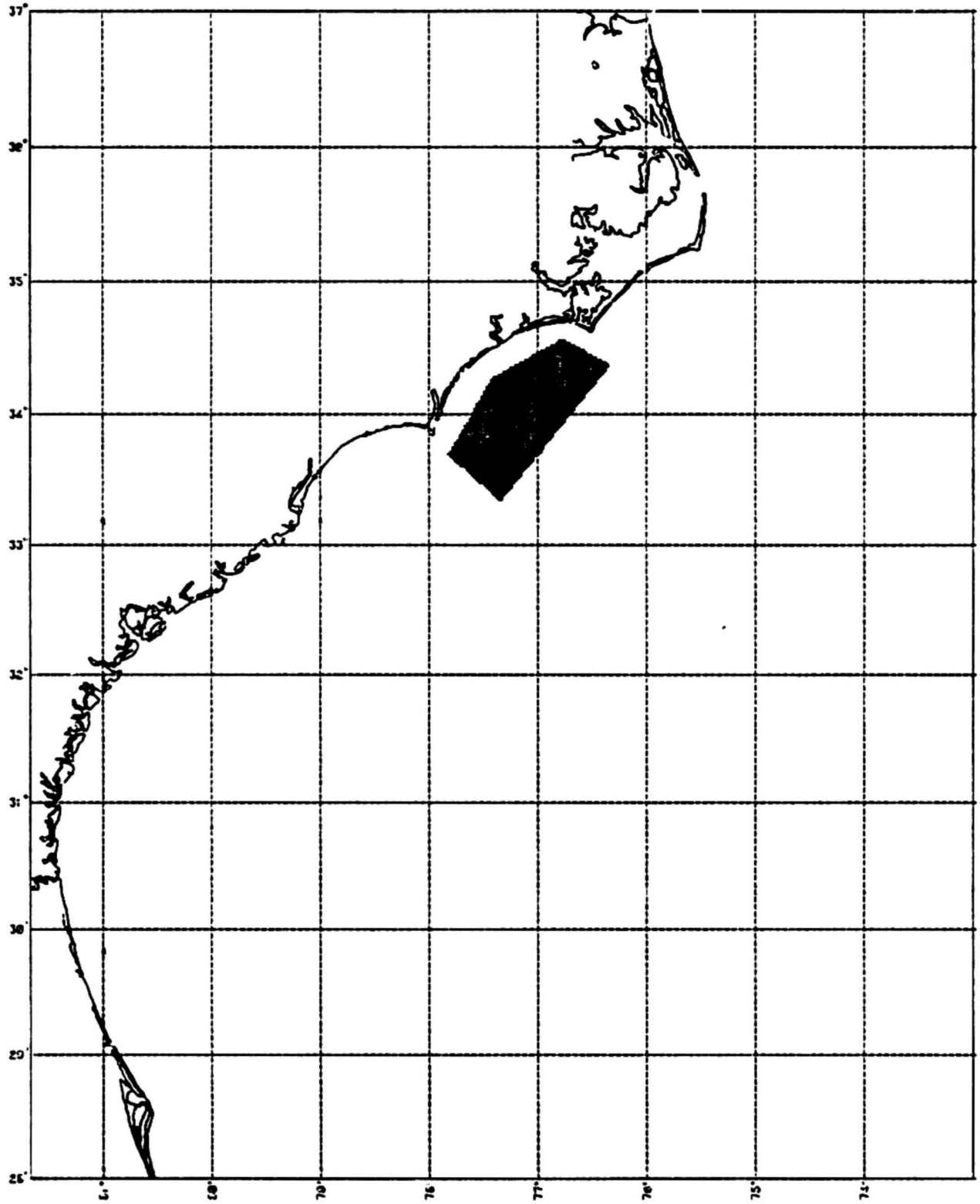

Figure A-3.--Map showing the location of Onslow Bay live bottom area, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

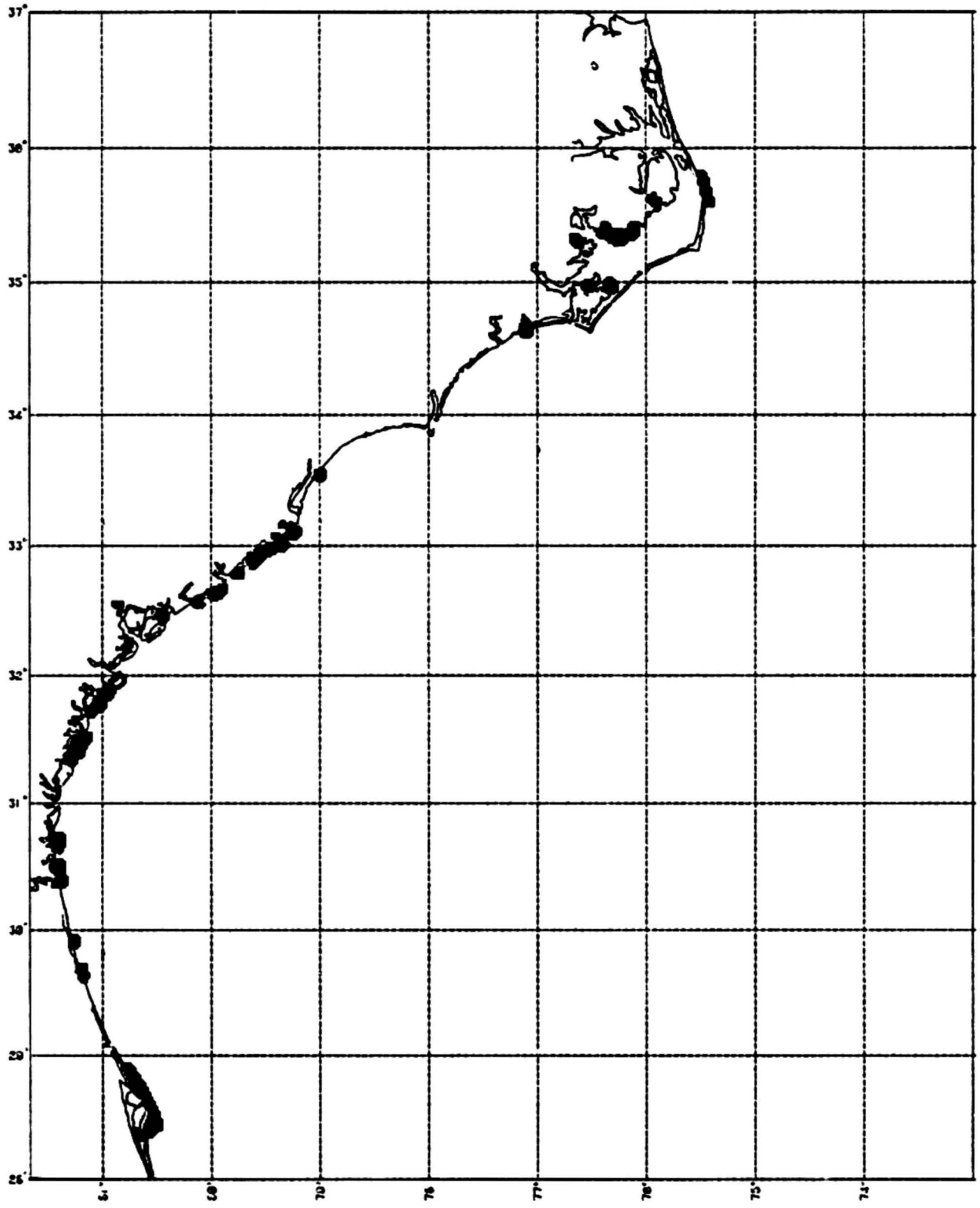

Figure A-4.--Map showing the location of Federal and State wildlife conservation areas, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

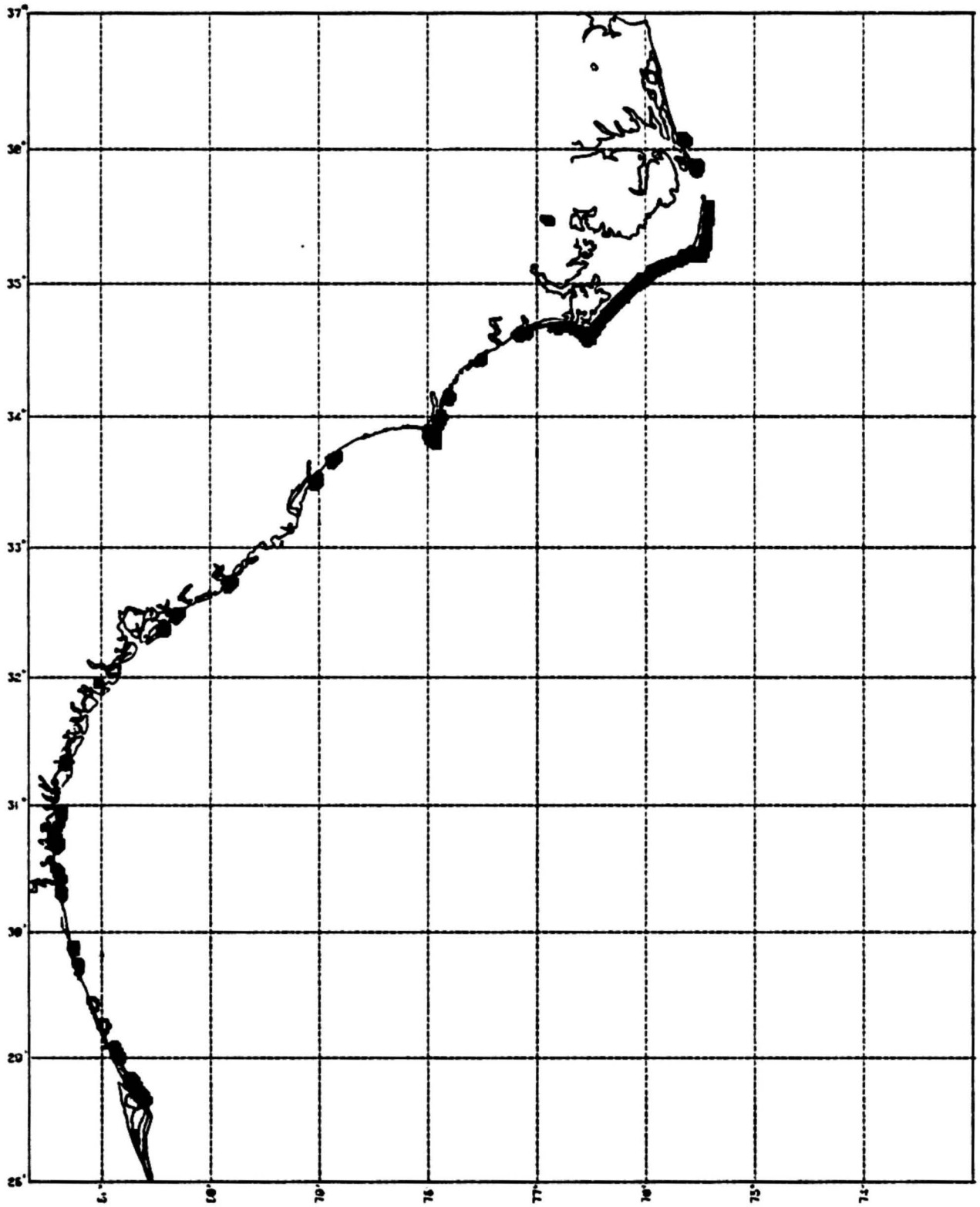

Figure A-5.--Map showing the location of Federal and State parks, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

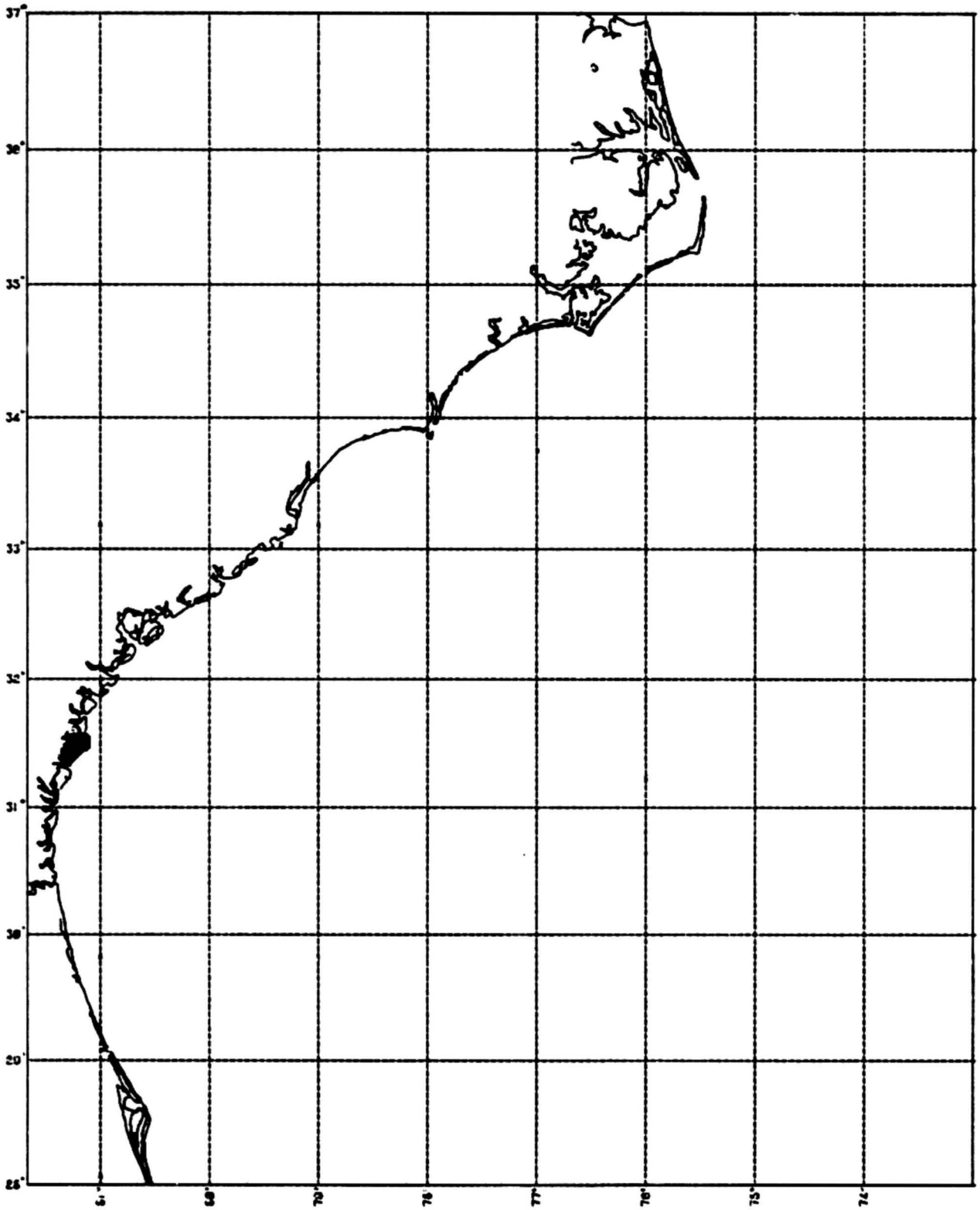

Figure A-6.--Map showing the location of Blackbeard Island, Sapelo Island, and Wolf Island, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

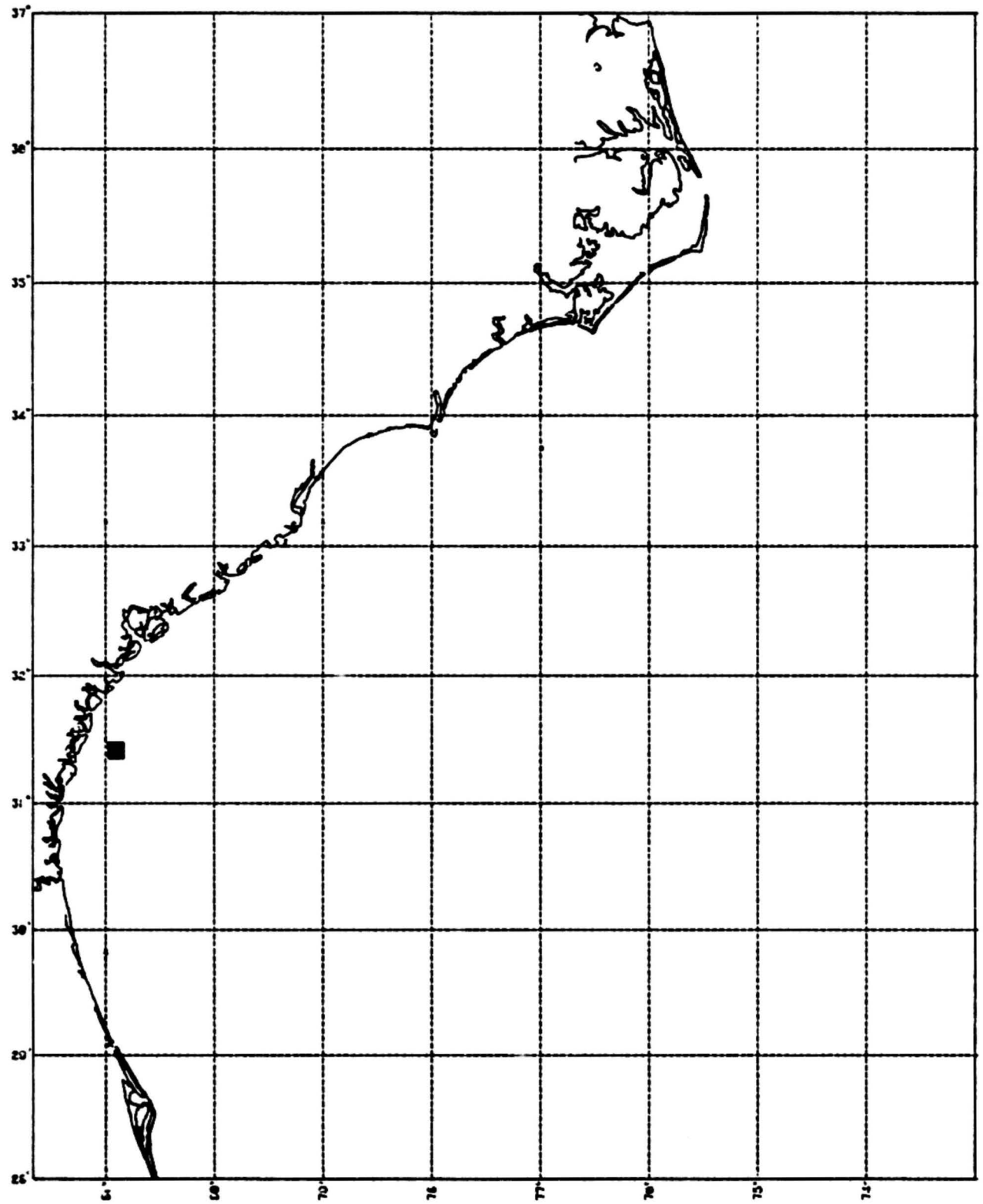

Figure A-7.--Map showing the location of Gray's Reef, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

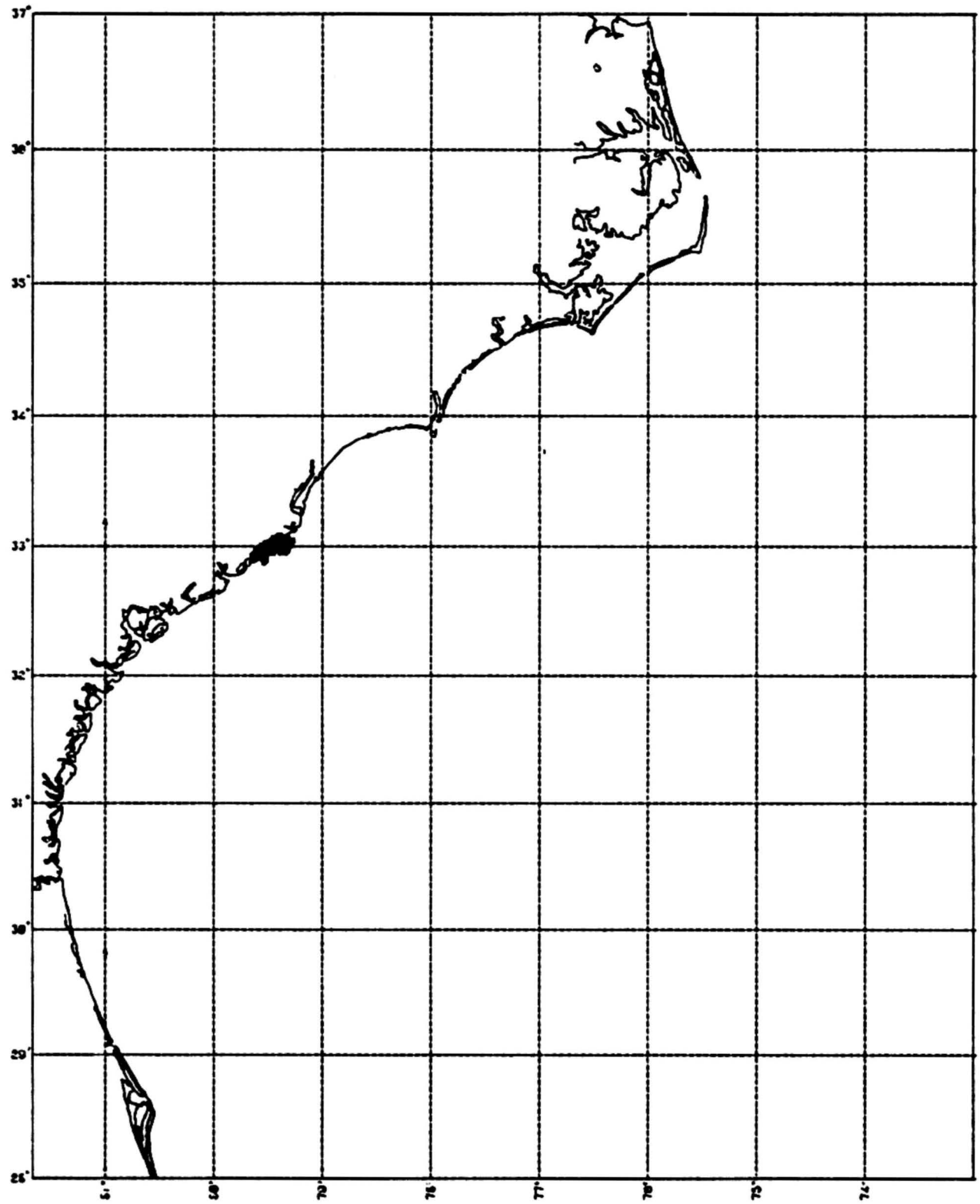

Figure A-8.--Map showing the location of Cape Romain national wilderness area, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

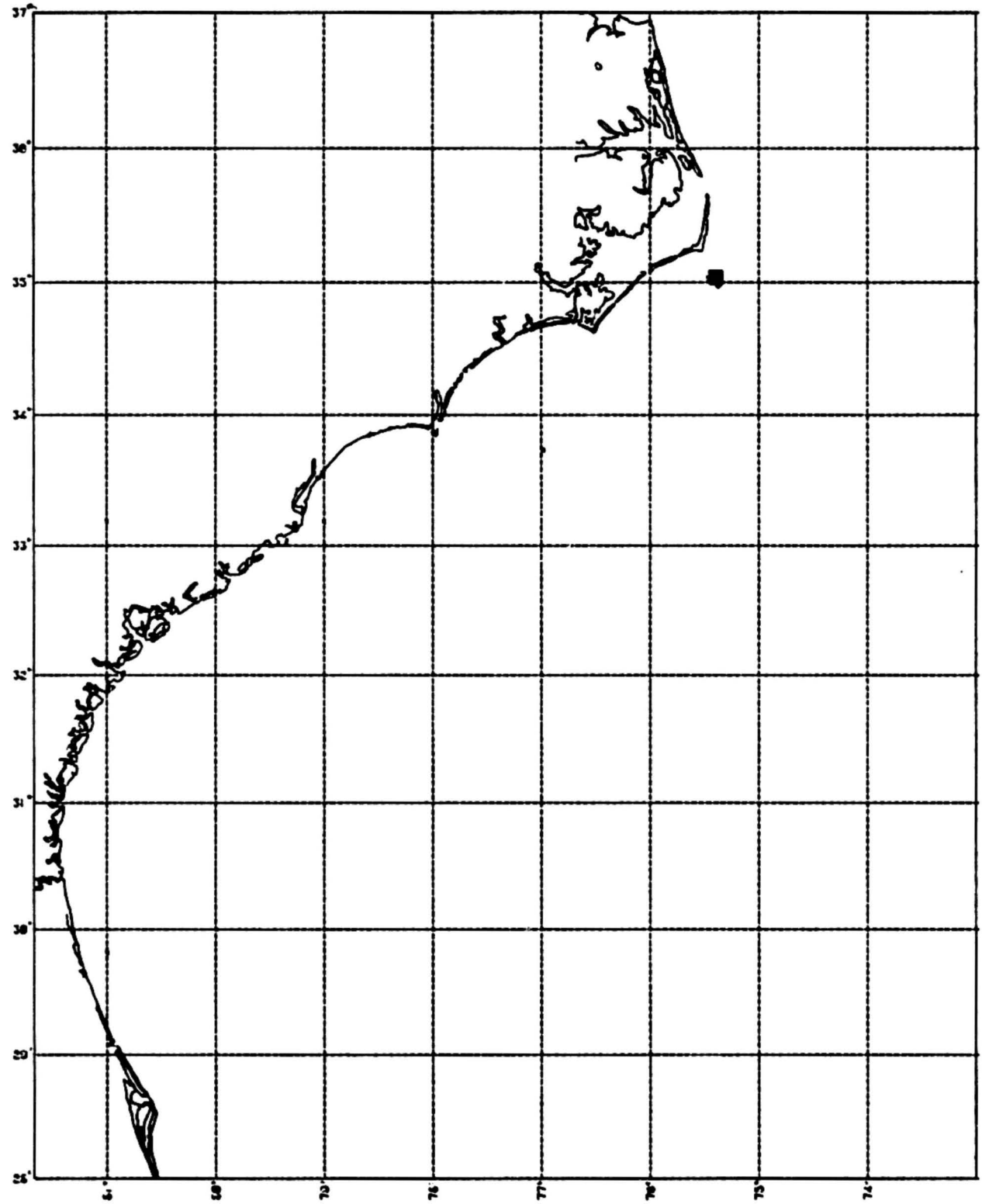

Figure A-9.--Map showing the location of Monitor marine sanctuary, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

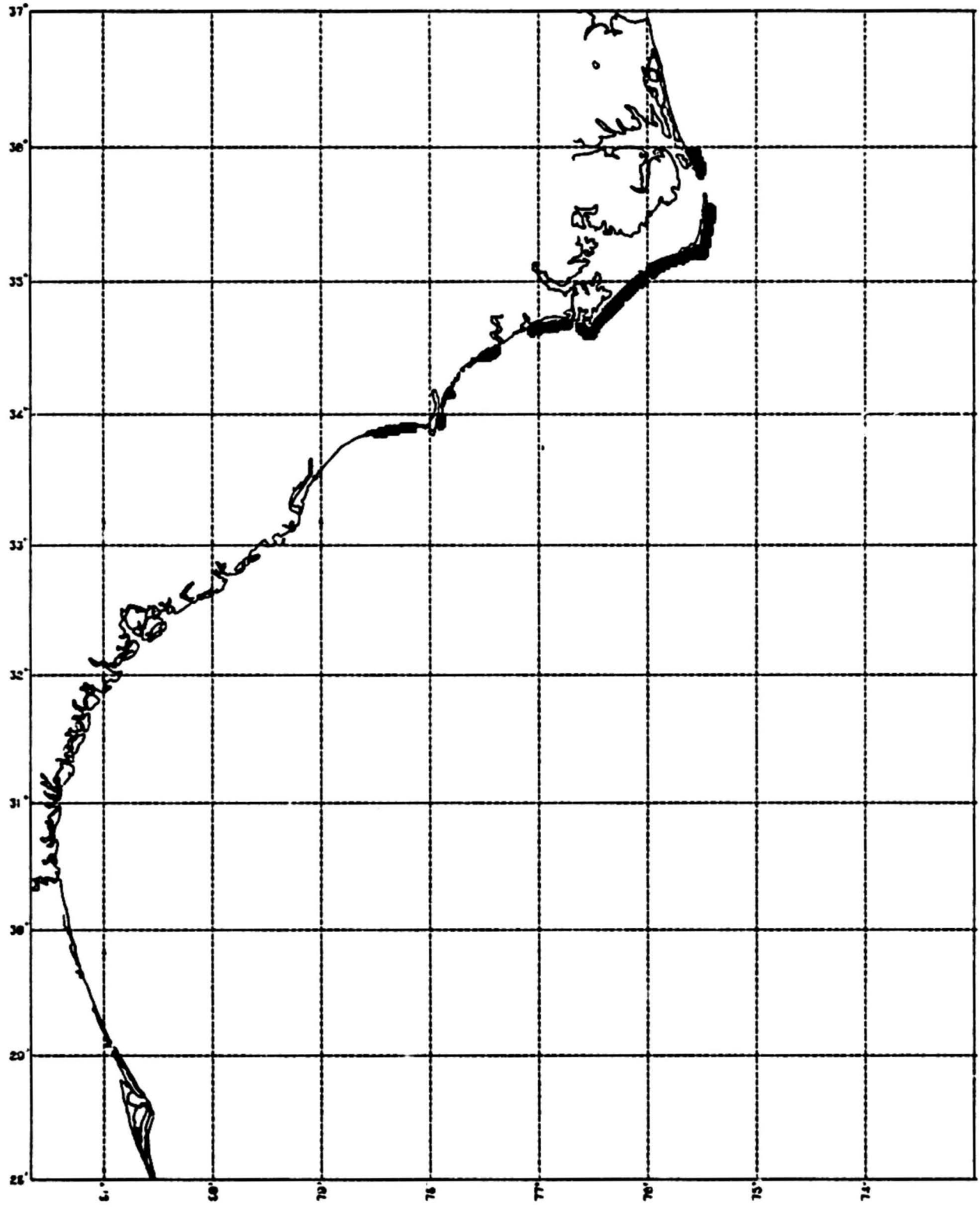

Figure A-10.--Map showing the location of tourist beaches-North Carolina, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

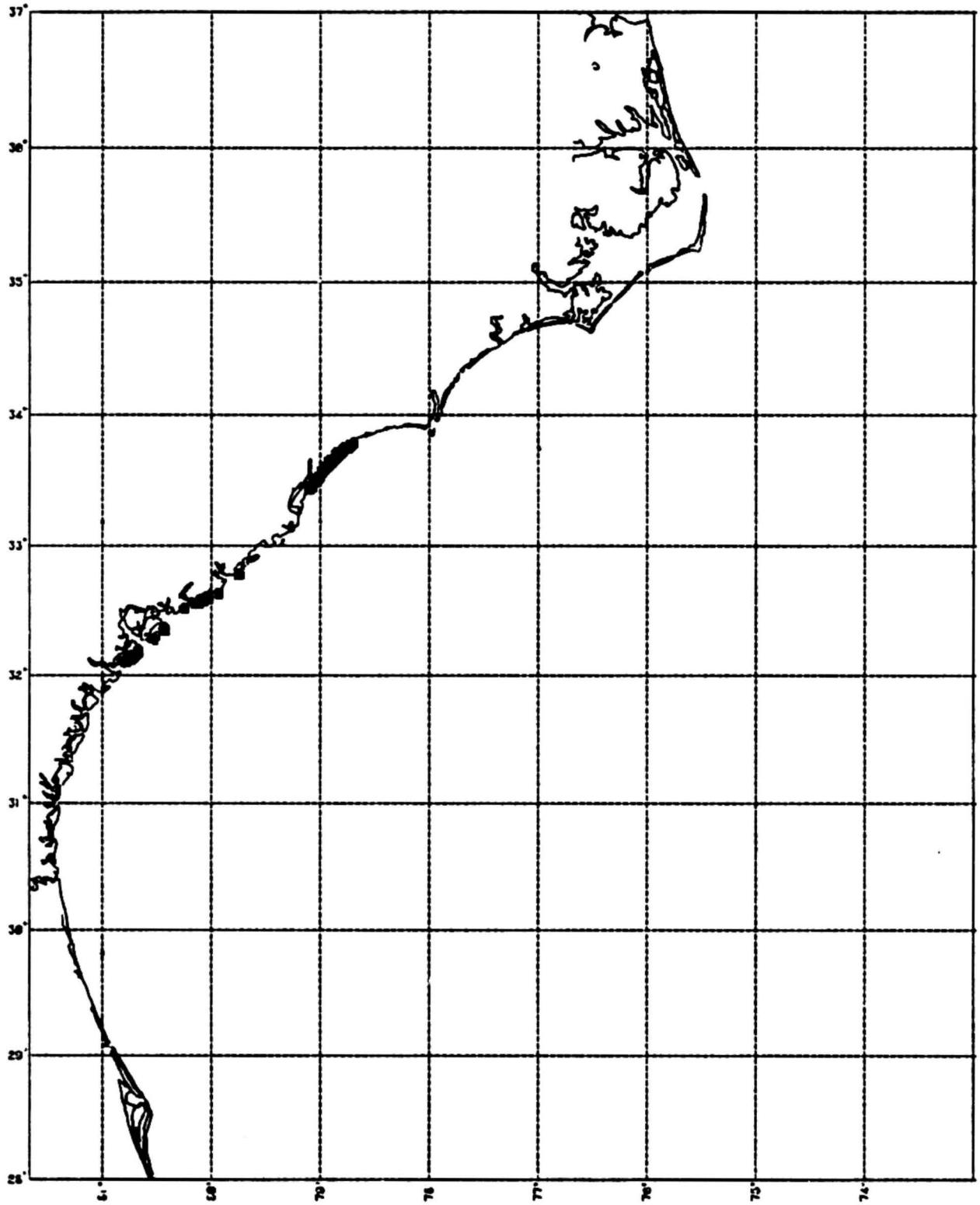

Figure A-11.--Map showing the location of tourist beaches-South Carolina, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

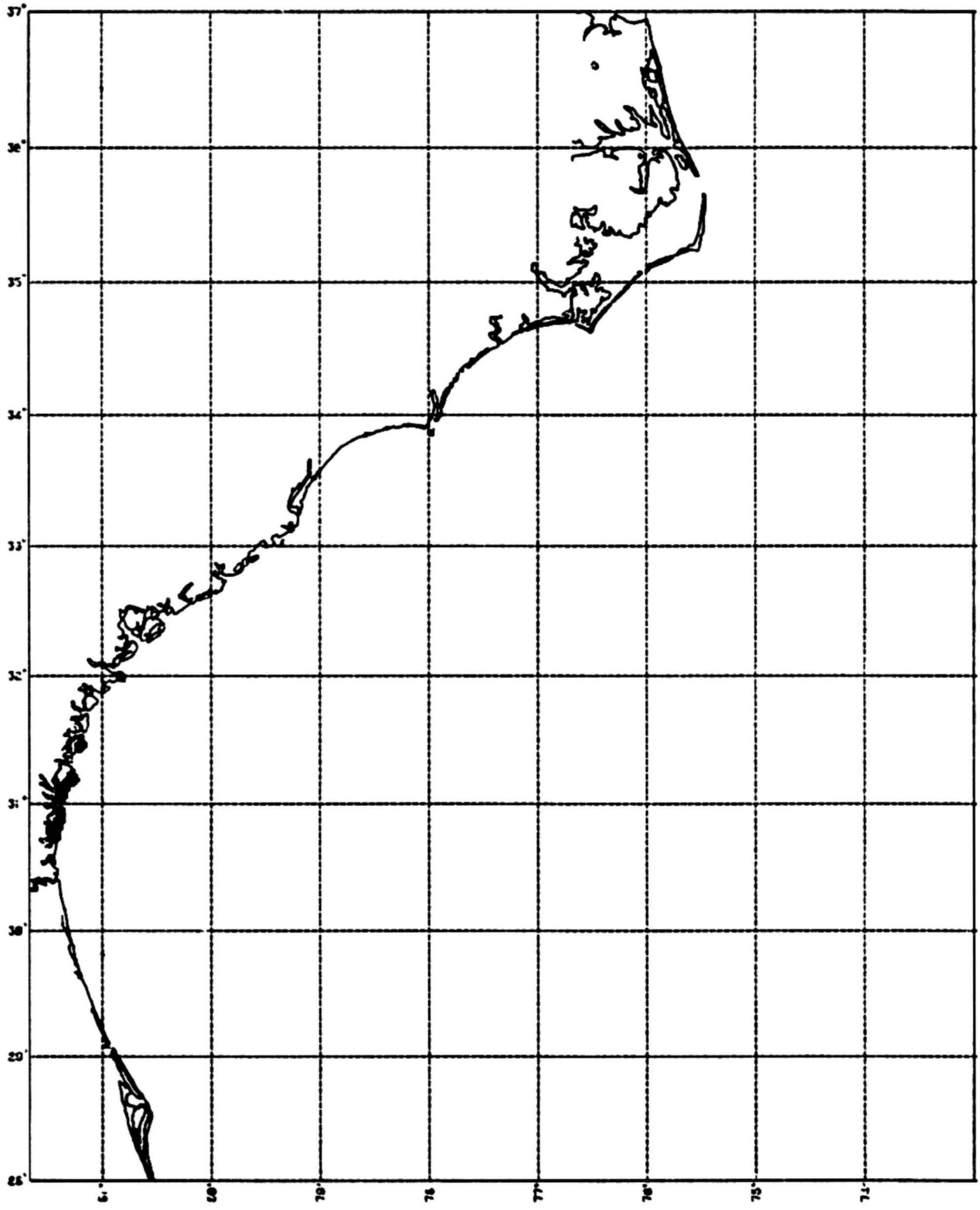

Figure A-12.--Map showing the location of tourist beaches-Georgia, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

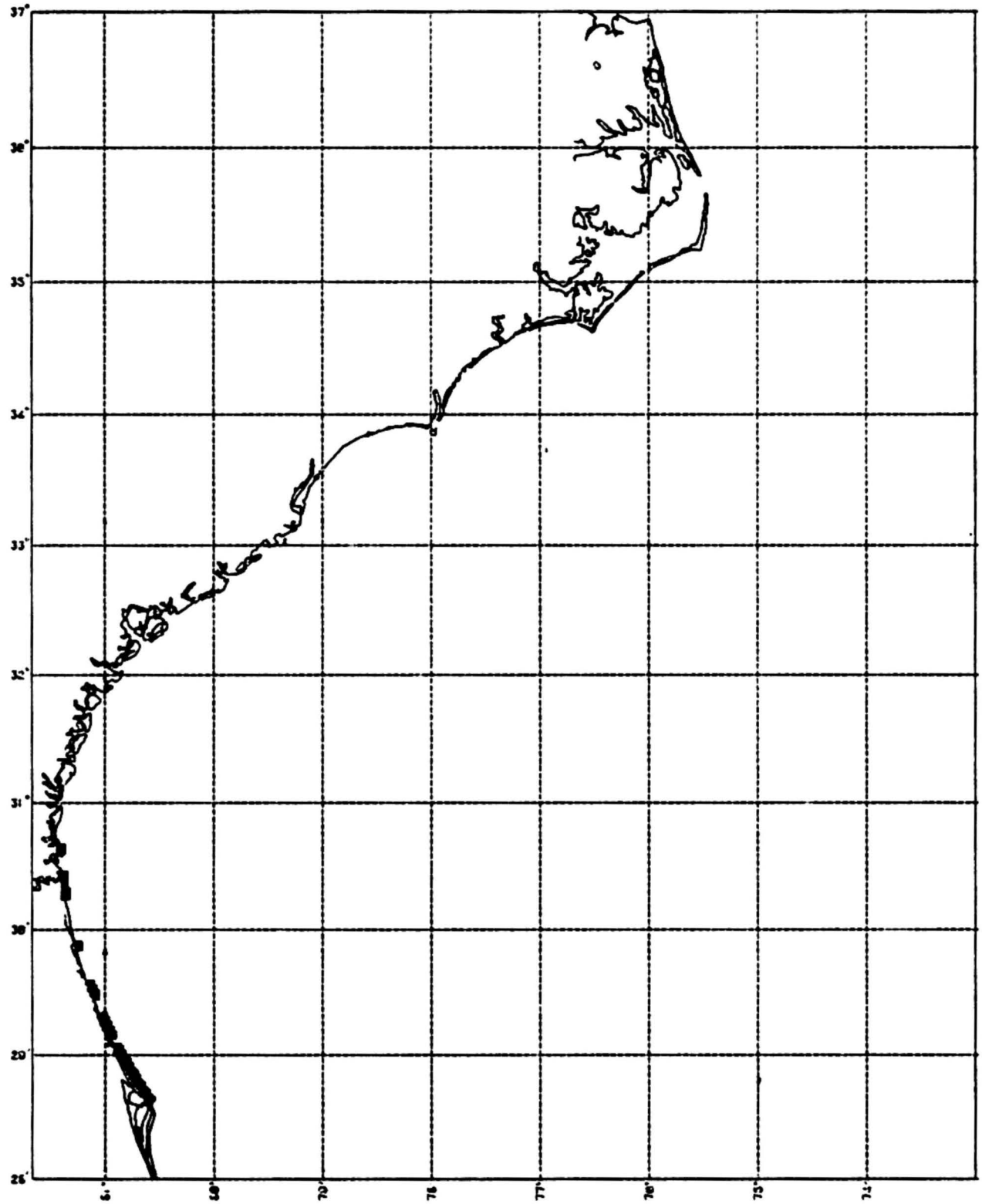

Figure A-13.--Map showing the location of tourist beaches-Florida, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

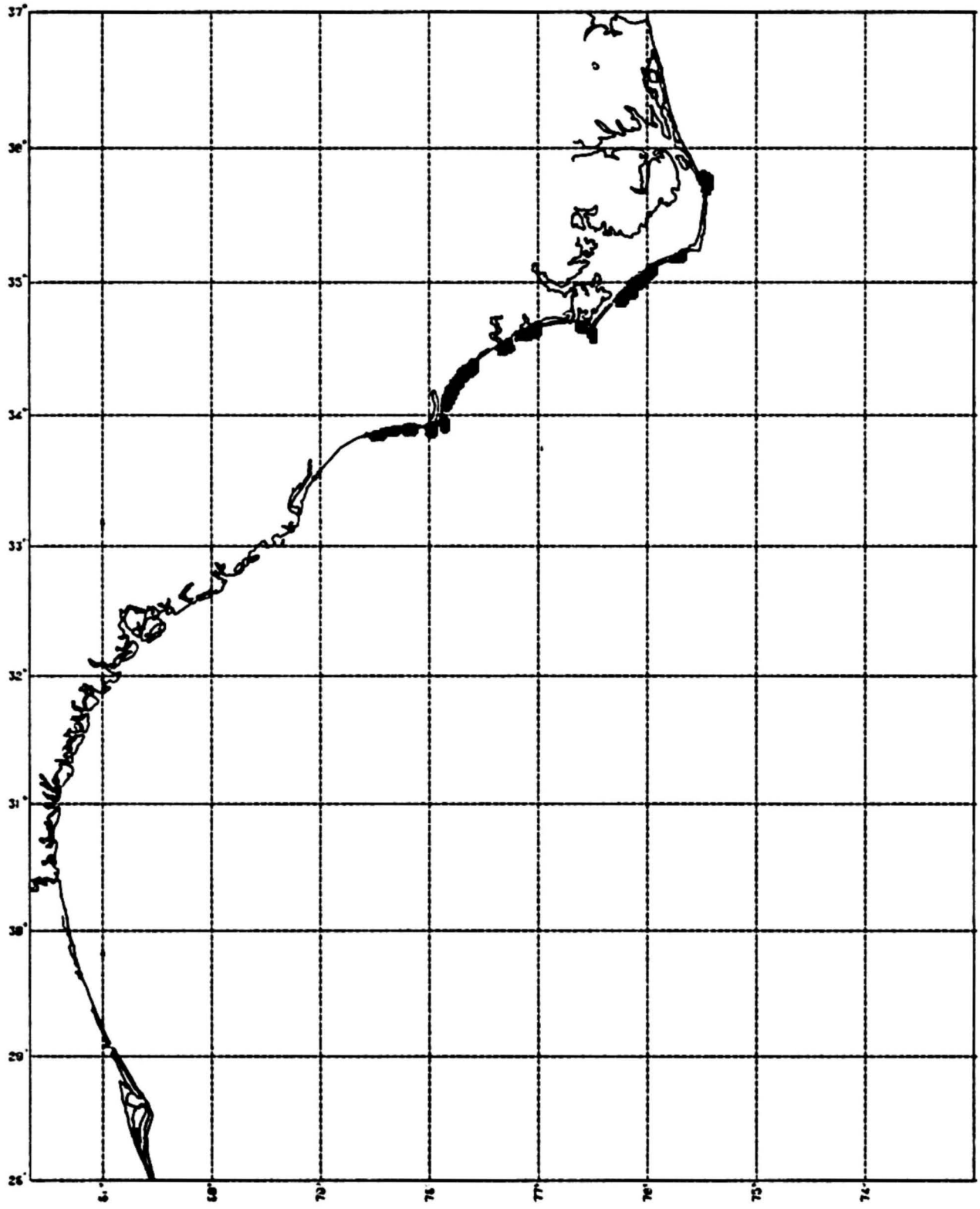

Figure A-14.--Map showing the location of coastal inlets-North Carolina, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

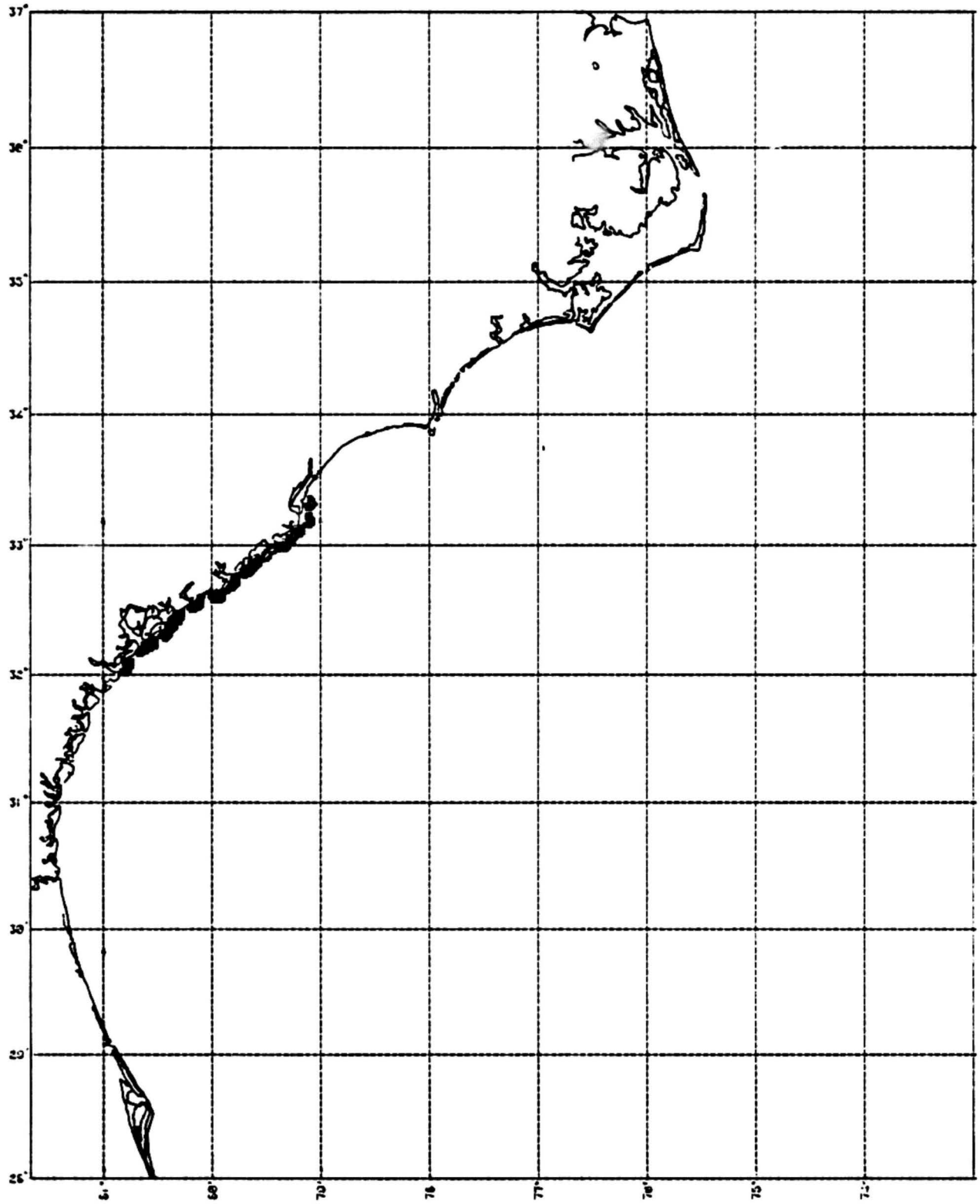

Figure A-15.--Map showing the location of coastal inlets-South Carolina, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

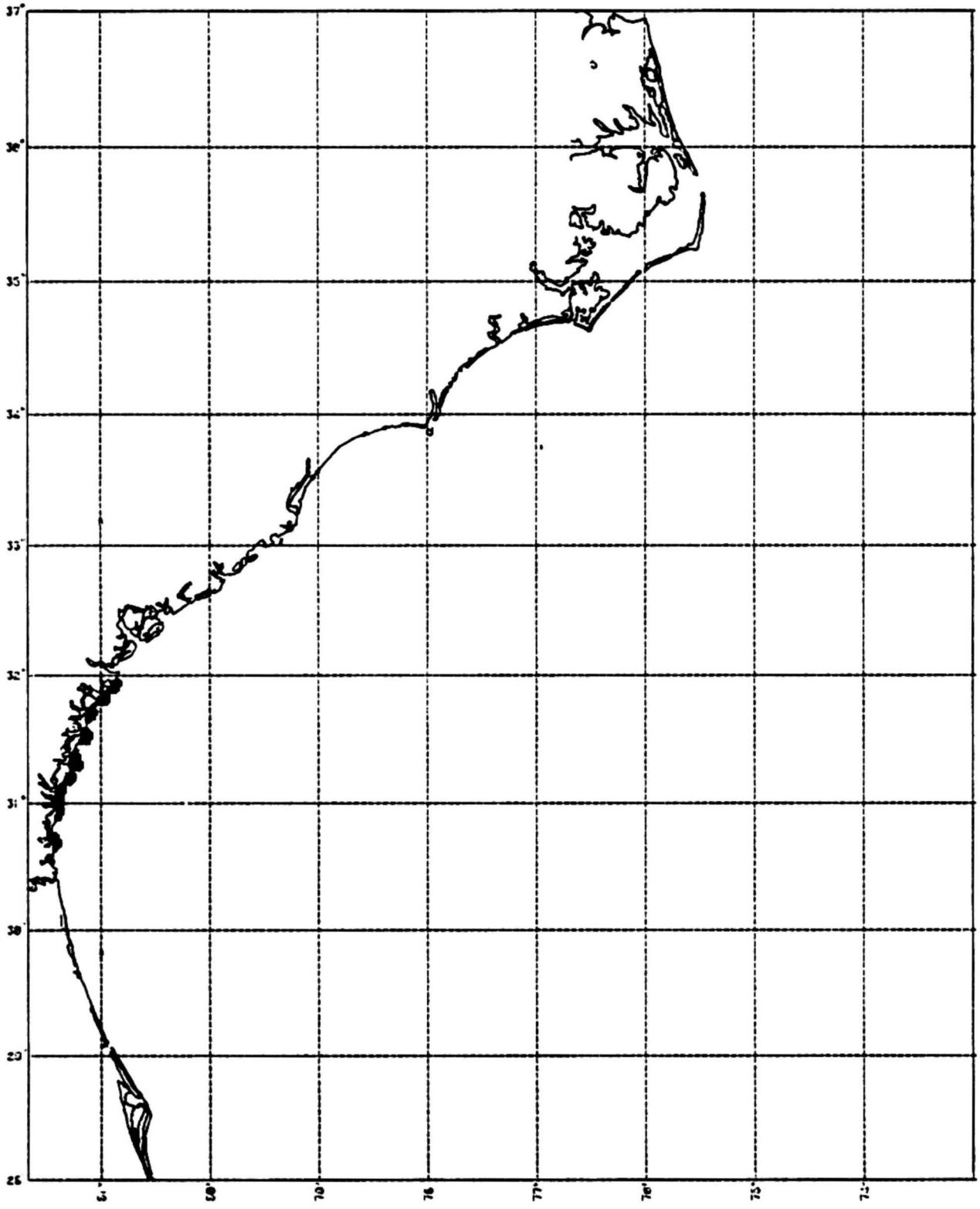

Figure A-16.--Map showing the location of coastal inlets-Georgia, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

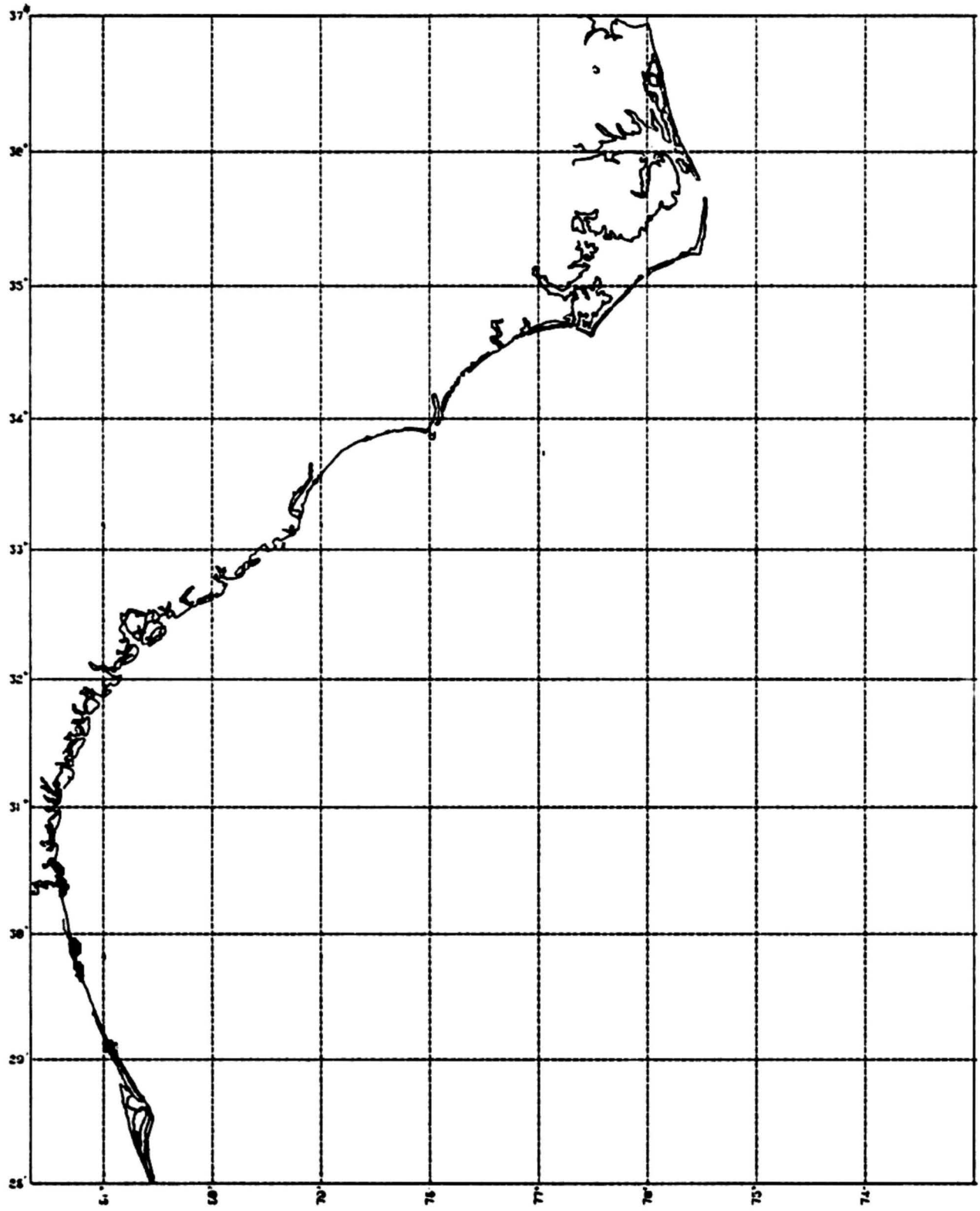

Figure A-17.--Map showing the location of coastal inlets-Florida, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

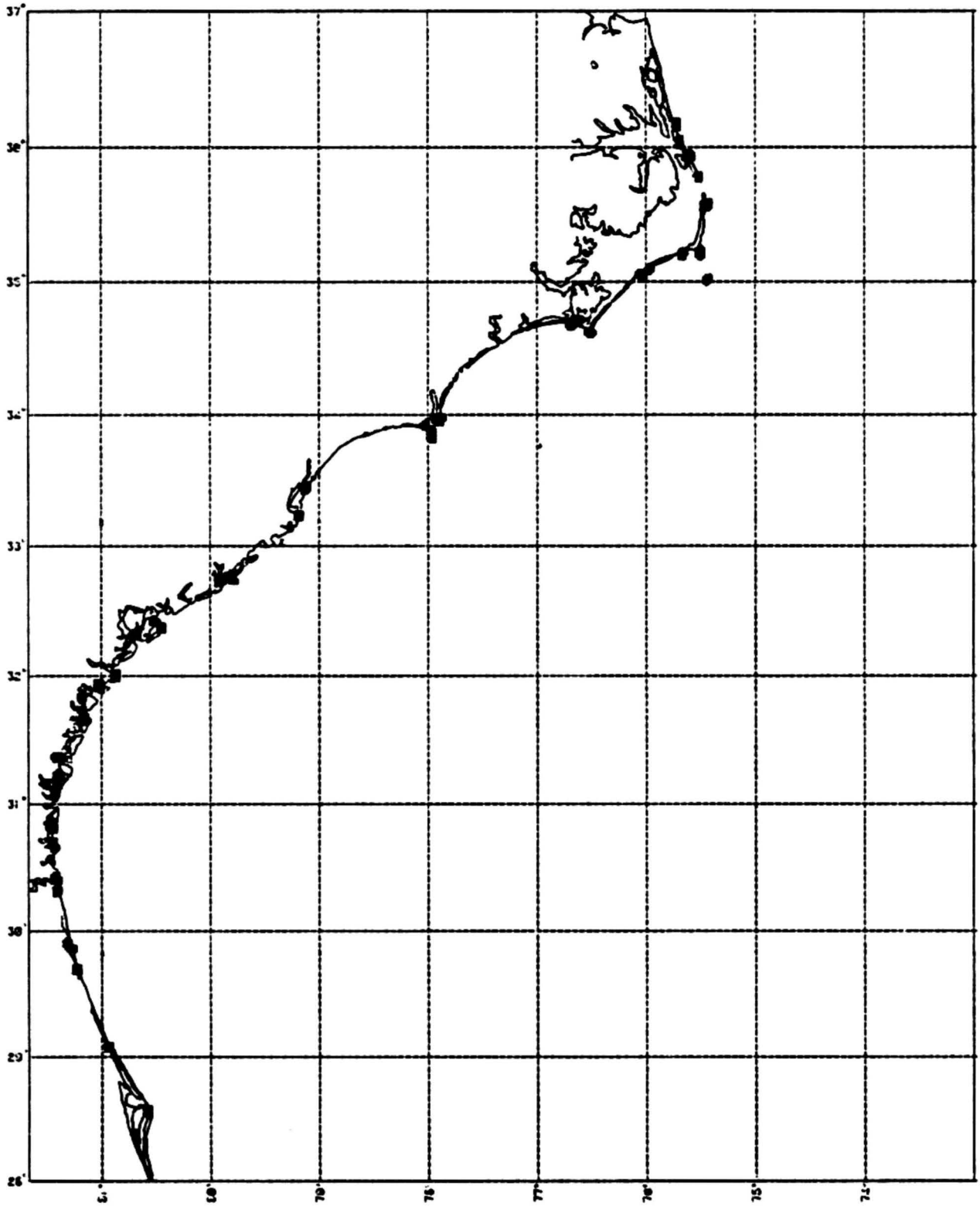

Figure A-18.--Map showing the location of historic sites, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

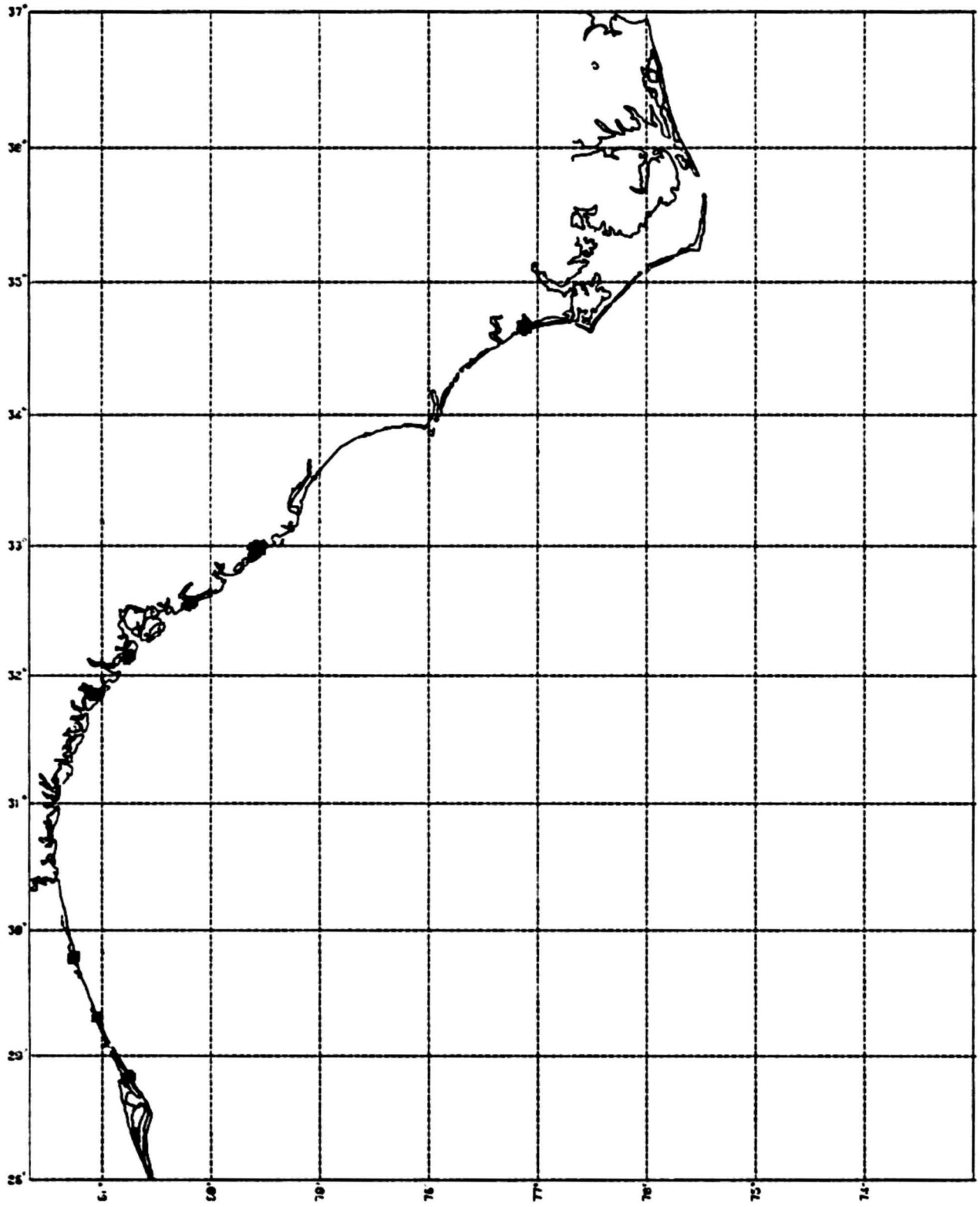

Figure A-19.--Map showing the location of prehistoric sites, South Atlantic OCS Lease Sale 56: crosshatching indicates areal extent.

Appendix B

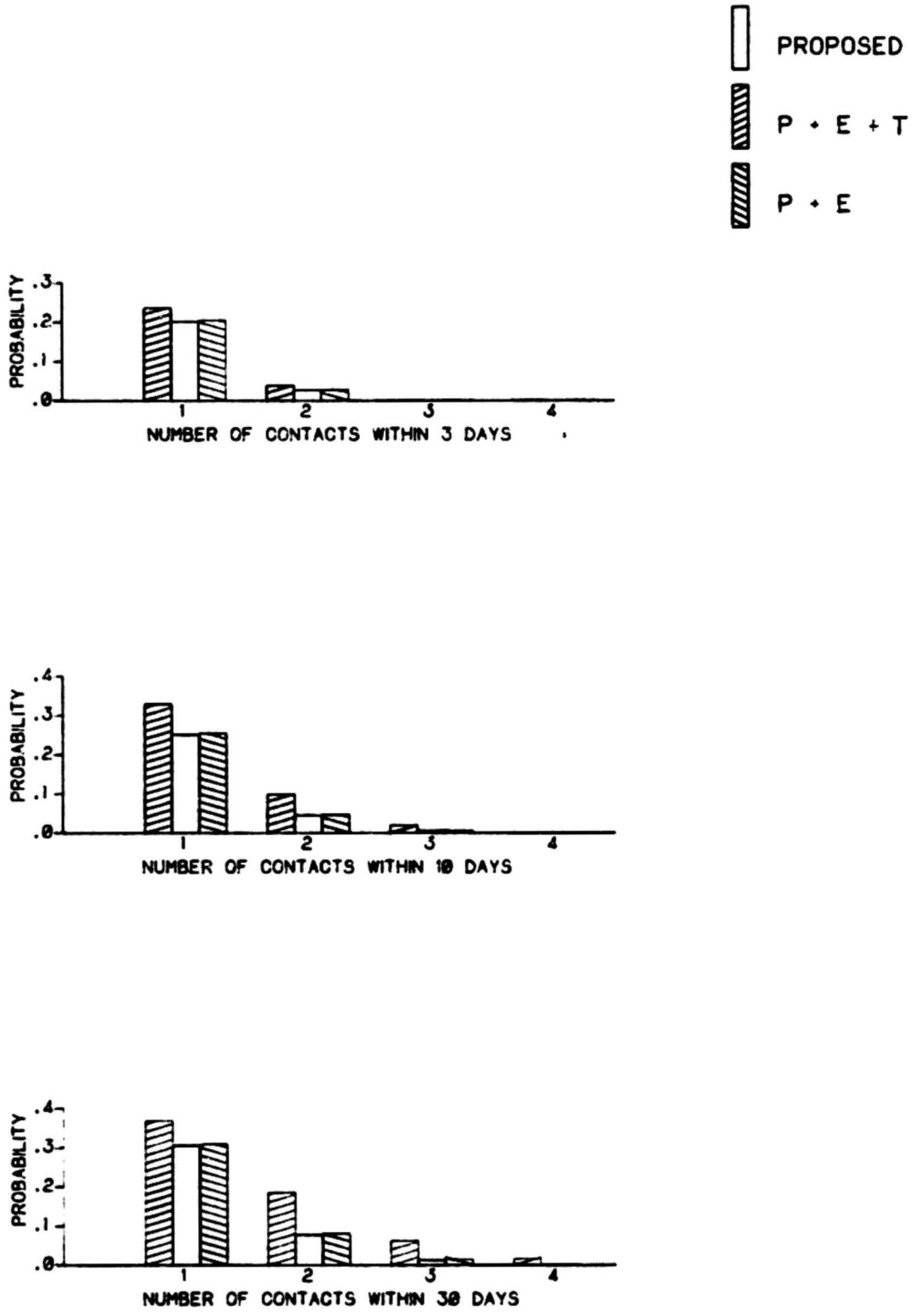

Figure B-1.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting brown pelican rookeries as as result of OCS Sale 56 (P), OCS Sales 56 and 43 (P & E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

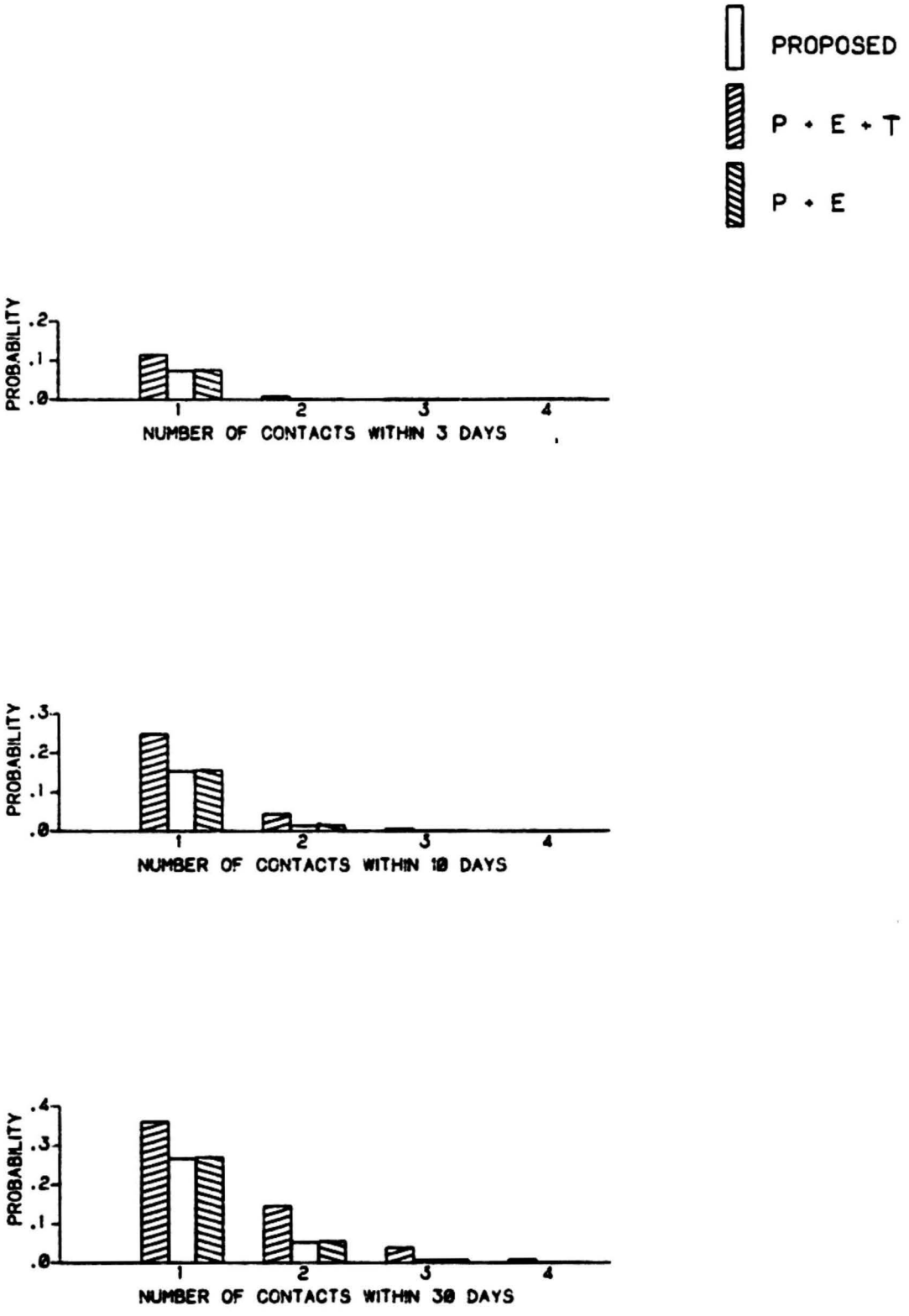

Figure B-2.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting marine turtle nesting habitat as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

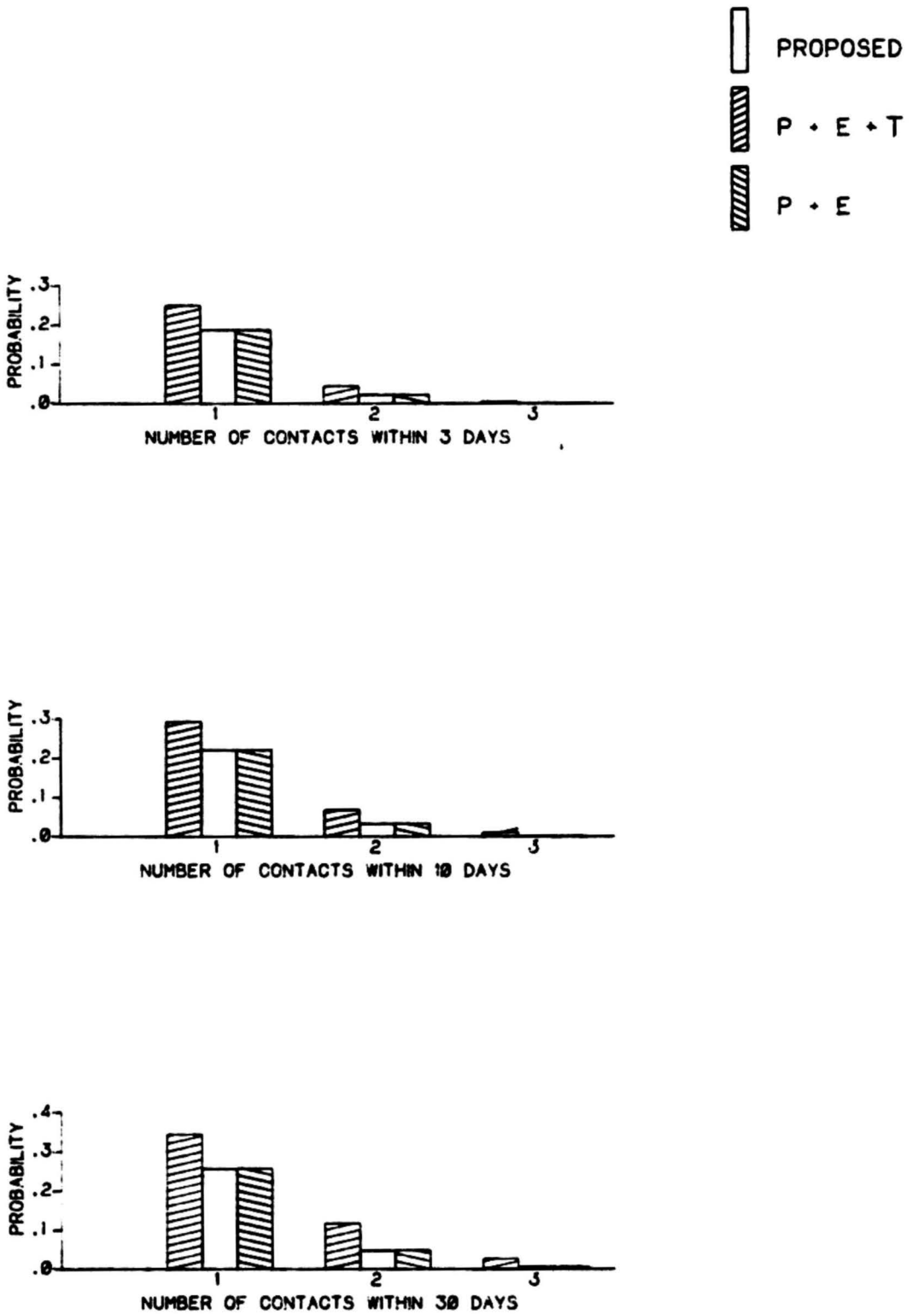

Figure B-3.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting the Onslow Bay live bottom area as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

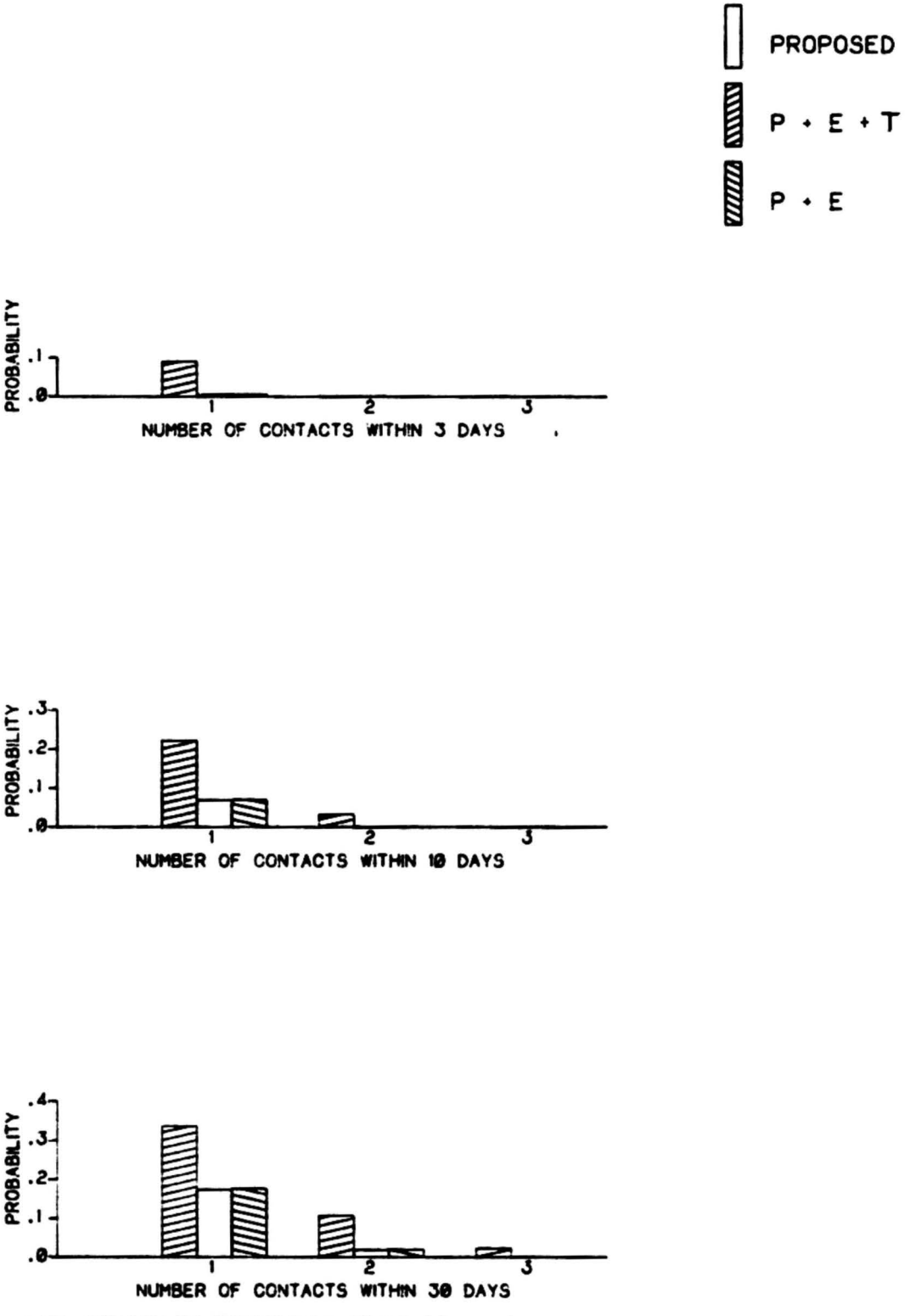

Figure B-4.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting Federal and State wildlife conservation areas as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

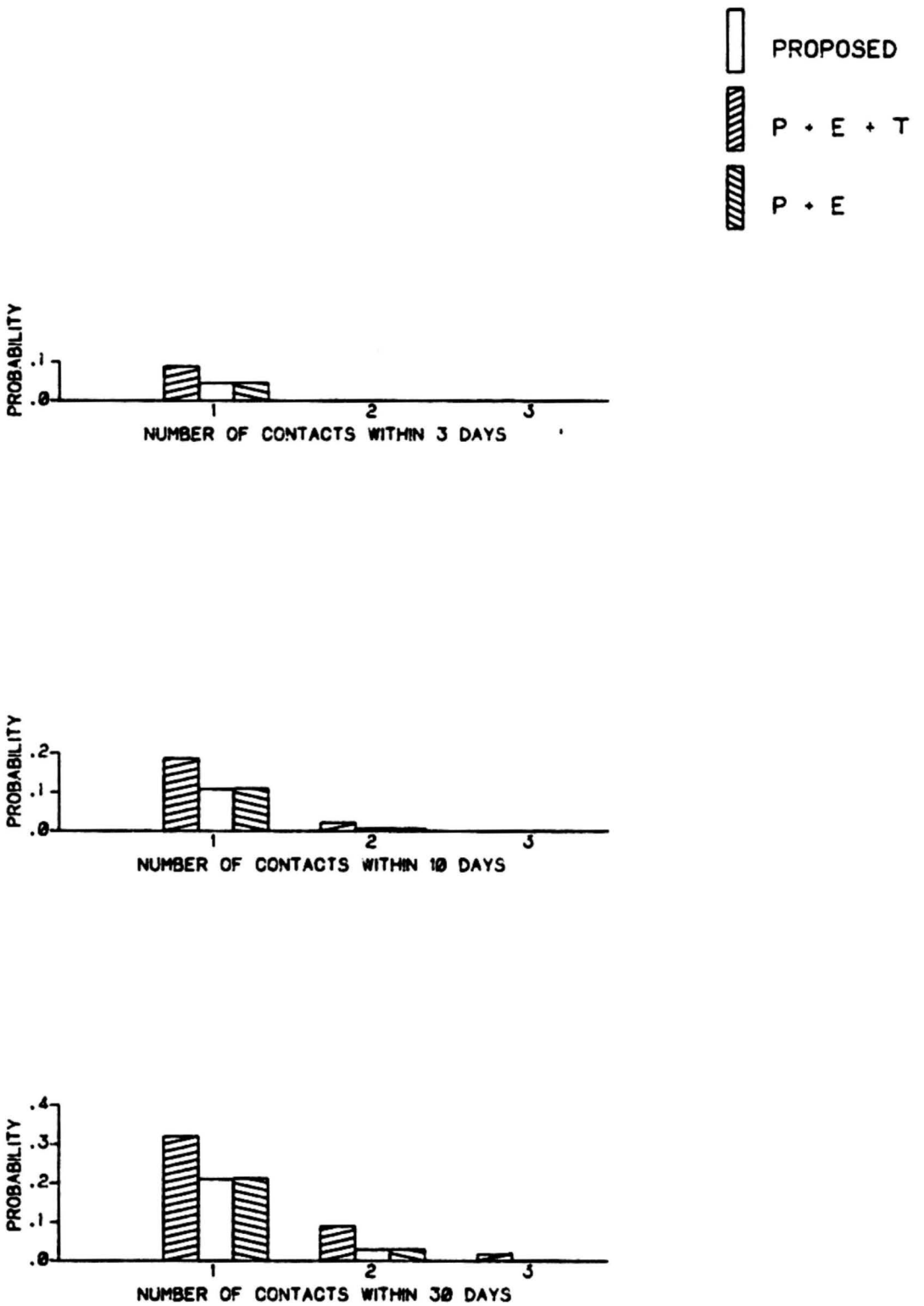

Figure B-5.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting Federal and State parks from May through October as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

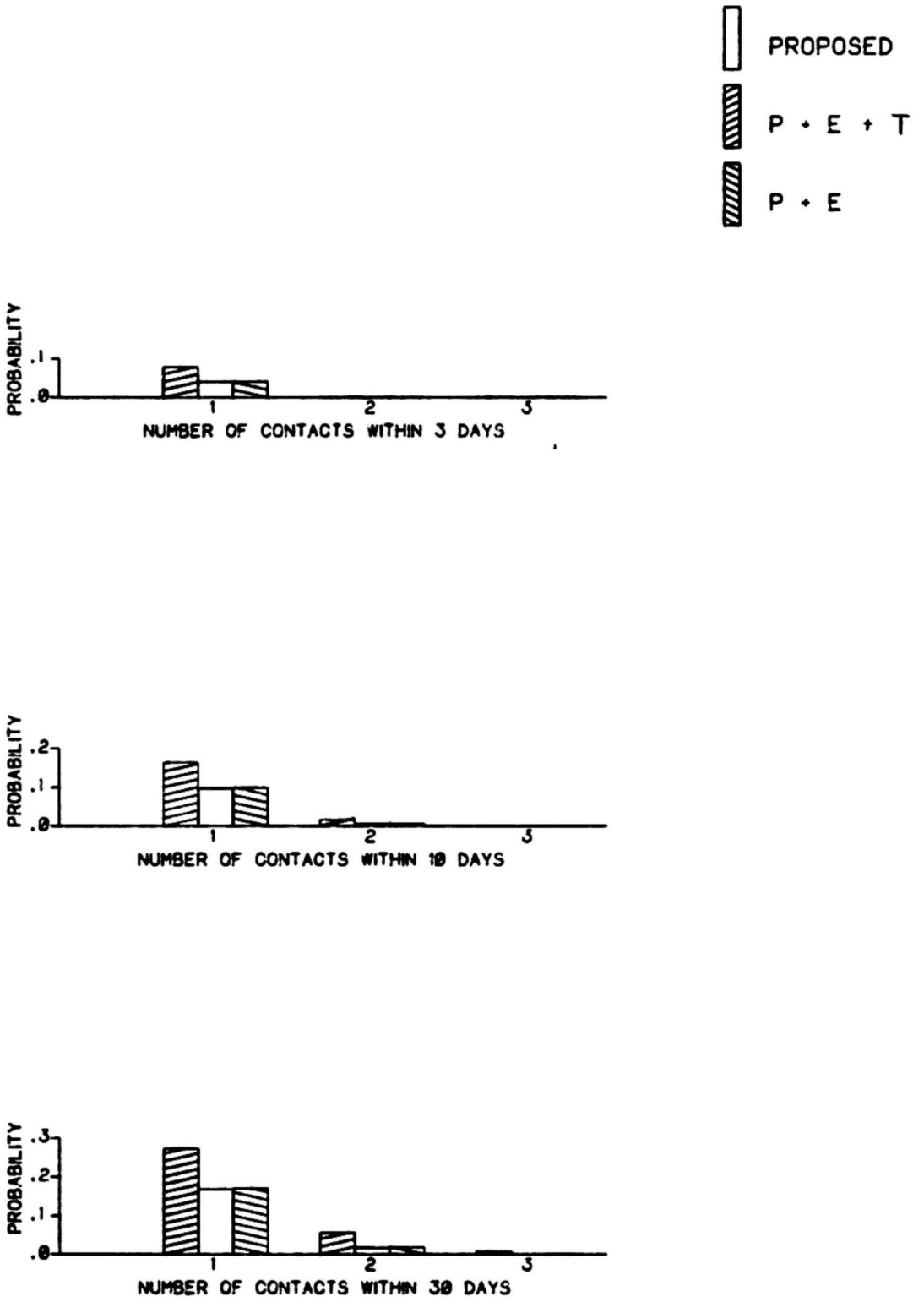

Figure B-6.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting Federal and State parks from November through April as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

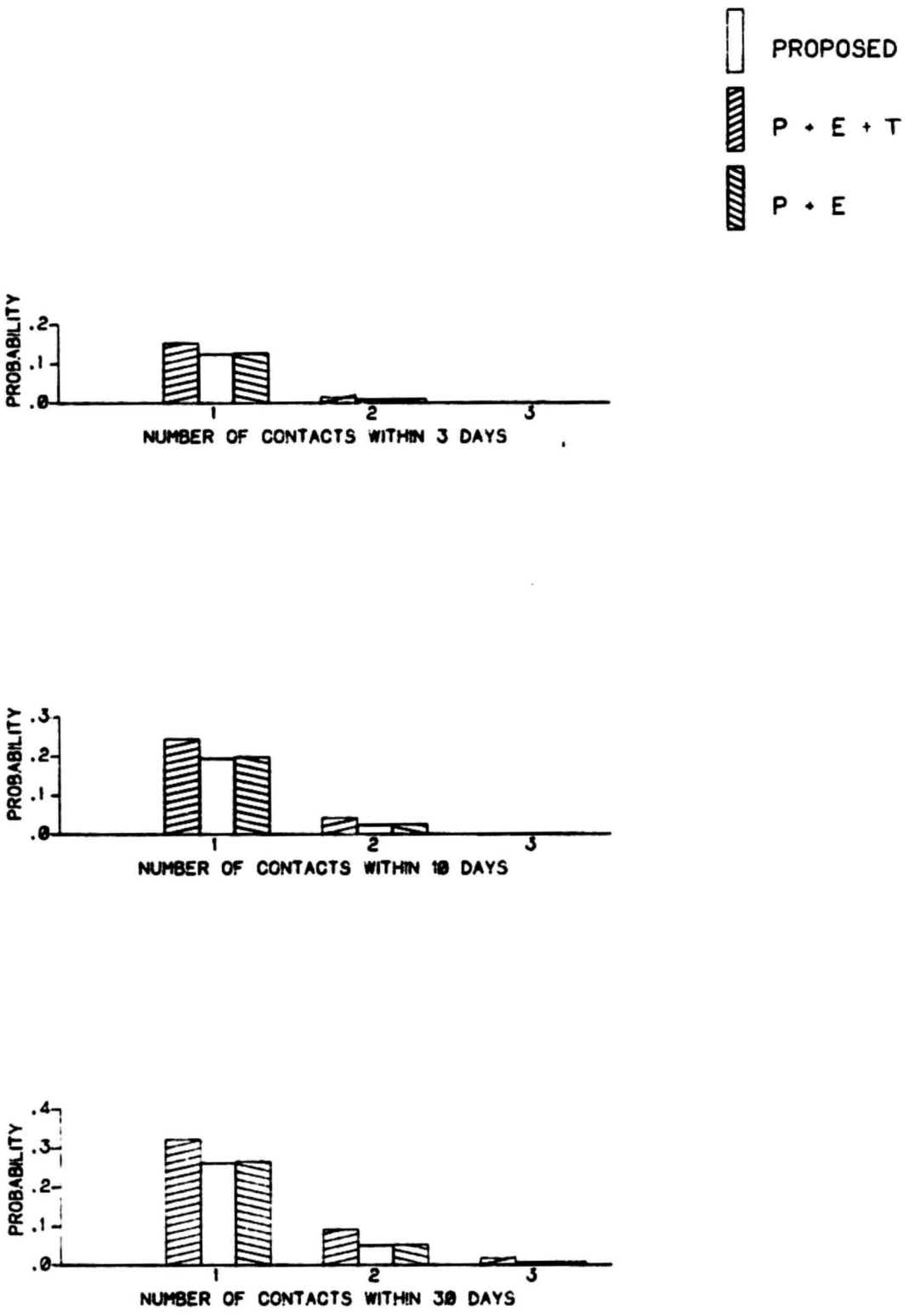

Figure B-7.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting coastal inlets of Georgia as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

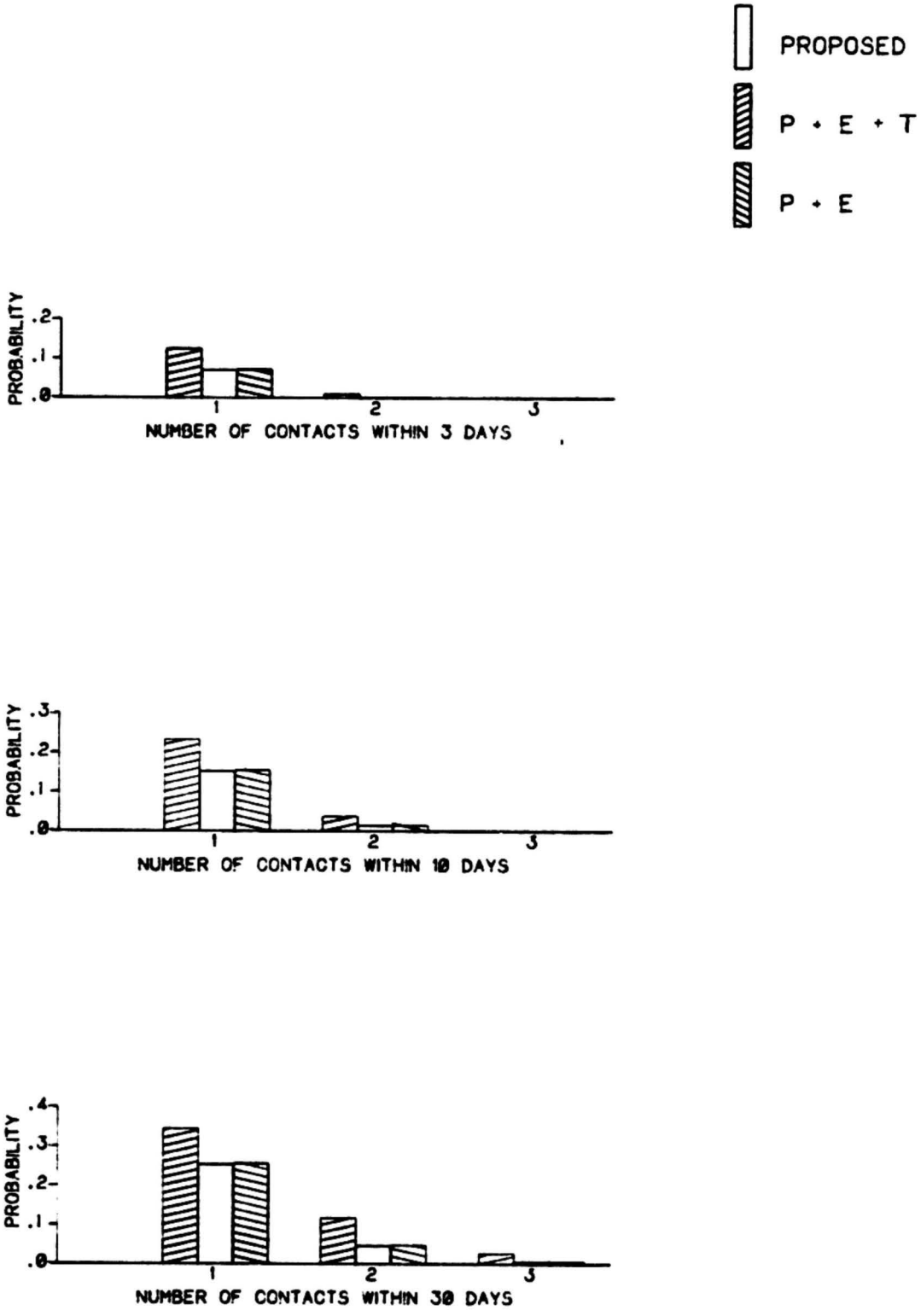

Figure B-8.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting historic sites as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

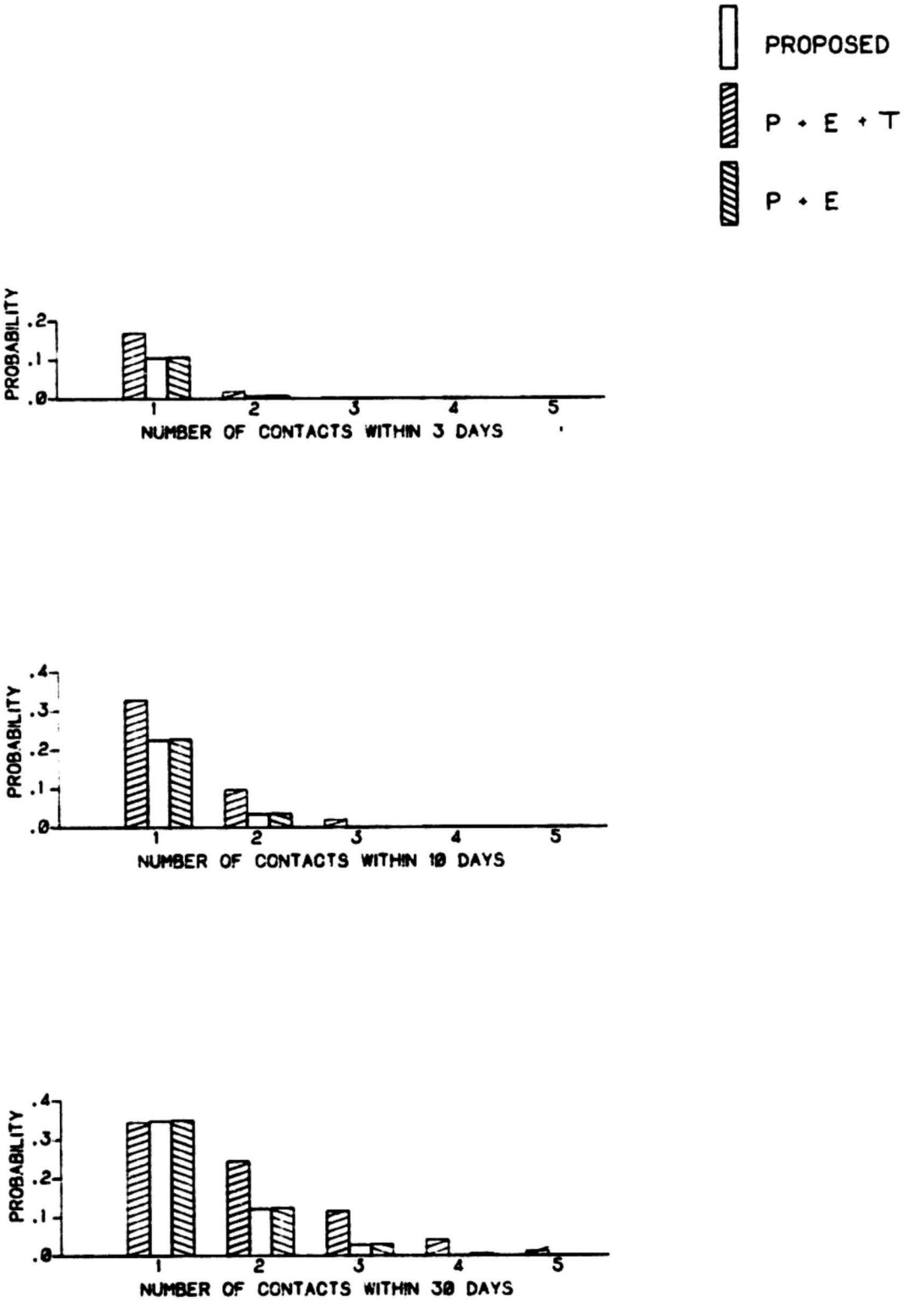

Figure B-9.--Histograms showing the probabilities of specific numbers of oilspills occurring and contacting land as a result of OCS Sale 56 (P), OCS Sales 56 and 43 (P&E), and OCS Sales 56 and 43 with existing tanker transportation (P&E&T).

Appendix C

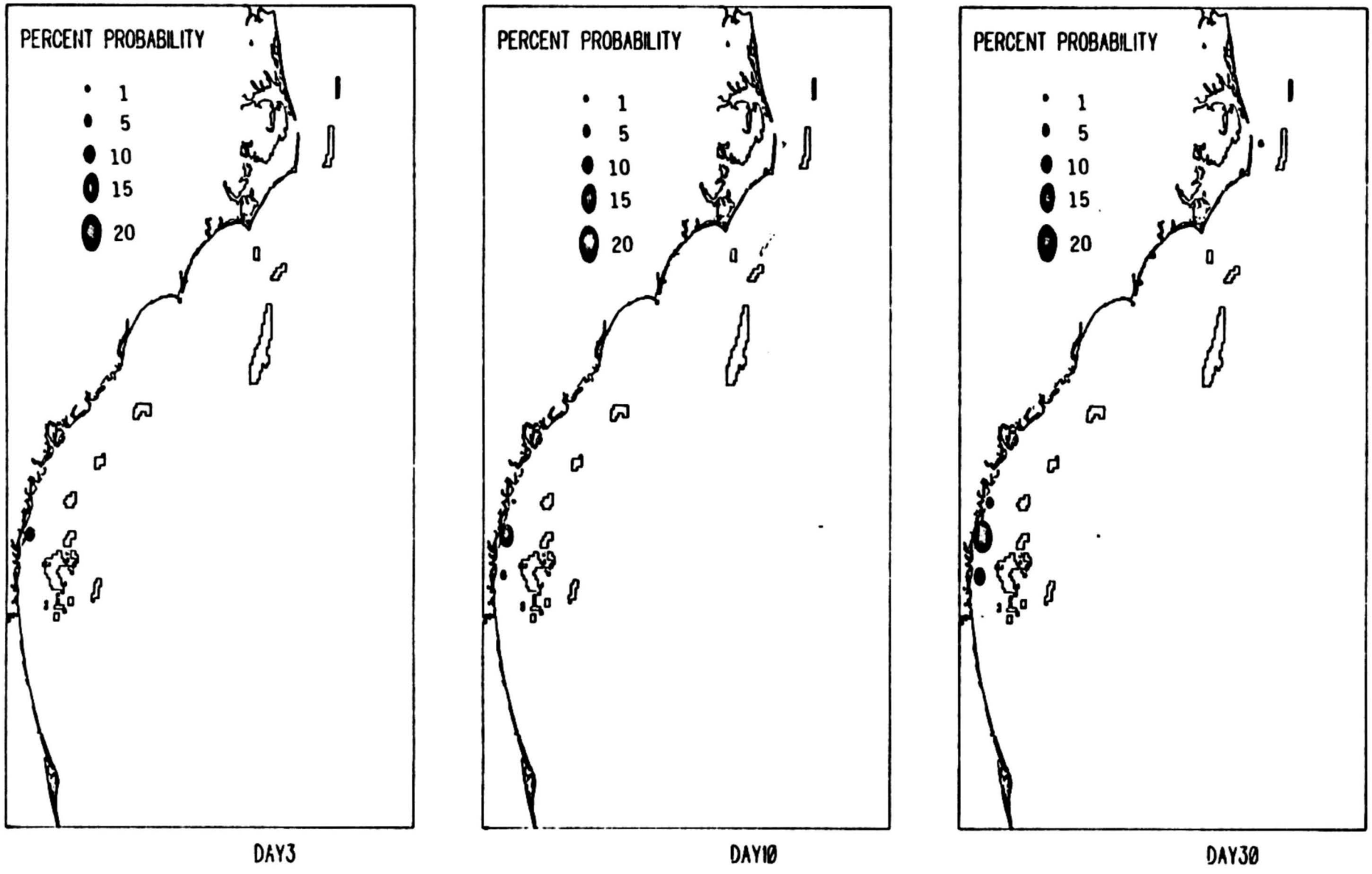

Figure C-1.--Maps showing the probability (percent chance) of one or more spills occurring and contacting sections of the coastline (set 1) for 3, 10, and 30 day travel times.

Appendix D

Table D-1.-- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting targets over the production life of the lease area and for existing tanker transportation.

Target	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing, Proposed and, Tankering			Proposed			Existing Proposed and, Tankering			Proposed			Existing, Proposed and, Tankering		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
Land	11	0	0.1	19	0	0.2	26	0	0.3	45	0	0.6	50	0	0.7	76	1	1.4
Brown Pelican	23	0	0.3	28	0	0.3	30	0	0.4	45	0	0.6	40	0	0.5	63	1	1.0
Marine Turtle	8	0	0.1	12	0	0.1	17	0	0.2	30	0	0.4	33	0	0.4	55	0	0.8
Onslow Bay Live Bot.	21	0	0.2	30	0	0.4	26	0	0.3	37	0	0.5	31	0	0.4	49	0	0.7
Wildlife Conser.	1	0	0.0	9	0	0.1	7	0	0.1	26	0	0.3	19	0	0.2	47	0	0.6
Parks (May-Oct)	5	0	0.0	9	0	0.1	11	0	0.1	21	0	0.2	24	0	0.3	43	0	0.6
Parks (Nov-Apr)	4	0	0.0	8	0	0.1	10	0	0.1	18	0	0.2	19	0	0.2	34	0	0.4
Blkbrd, Sapelo, Wolf	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0	4	0	0.0	6	0	0.1
Gray's Reef	1	0	0.0	3	0	0.0	6	0	0.1	10	0	0.1	10	0	0.1	16	0	0.2
Cape Romain Wild.	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0
Monitor	1	0	0.0	2	0	0.0	5	0	0.1	8	0	0.1	10	0	0.1	18	0	0.2
Tourist Beaches, NC	1	0	0.0	2	0	0.0	4	0	0.0	6	0	0.1	12	0	0.1	19	0	0.2
Tourist Beaches, SC	n	0	0.0	1	0	0.0	n	0	0.0	1	0	0.0	3	0	0.0	7	0	0.1
Tourist Beaches, GA	8	0	0.1	9	0	0.1	13	0	0.1	16	0	0.2	19	0	0.2	26	0	0.3
Tourist Beaches, FL	n	0	0.0	4	0	0.0	1	0	0.0	10	0	0.1	3	0	0.0	18	0	0.2
Coastal Inlets, NC	4	0	0.0	5	0	0.1	7	0	0.1	11	0	0.1	16	0	0.2	26	0	0.3
Coastal Inlets, SC	n	0	0.0	2	0	0.0	1	0	0.0	5	0	0.0	7	0	0.1	17	0	0.2
Coastal Inlets, GA	13	0	0.1	17	0	0.2	22	0	0.2	29	0	0.3	32	0	0.4	43	0	0.6
Coastal Inlets, FL	n	0	0.0	5	0	0.0	1	0	0.0	8	0	0.1	3	0	0.0	13	0	0.1
Historic Sites	7	0	0.1	13	0	0.1	17	0	0.2	27	0	0.3	31	0	0.4	49	0	0.7
Prehistoric sites	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	7	0	0.1

Note: n = less than 0.5 percent.

Table D-2. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments (set 1) over the production life of the lease area and for existing tanker transportation.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing, Proposed and, Tankering			Proposed			Existing, Proposed and, Tankering			Proposed			Existing, Proposed and, Tankering		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	3	0	0.0
3	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	6	0	0.1
4	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	4	0	0.0	7	0	0.1
5	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	3	0	0.0	6	0	0.1
7	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	2	0	0.0	3	0	0.0
8	n	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0	3	0	0.0	5	0	0.0
9	1	0	0.0	2	0	0.0	2	0	0.0	3	0	0.0	3	0	0.0	4	0	0.0
12	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	2	0	0.0
13	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	6	0	0.1
14	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0
15	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0
16	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	2	0	0.0	6	0	0.1
17	n	0	0.0	1	0	0.0	2	0	0.0	4	0	0.0	6	0	0.1	9	0	0.1
18	8	0	0.1	9	0	0.1	13	0	0.1	15	0	0.2	18	0	0.2	23	0	0.3
19	1	0	0.0	2	0	0.0	5	0	0.0	8	0	0.1	10	0	0.1	15	0	0.2
20	n	0	0.0	3	0	0.0	1	0	0.0	6	0	0.1	2	0	0.0	9	0	0.1
21	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0	n	0	0.0	4	0	0.0
22	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	2	0	0.0
23	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0
24	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	8	0	0.1

Note: n = less than 0.5 percent. Those land segments for which all probabilities of one or more spills are less than 0.5 percent are not shown.

Table D-3. -- Probabilities (expressed as percent chance) of one or more spills, the most likely number of spills (mode), and the expected number of spills (mean) occurring and contacting land segments (set 2) over the production life of the lease area and for existing tanker transportation.

Land Segment	Within 3 days						Within 10 days						Within 30 days					
	Proposed			Existing, Proposed and, Tankering			Proposed			Existing, Proposed and, Tankering			Proposed			Existing, Proposed and, Tankering		
	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean	Prob	Mode	Mean
2	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0	6	0	0.1	11	0	0.1
3	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	3	0	0.0	4	0	0.0
4	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	5	0	0.0	9	0	0.1
5	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	2	0	0.0
6	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0
7	1	0	0.0	2	0	0.0	2	0	0.0	3	0	0.0	4	0	0.0	6	0	0.1
8	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	1	0	0.0	2	0	0.0
10	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
11	n	0	0.0	1	0	0.0	n	0	0.0	3	0	0.0	4	0	0.0	9	0	0.1
13	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	2	0	0.0	4	0	0.0
14	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
15	n	0	0.0	1	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	5	0	0.0
16	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	2	0	0.0	3	0	0.0
17	n	0	0.0	n	0	0.0	2	0	0.0	3	0	0.0	4	0	0.0	6	0	0.1
18	7	0	0.1	7	0	0.1	10	0	0.1	12	0	0.1	14	0	0.2	18	0	0.2
19	3	0	0.0	3	0	0.0	7	0	0.1	8	0	0.1	11	0	0.1	15	0	0.2
20	n	0	0.0	n	0	0.0	2	0	0.0	2	0	0.0	3	0	0.0	5	0	0.0
21	n	0	0.0	3	0	0.0	1	0	0.0	5	0	0.0	2	0	0.0	7	0	0.1
22	n	0	0.0	1	0	0.0	n	0	0.0	4	0	0.0	1	0	0.0	8	0	0.1
23	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0
24	n	0	0.0	n	0	0.0	n	0	0.0	1	0	0.0	n	0	0.0	5	0	0.0
25	n	0	0.0	n	0	0.0	n	0	0.0	3	0	0.0	n	0	0.0	9	0	0.1

Note: n = less than 0.5 percent. Those land segments for which all of the probabilities of one or more spills are less than 0.5 percent are not shown.