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SUMMARY OF THE 1987 U.S. TUNA/PORPOISE OBSERVER DATA

Alan R. Jackson

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U.S. DEPARTMENT OF COMMERCE
National Oceanic & Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Center

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U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service
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INTRODUCTION

Since 1971, the National Marine Fisheries Service's (NMFS) Tuna/Porpoise Observer Program has collected data on the mortality, life history, distribution and abundance of dolphins (historically referred to as "porpoise") biologically associated with yellowfin tuna (Thunnus albacares) in the eastern tropical Pacific Ocean (ETP). This program, which became mandatory for the U.S. fleet in 1976 under the Marine Mammal Protection Act, places biological technicians (observers) aboard commercial U.S. purse seiners holding certificates of inclusion (certificated U.S. seiners) under a general permit to take (chase and/or set nets on) certain species of dolphins within the "permit area" (that area of the Pacific Ocean bounded by 40°N latitude, 40°S latitude, 160°W longitude and the coastlines of the Americas). The yellowfin tuna purse seine fishery exploits the tuna-dolphin bond by netting the highly visible, surface-swimming dolphins in an attempt to catch the tuna schooling below them. This fishing strategy is referred to by the fishermen as "porpoise fishing" or "fishing on porpoise," and, as employed by the international fleet, has accounted for about 25% of the worldwide yellowfin tuna catch in recent years (IATTC 1987, FAO 1988). Each year thousands of dolphins are killed (annual U.S. allowable mortality presently may not exceed 20,500) in the purse seines before they can be separated from the tuna and safely returned to the open ocean. Most frequently killed in this fishery are the offshore spotted dolphin (Stenella attenuata) and the eastern and whitebelly spinner dolphins (S. longirostris) (Smith 1983). Also killed, but not as frequently, is the common dolphin (Delphinus delphis).

The primary responsibility of the tuna/porpoise observer is to keep an accurate count of the number, the species and the stock of dolphins killed in each purse seine set.[1] The observers are employees of NMFS, and collect data under the direction of either the NMFS's Tuna/Porpoise Management Branch or the Inter-American Tropical Tuna Commission (IATTC), an international agency concerned with the biology and conservation of tunas and associated dolphins in the ETP. Depending on the type of observed

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[1]1987 Tuna/Porpoise Observer Administrative Handbook. Edited by Ben Meyer, National Marine Fisheries Service. 1520 State Street, Suite 200, San Diego, CA 92101.

trip, whether directed by NMFS or IATTC, slightly different sets of data are collected.[2,3] However, dolphin mortality information is collected by all observers.

This report is the first in a series of annual reports that will summarize U.S. tuna/porpoise observer data collected in the ETP. Included here are dolphin set totals, mortality rates and sightings categorized by dolphin population and geographic area for the 1987 calendar year.

SAMPLING COVERAGE

All U.S. tuna purse seiners fishing on dolphins within the permit area are required to carry observers on some or all of their fishing trips, depending on a sampling scheme designed to provide a reliable estimate of the entire U.S. fishery-related dolphin mortality (Lo et al. 1982). In 1987, however, an effort was made by NMFS to place observers on all certificated U.S. seiners making fishing trips into the permit area. The result of this was that U.S. observers were aboard 123 of the 134 fishing trips made entirely or partially within the 1987 calendar year.[4]

The 11 unobserved trips in 1987 included 6 trips begun in 1986 without an observer and continued into 1987, and 5 trips begun in 1987 that, for various reasons, went unobserved. Of the 34 certificated U.S. seiners active in the ETP in 1987, 33 carried an observer on at least two trips; 1 seiner, making its maiden voyage in late 1987, went unobserved. The average length of an observed trip was 69 days (excluding transit time outside the permit area and unloading time) with a range of 16 to 150 days (Table 1). Trips that departed during the first quarter of the year were shorter, on average, than trips that departed later in the year.

DOLPHIN SETS

The 123 trips observed in 1987 resulted in 4,294 intentional dolphin sets (setting the net in an attempt to capture dolphins) with a total catch of 74,446 short tons of yellowfin tuna (catch estimated at sea--Table 2). These observed dolphin sets accounted for approximately 67% of all yellowfin tuna caught by

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[2]1987 Tuna/Porpoise Observer Field Manual. National Marine Fisheries Service. 1520 State Street, Suite 200, San Diego, CA 92101.

[3]1987 Inter-American Tropical Tuna Commission Tuna-Dolphin Investigation Field Manual. Edited by David Bratten, Inter-American Tropical Tuna Commission. c/o Scripps Institution of Oceanography, La Jolla, CA 92093

[4]Fleet Activity Report. Prepared by Michael G. Thabault, National Marine Fisheries Service. 300 South Ferry Street, Terminal Island, CA 90731.

U.S. vessels in the ETP in 1987, or 24% of the yellowfin tuna caught in that area in 1987 by vessels of all flags (IATTC 1988). The average observed yellowfin tuna catch-per-set on a school of dolphins was 17.3 short tons, up from the 1981-86 average observed catch-per-set rate of 14.7 short tons. In addition to the 4,294 intentional dolphin sets, 17 accidental dolphin sets (sets in which dolphins were captured merely by chance or without intention) and 6 sets on whales were reported for 1987.

The geographic patterns of fishing on dolphins in 1987 generally reflected those of previous years (IATTC 1985), with concentrations of sets occurring between 8-15°N and 97-111°W, 16-18°N and 113-116°W, and 8-11°N and 125-130°W (Figure 1A). However, there were some differences in the 1987 dolphin fishing patterns: 1) there was a heavier than usual concentration of sets between 11-14°N and 91-95°W, an area ranging 100-200 miles off the coast of Guatemala; 2) the observed fleet did not venture as far west--no sets were made west of 136°W; and 3) the southern area was unfished, with no dolphin sets made south of 2°S.

Dolphin fishing areas tended to change over the course of the 1987 calendar year. Activity for the first quarter of the year was generally confined to an area within 500-600 miles of the coastline between 5-18°N, with a concentration of sets between 11-14°N and 91-94°W (Figure 1B). Fishing effort shifted westward in the second quarter (Figure 1C). During the third quarter, there was a marked narrowing of the fishing grounds as sets became concentrated between 8-12°N and 93-136°W (Figure 1D). There was a return to the nearer-shore area in the fourth quarter (Figure 1E). Also in the fourth quarter, activity increased in two other areas: 1) off the coast of Baja California; and 2) in the vicinity of the equator from 84-104°W. The movement of the fleet throughout 1987 generally traced the seasonal fleet patterns of previous years (IATTC 1985).

DOLPHIN MORTALITY

A total of 13,382 dolphins was killed by the observed U.S. fleet in 1987 (Table 3). Of this, 13,345 were killed in intentional dolphin sets and 37 in accidental dolphin sets. The dolphin population sustaining the most mortalities was the offshore spotted dolphin (8,436 mortalities), followed by the eastern spinner dolphin (2,557), the whitebelly spinner dolphin (981) and the common dolphin (882). Also killed, but in relatively low numbers, were the bottlenose dolphin (Tursiops truncatus, 52), the rough-toothed dolphin (Steno bredanensis, 16), the striped dolphin (S. coeruleoalba, 8) and the Pacific white-sided dolphin (Lagenorhynchus obliquidens, 5). The geographic distributions of the total dolphin mortality, by population, are depicted in Figures 2A-E.

Because dolphins from different populations (especially spotted and spinner dolphins) often school together and, consequently, are often netted together, determining dolphin mortality rates by dolphin population is problematical. For this

report, the following methods were used: The overall dolphin kill-per-set and kill-per-ton rates are the total number of dolphins (of all populations) killed in intentional dolphin sets, 1) divided by the total number of intentional dolphin sets; and 2) divided by the total number of short tons of yellowfin tuna caught (estimated at sea) from intentional dolphin sets. For mortality rates by specific dolphin populations, a set is included for a population only if the dolphin school that was chased and set upon contained individuals of that population (observer's determination--recorded on the sighting record as one percent, or more, of the entire school); no attempt was made to allocate or proportion the tuna catch between populations if more than one dolphin population was involved in the set.

For example, a dolphin school comprised of 99% offshore spotted dolphins and 1% eastern spinner dolphins is chased and set upon, and the resulting catch is 25 tons of yellowfin tuna and a dolphin kill of 10 offshore spotted dolphins, 3 eastern spinner dolphins and 1 unidentified dolphin that, for some reason, the observer could not distinguish between an offshore spotted or an eastern spinner. This set would be included in the offshore spotted rates as one set, 10 mortalities and 25 tons of tuna. It would also be included in the eastern spinner rates as one set, 3 mortalities and 25 tons of tuna; and in the overall dolphin mortality rates as one set, 14 mortalities and 25 tons of tuna caught.

The dolphin most frequently set on in 1987 was the offshore spotted dolphin (4,199 intentional sets), resulting in average kill-per-set and kill-per-ton of yellowfin tuna rates of 2.01 and 0.11 dolphins (Table 4). This was followed, in decreasing frequency of intentional sets, by the eastern spinner (1,716), with rates of 1.49 and 0.08, and the whitebelly spinner (627), with rates of 1.56 and 0.07. The 1987 overall dolphin kill-per-set and kill-per-ton rates of 3.11 and 0.18 are lower than the 1981-86 average rates of 4.72 and 0.32. When examined on a yearly basis since 1981, there appears to be a trend toward a lower kill-per-ton rate, but no such trend is apparent for the kill-per-set rate (Figures 3A,B).

Common dolphins were much more vulnerable in the nets than were other dolphins: 864 common dolphins were killed in a total of only 36 intentional sets involving this species, with resulting kill-per-set and kill-per-ton rates of 24.0 and 1.87, compared to rates of 2.93 and 0.17 for sets on all dolphins other than the common dolphin. The 1987 common dolphin mortality rates were affected by a single set that resulted in a kill of 229 common dolphins and a tuna catch of 35 tons. Even when one removes this one set, the common dolphin kill-per-set and kill-per-ton rates (18.1 and 1.49) are still high.

Of the 4,294 intentional dolphin sets, 2,659 sets (or 61.9% of the total) resulted in no dolphin mortality, and 184 (4.3% of the total) were sets in which more than 15 dolphins were killed--

referred to as "problem sets" (Table 5). This compares favorably to 1981-86 when no-kill sets accounted for 59.8% of the total, and problem sets accounted for 6.1%. The greatest number of dolphins killed in a single set in 1987 was 419 (211 offshore spotted and 208 eastern spinner dolphins). The relative frequencies of numbers of dolphins killed per set were quite similar for the three most heavily targeted populations: offshore spotted, eastern spinner and whitebelly spinner dolphins. However, for the less-frequently targeted and differently-behaving common dolphin, there is a pronounced shift to the high end in the kill-per-set frequencies, with problem sets accounting for 41.7% of the total (Figure 4).

Although dolphins can only practicably be herded and set upon during daylight hours, sometimes, especially for sets that are started shortly before or at sunset, the dolphins may remain in the net until after nightfall. These "night sets" present unique problems to the safe release of the dolphins from the net. In 1987, 10.2% of intentional dolphin sets were night sets, with resulting kill-per-set and kill-per-ton rates of 7.88 and 0.46, versus 2.57 and 0.15 for daylight sets (Figures 5A,B). For 1979-86, 9.2% of all intentional dolphin sets were night sets, with resulting average kill-per-set and kill-per-ton rates of 14.14 and 0.92, versus 2.92 and 0.22 for daylight sets for the same period.[5]

Geographically, areas of high dolphin kill-per-set and kill-per-ton tended to be located along the southern periphery of the general fishing area, an area that traditionally is not heavily fished, and off Baja California (Figures 6A,B). This situation is consistent with those of previous years (IATTC 1985). The dolphin most often involved in problem sets along the southern periphery was the offshore spotted dolphin; the problem sets off of Baja California involved the common dolphin, exclusively.

MARINE MAMMAL WATCH EFFORT AND SIGHTINGS

Marine mammal watch effort is an activity in which the observer keeps a lookout for marine mammals, or is otherwise in a position to note marine mammal sightings made by the seiner's crew. During periods of watch effort, various conditions are monitored and recorded, including vessel speed and position, sea surface temperature and sea state.

In 1987, U.S. observers logged 32,348 hours of watch effort, during which 626,640 kilometers of distance were traveled. There were 6,034 sightings reported by observers of offshore spotted dolphins, the population normally sought by the fishery, with an estimated average school size of 568 dolphins (Table 6). Also

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[5]Coan, A.L., K.E. Wallace and A.R. Jackson. 1988. Comparisons of dolphin mortality rates between day and night sets for the U.S. eastern tropical Pacific tuna purse seine fishery. Southwest Fisheries Center Admin. Rep. LJ-88-29, 24 p.

frequently sighted, and often in association with spotted dolphins, were eastern spinner dolphins (2,567 sightings, average school size of 376) and whitebelly spinner dolphins (781 sightings, average school size of 226). Other cetaceans quite frequently encountered, yet not normally associated with yellowfin tuna, were bottlenose dolphins (557 sightings), short-finned pilot whales (Globicephala macrorhynchus, 272 sightings) and sperm whales (Physeter macrocephalus, 216 sightings). Locations of dolphin sightings, by population, are depicted in Figures 7A-D. Because of the broad overlap of the ranges of eastern and whitebelly spinner dolphins, and because of problems observers have in distinguishing between these two forms at sea, the distribution data for whitebelly and eastern spinner dolphins should be regarded as less reliable than the data for spotted and common dolphins (Perrin et al. 1985).

DOLPHIN LIFE HISTORY SPECIMENS

Under certain conditions, the observer has access to dolphin carcasses and can collect data, organs and tissues for later analysis at the Southwest Fisheries Center. The minimum amount of data recorded for each processed specimen includes species identification, sex, date, position of capture and body length. A more complete record includes, in addition to data collected at sea, information obtained from the laboratory examination of the the teeth, fetuses and testes or ovaries collected in the field.

Complete life history data were collected for 1,747 dolphins, or 13% of the animals that were observed to be taken in the fishery in 1987; minimum data were collected for an additional 1,127 dolphins (Table 7).

SUMMARY

In 1987, NMFS attempted to place observers on all U.S. tuna purse seiners fishing in the permit area, and 123 of the 134 fishing trips made entirely or partially within the calendar year carried observers. On these 123 observed trips, 4,294 intentional dolphin sets were made, resulting in a yellowfin tuna catch of 74,446 short tons and 13,345 dolphins killed. The observed dolphin kill-per-set and kill-per-ton of yellowfin tuna rates were 3.11 and 0.18 dolphins, down from the 1981-86 average rates of 4.72 and 0.32 dolphins. Of all intentional dolphin sets, 10.2% were night sets, with resulting kill-per-set and kill-per-ton rates of 7.88 and 0.46. These night-set kill rates were below the 1979-86 night set averages of 14.14 and 0.92. Geographic areas of high dolphin kill-per-set and kill-per-ton tended to be located along the southern periphery of the traditional fishing grounds and off Baja California. The kill-per-set and kill-per-ton rates for common dolphins were found to be much higher than for the other dolphins, although there were only 36 observed sets on common dolphins in 1987.

ACKNOWLEDGMENTS

I wish to acknowledge the efforts and perseverance of the observers who spent many long months at sea collecting the data summarized in this report; theirs is a difficult and, too often, thankless job. I also wish to acknowledge R. Rasmussen and M. Trianni who edited the NMFS data. My thanks go to the IATTC for providing the data collected by their observers and to S. Boyer for extracting from the larger IATTC data files only the data I required. K. Wallace provided assistance in producing the ETP plots. R. Allen enhanced the appearance of the figures. A. Coan, D. DeMaster, A. Dizon, W. Perrin, S. Reilly, G. Sakagawa, R. Salomons, S. Smith and K. Wallace reviewed this manuscript and offered useful suggestions for its improvement. I thank these people and others who helped me.

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Perrin, W.F., M.D. Scott, G.J. Walker, and V.L. Cass. 1985. Review of geographical stocks of tropical dolphins (Stenella spp. and Delphinus delphis) in the eastern Pacific. NOAA Tech. Rep. NMFS 28, 28 p.

Smith, T.D. 1983. Changes in size of three dolphin populations in the eastern tropical Pacific. Fish. Bull., U.S. 81(1):1-14.

Table 1. Trip lengths, in days, of observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

	Observed Trip Lengths (Days) .....Trips Departing..... 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
Average trip length	56	74	69	82	69
Maximum trip length	93	135	150	123	150
Minimum trip length	24	16	38	36	16
Number of departures	37	32	24	24	117

(This table excludes 4 cruises which departed in December, 1986. Also excluded are 2 cruises which transited the fishing grounds in December, 1987, but did not begin actual fishing operations until January, 1988.)

Table 2. Sets on marine mammals by observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

Set Type	Number Sets	Tons Yellowfin	Tons Skipjack
Intentional dolphin	4,294	74,446	382
Accidental dolphin	17	379	183
Whale	6	77	18
-Total-	4,317	74,902	583

Table 3. Dolphins killed by observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

Population	Number of Dolphins Killed			
	Male	Female	?-Sex	Total
Offshore spotted dolphin	1,413	1,763	5,260	8,436
Eastern spinner dolphin	565	490	1,502	2,557
Whitebelly spinner dolphin	198	194	589	981
Common dolphin	149	224	509	882
Unidentified dolphin	0	0	389	389
Unidentified spinner dolphin	8	11	36	55
Bottlenose dolphin	9	11	32	52
Rough-toothed dolphin	4	8	4	16
Striped dolphin	5	0	3	8
Pacific white-sided dolphin	0	2	3	5
Unidentified spotted dolphin	0	0	1	1
-Total-	2,351	2,703	8,328	13,382

(Includes kill resulting from 4,294 intentional and 17 accidental dolphin sets.)

Table 4. Dolphin kill-per-set and kill-per-ton of yellowfin tuna resulting from intentional dolphin sets made by observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

Population	Sets	Kill	Tons	Kill /Set	Kill /Ton
Offshore spotted	4,199	8,436	73,481	2.01	0.11
Eastern spinner	1,716	2,557	31,019	1.49	0.08
Whitebelly spinner	627	981	14,448	1.56	0.07
Common	36	864	461	24.00	1.87
-All Dolphin Sets-	4,294	13,345	74,446	3.11	0.18

(Totals do not necessarily equal the sum of the values for each column due to the fact that dolphins from more than one population may be present in a given set, and totals include unidentified dolphins and other populations.)

Table 5. Dolphin kill-per-set frequencies for observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

Population	Number of Dolphins Killed Per Set					
	0	1	2-5	6-10	11-15	>15
	.....Number of Dolphin Sets.....					
Offshore spotted	2,897	481	528	137	50	106
Eastern spinner	1,269	176	169	48	24	30
Whitebelly spinner	406	92	99	15	4	11
Common	8	2	5	6	0	15
-All Populations-	2,659	508	674	199	70	184

(Totals do not necessarily equal the sum of the values for each column due to the fact that dolphins from more than one population may be present in a given set, and totals include unidentified dolphins and other populations.)

Table 6. Marine mammal sightings made by observers aboard U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

Population	Sightings	Average School Size
Offshore spotted dolphin	6,034	568
Eastern spinner dolphin	2,567	376
Whitebelly spinner dolphin	781	226
Bottlenose dolphin	557	60
Unidentified spinner dolphin	369	226
Common dolphin	331	864
Short-finned pilot whale	272	19
Sperm whale	216	7
Striped dolphin	146	173
Killer whale	50	4
Unidentified rorqual	45	1
Unidentified spotted dolphin	40	747
Rough-toothed dolphin	30	19
Unidentified beaked whale	28	2
Risso's dolphin	26	20
Coastal spotted dolphin	18	887
Pacific white-sided dolphin	18	154
False killer whale	13	17
Blue whale	13	2
Fraser's dolphin	8	232
Minke whale	7	2

Table 6. (continued)

Population	Sightings	Average School Size
Cuvier's beaked whale	6	5
Humpback whale	5	2
Melon-headed whale	4	14
Gray whale	4	5
Fin whale	3	1
Bryde's whale	2	2
Pygmy killer whale	1	7
Unidentified mesoplodon	1	1
Baird's beaked whale	1	1
Sei whale	1	2
Costa Rican spinner dolphin	1	200

Table 7. Dolphin life history specimens collected from U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987

Population	Complete Data Specimens Collected			Minimum Data Specimens Collected		
	Male	Female	Total	Male	Female	Total
Offshore spotted	451	631	1,082	814	1,028	1,842
Eastern spinner	224	215	439	354	332	686
Whitebelly spinner	68	54	122	111	103	214
Common	31	44	75	37	52	89
Spinner, stock unk.	4	6	10	10	12	22
Bottlenose	6	7	13	8	7	15
Striped	3	0	3	3	0	3
Rough-toothed	1	2	3	1	2	3
-Total-	788	959	1,747	1,338	1,536	2,874

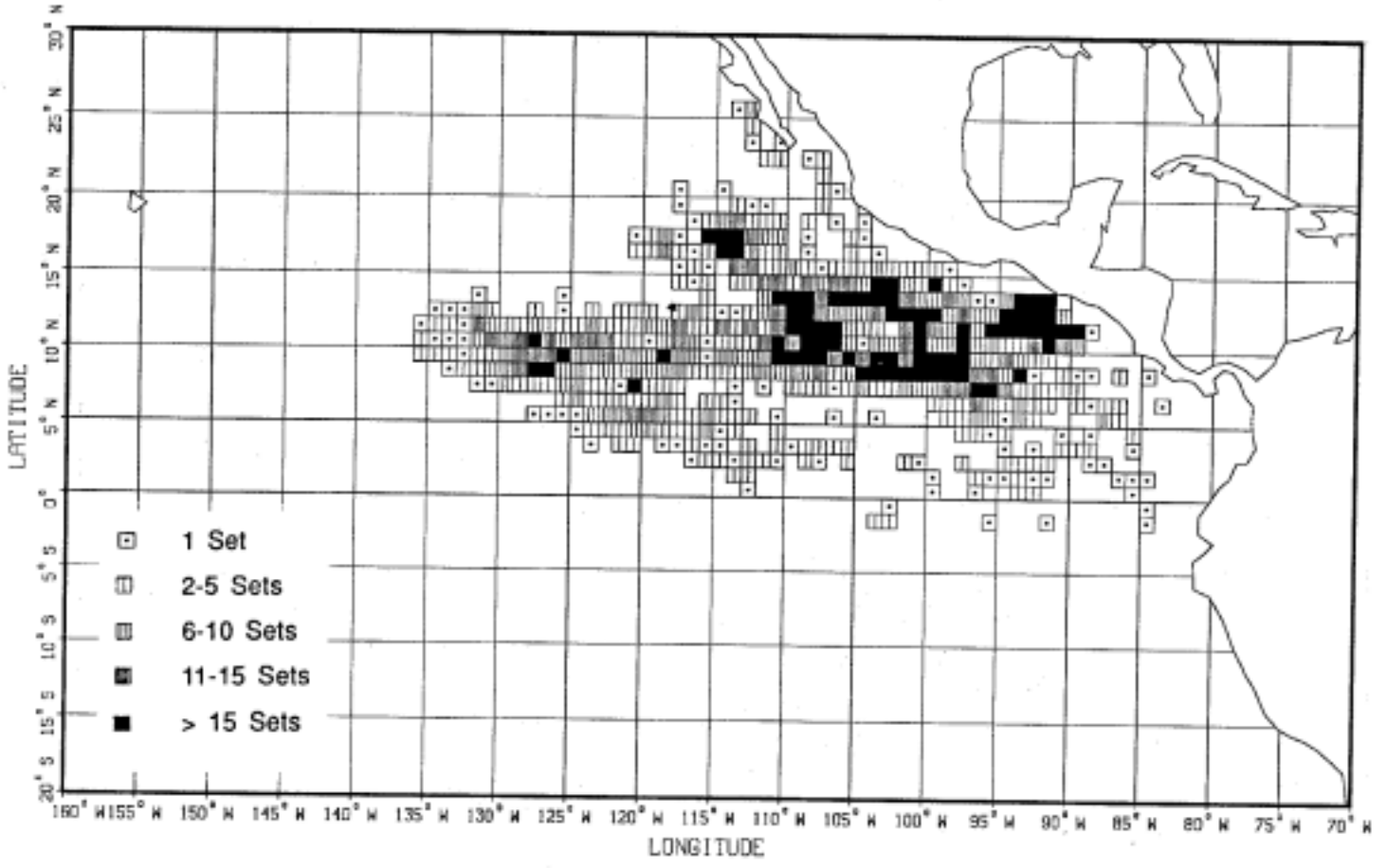


Figure 1A. The number of intentional dolphin sets, by 1^{o} quadrats, made by observed U.S. tuna purse seiners in 1987.

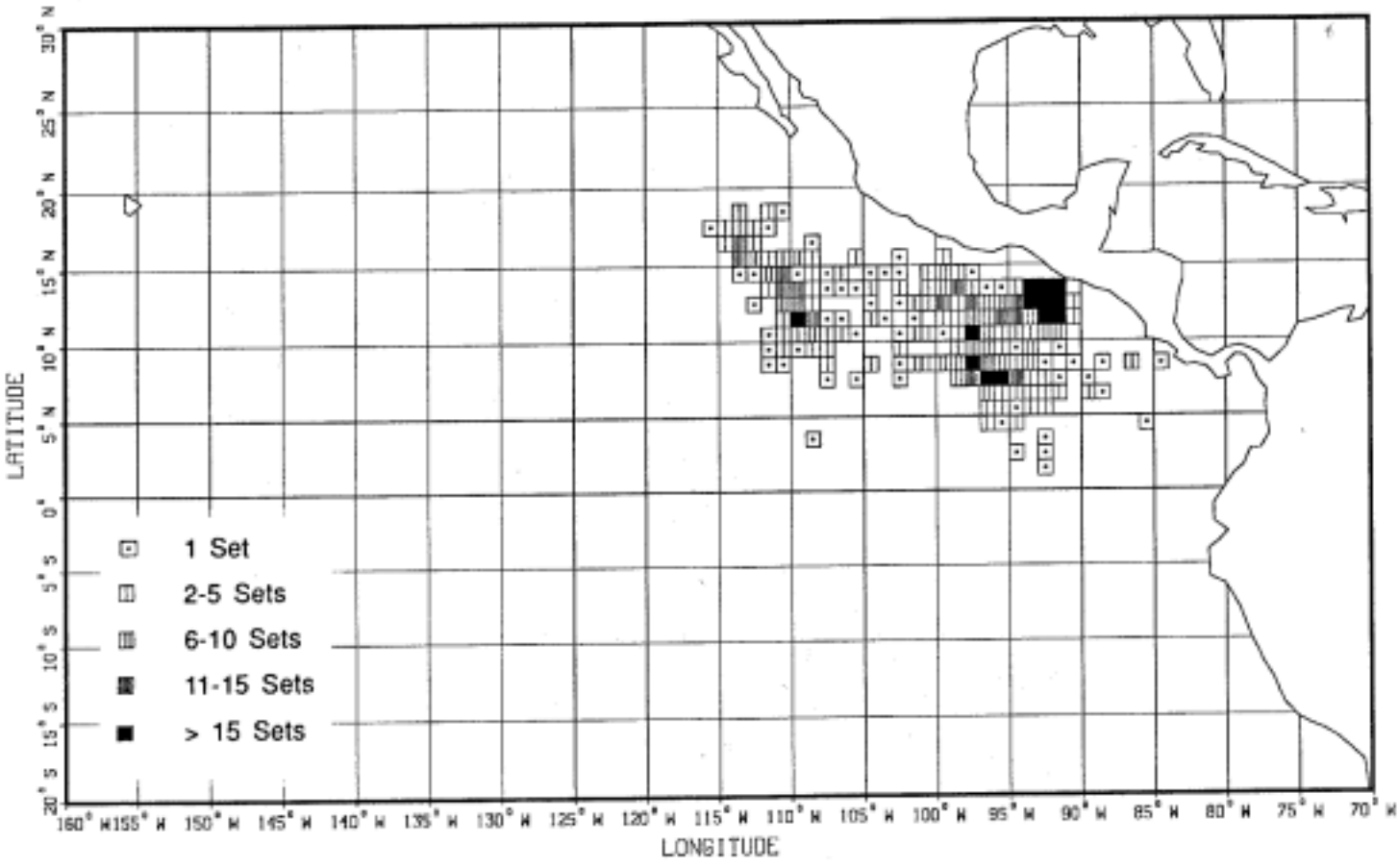


Figure 1B. The number of intentional dolphin sets, by 1^{o} quadrats, made by observed U.S. tuna purse seiners in the first quarter of 1987.

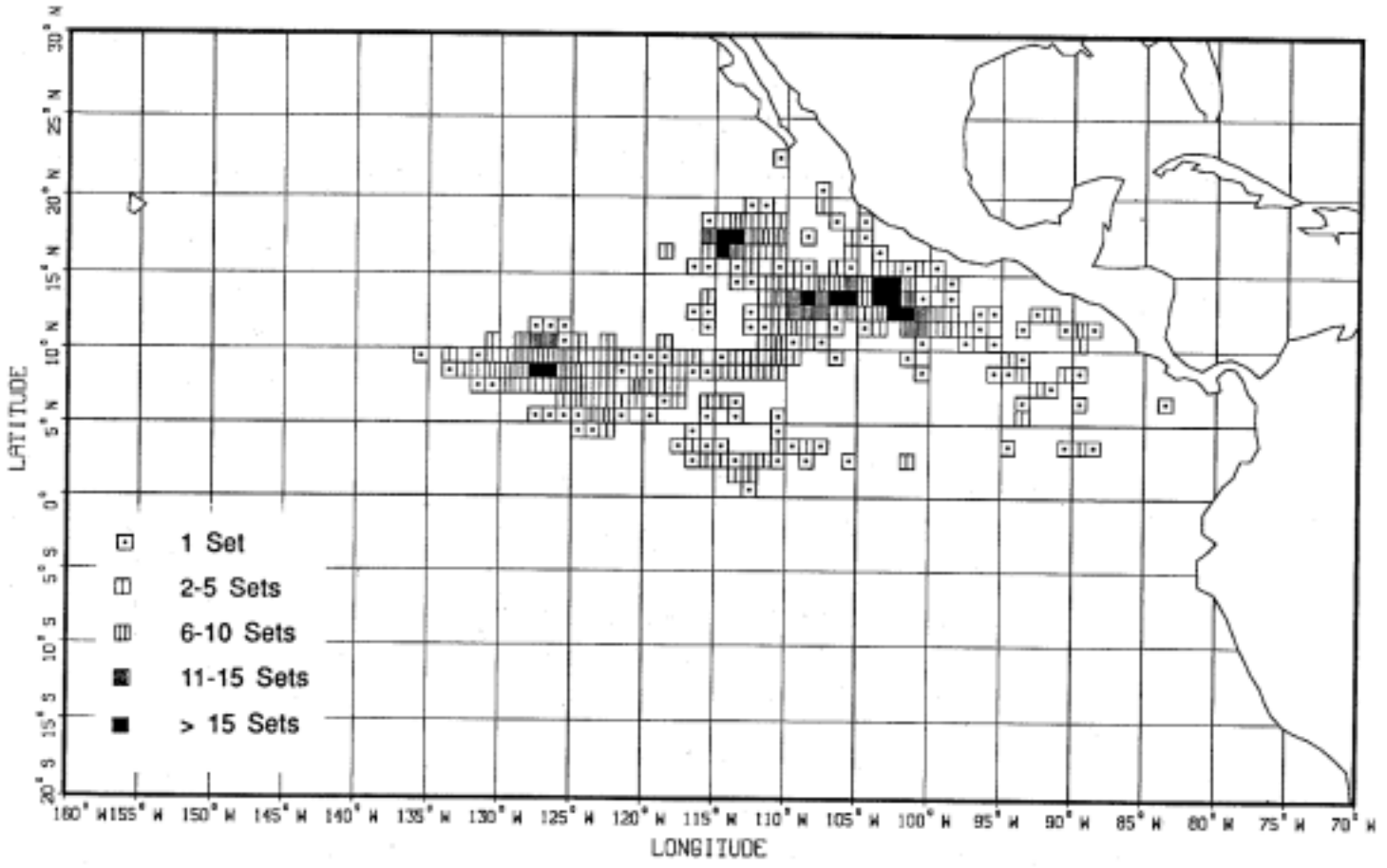


Figure 1C. The number of intentional dolphin sets, by 1° quadrats, made by observed U.S. tuna purse seiners in the second quarter of 1987.

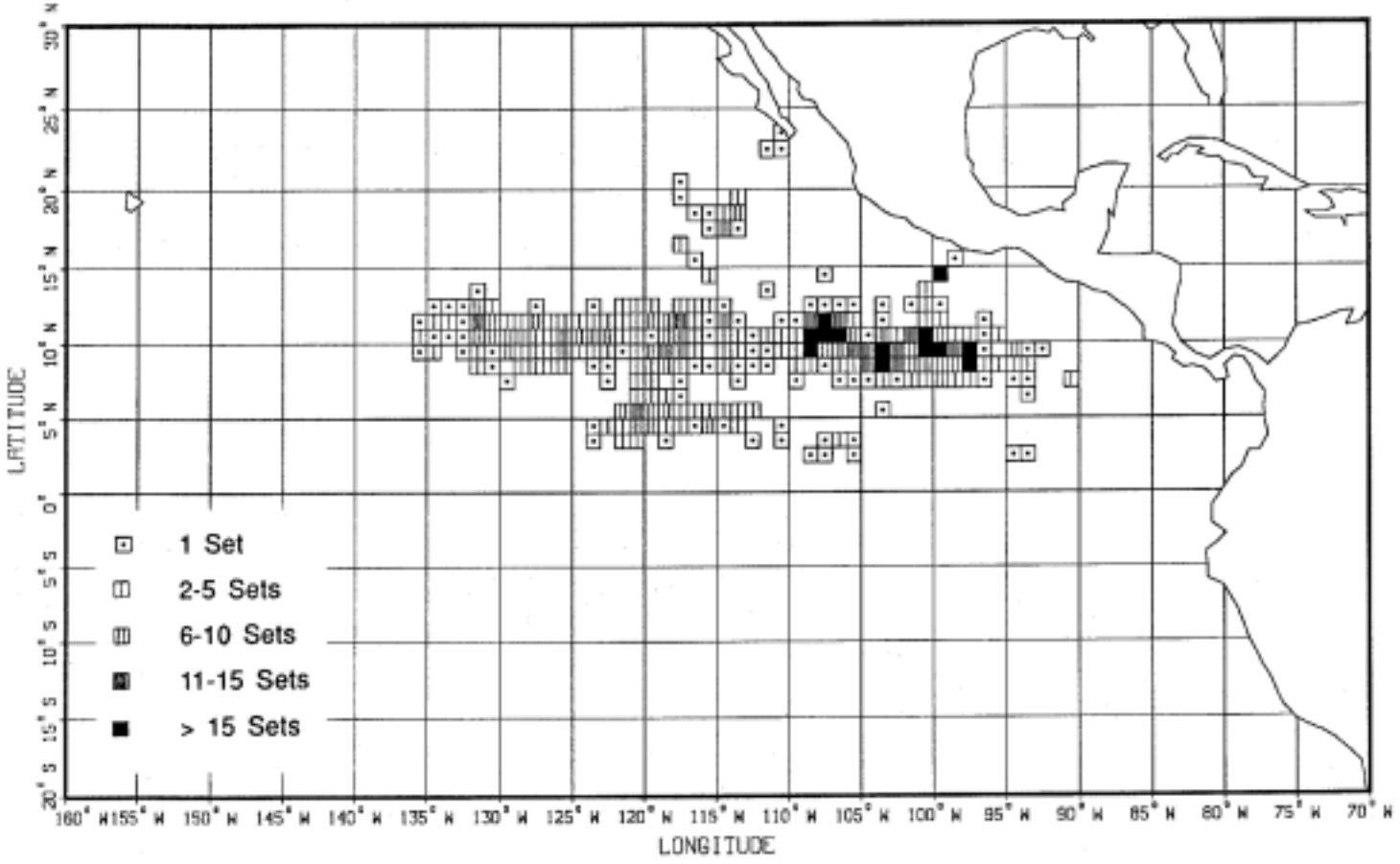


Figure 1D. The number of intentional dolphin sets, by 1^{o} quadrats, made by observed U.S. tuna purse seiners in the third quarter of 1987.

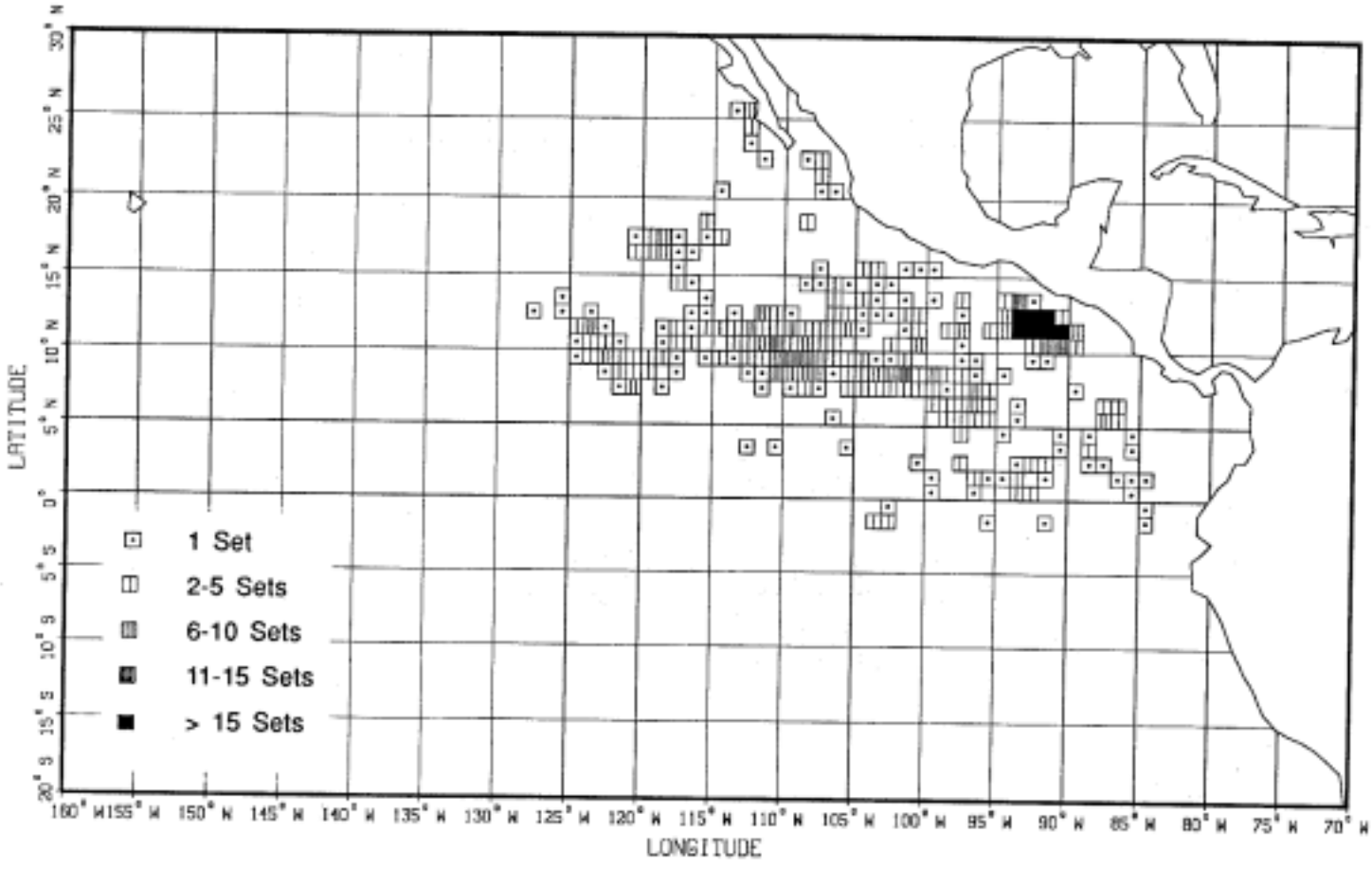


Figure 1E. The number of intentional dolphin sets, by 1^{o} quadrats, made by observed U.S. tuna purse seiners in the fourth quarter of 1987.

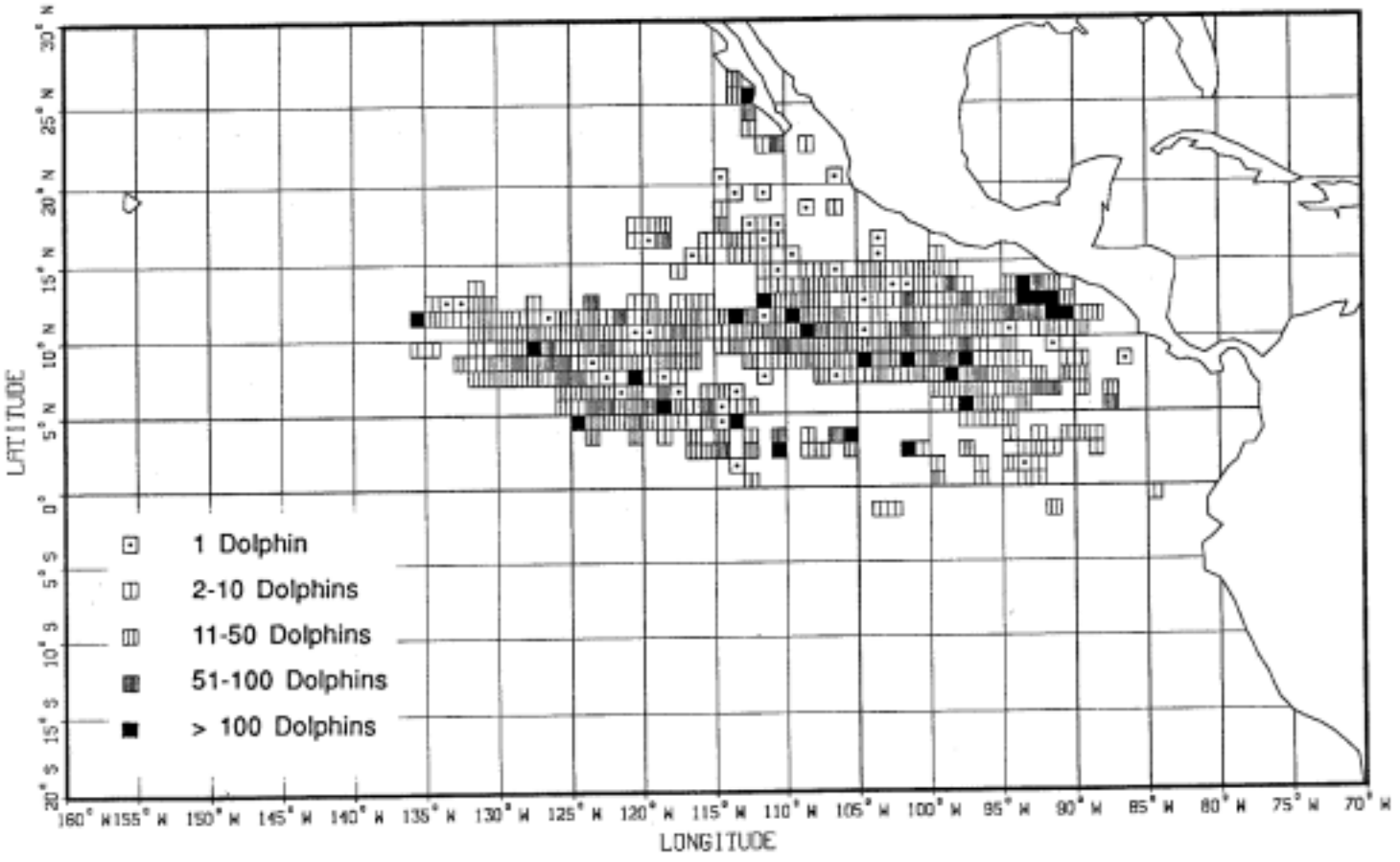


Figure 2A. The total number of dolphins, by 1^{o} quadrats, killed by observed U.S. tuna purse seiners in 1987.

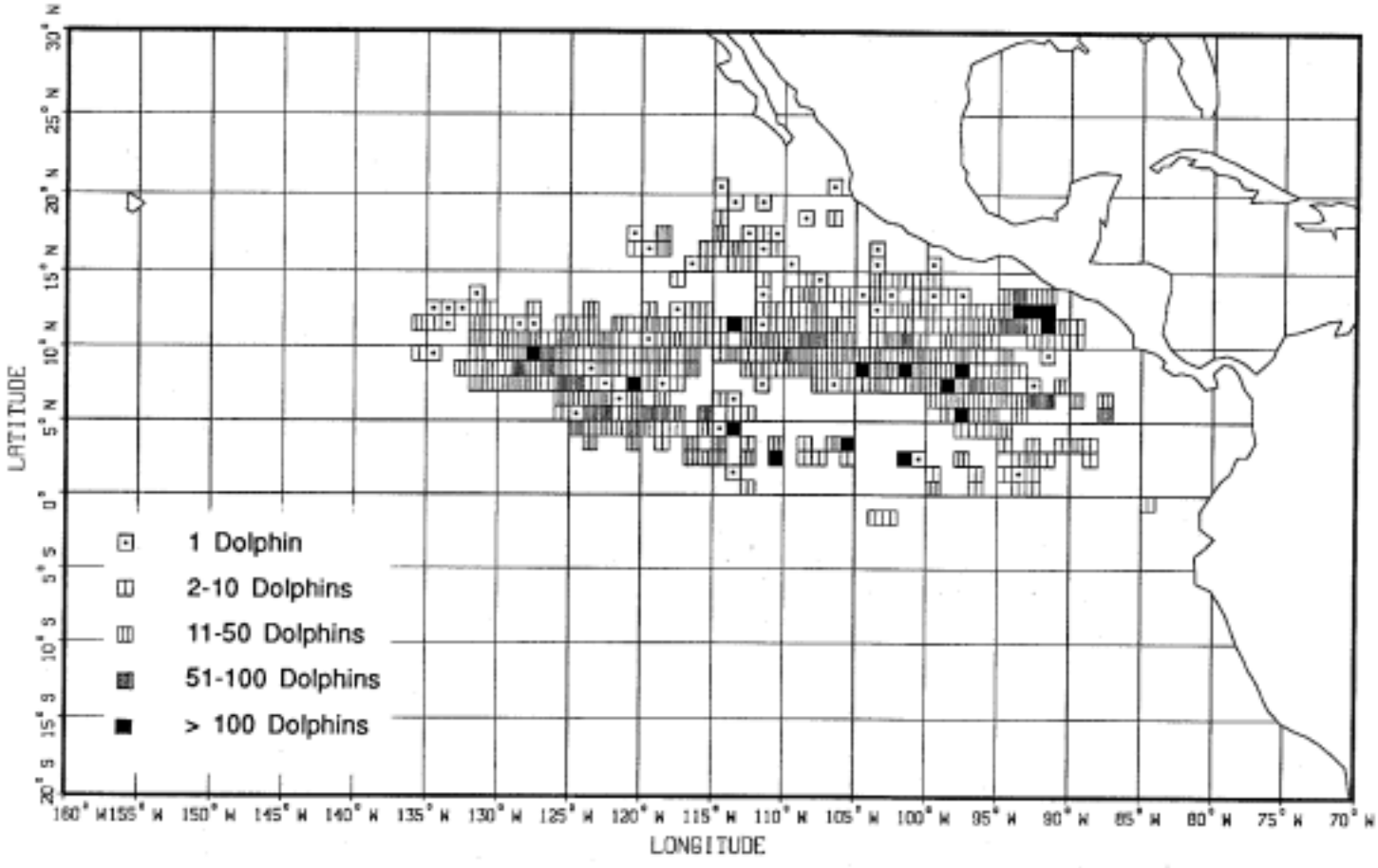


Figure 2B. The total number of offshore spotted dolphins, by 1^{o} quadrats, killed by observed U.S. tuna purse seiners in 1987.

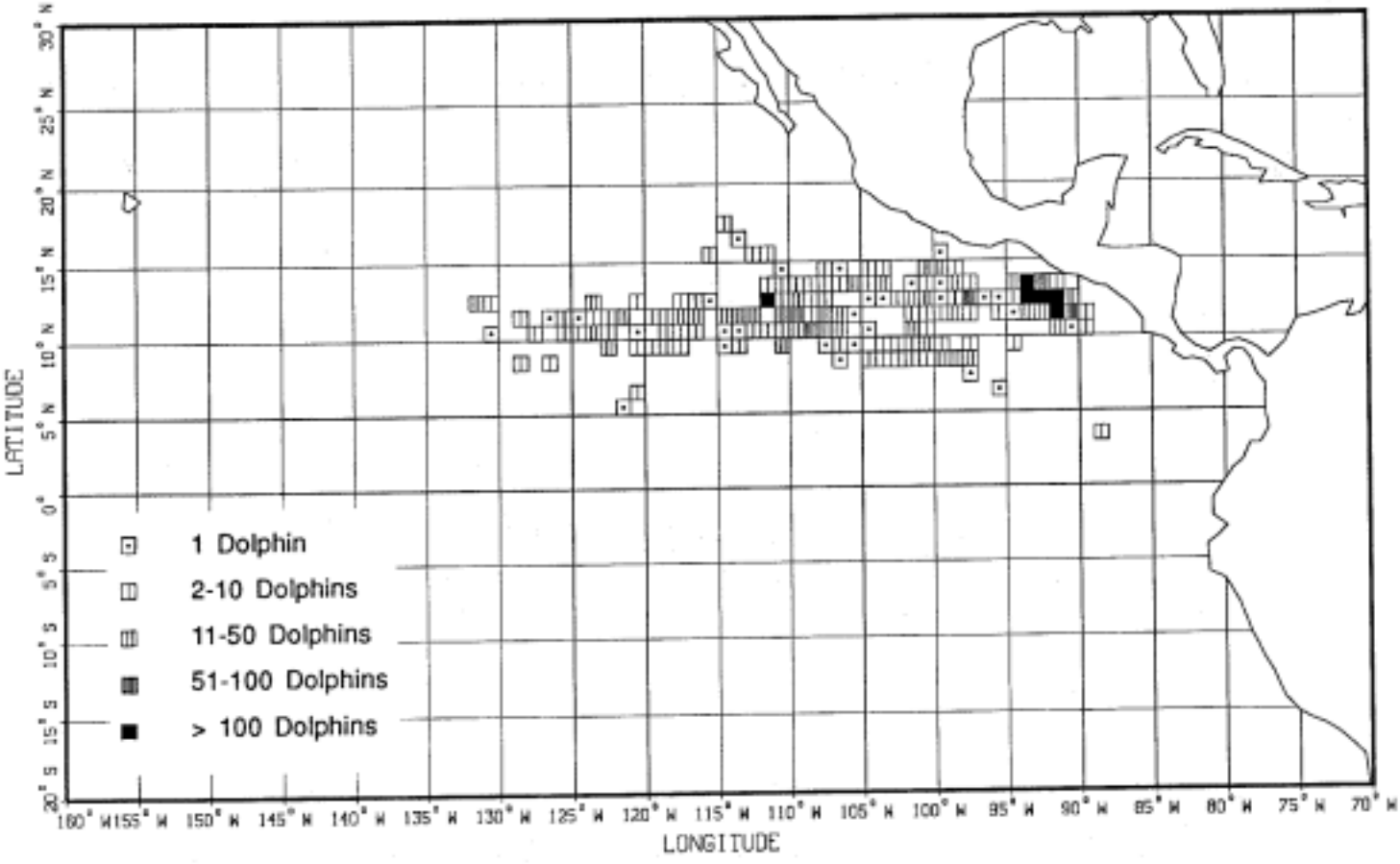


Figure 2C. The total number of eastern spinner dolphins, by 1^{o} quadrats, killed by observed U.S. tuna purse seiners in 1987.

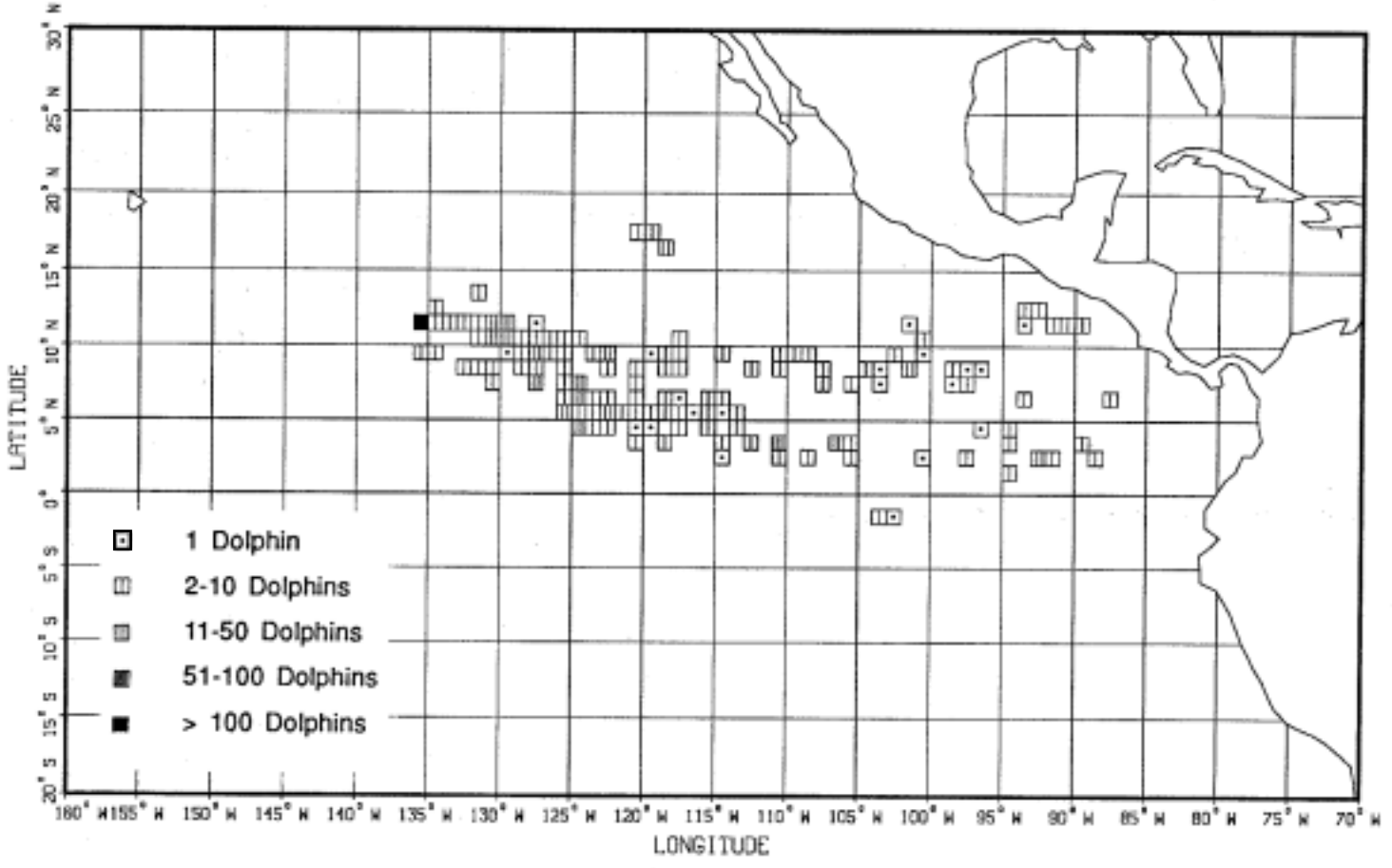


Figure 2D. The total number of whitebelly spinner dolphins, by 1° quadrats, killed by observed U.S. tuna purse seiners in 1987.

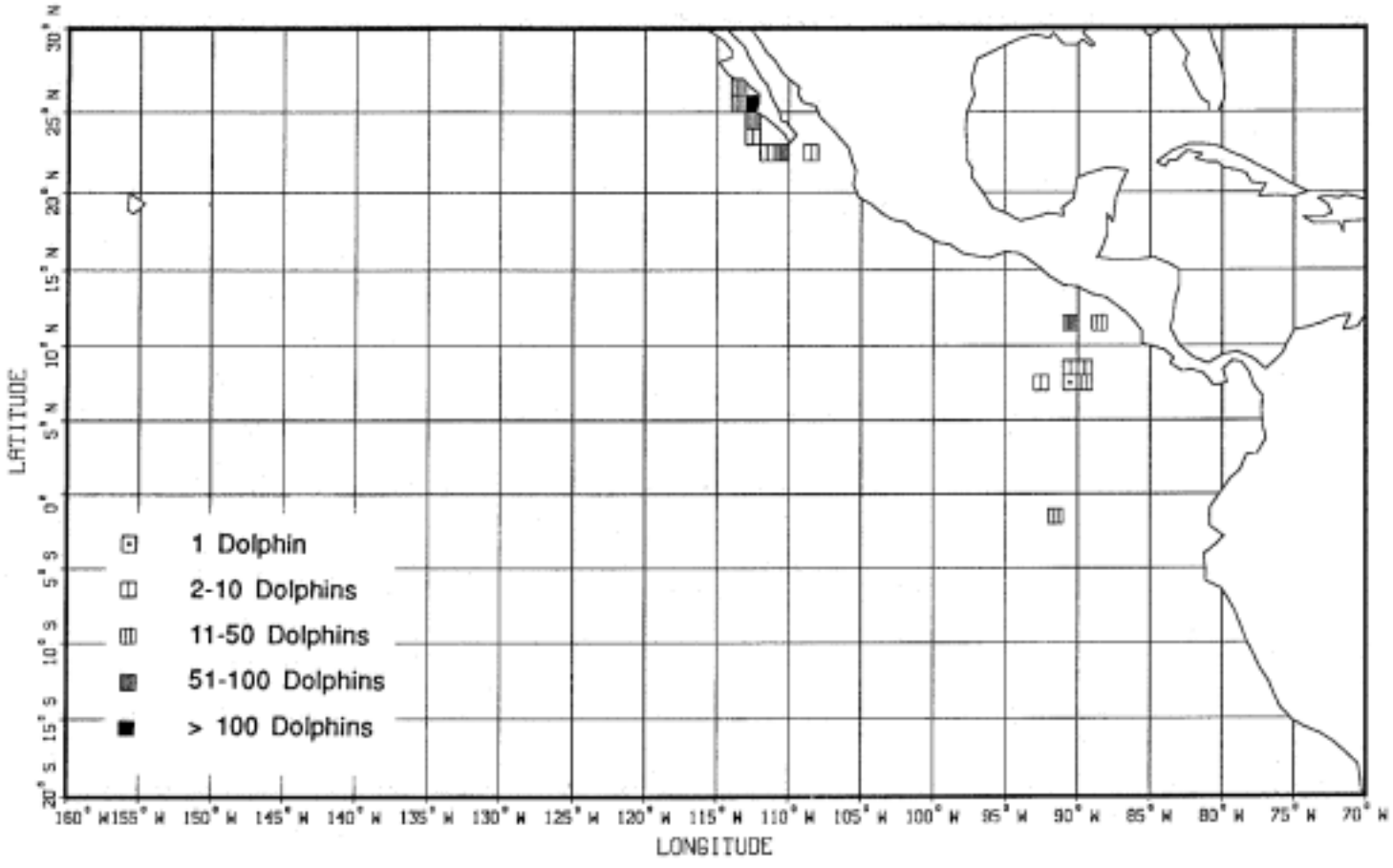


Figure 2E. The total number of common dolphins, by 1^{o} quadrats, killed by observed U.S. tuna purse seiners in 1987.

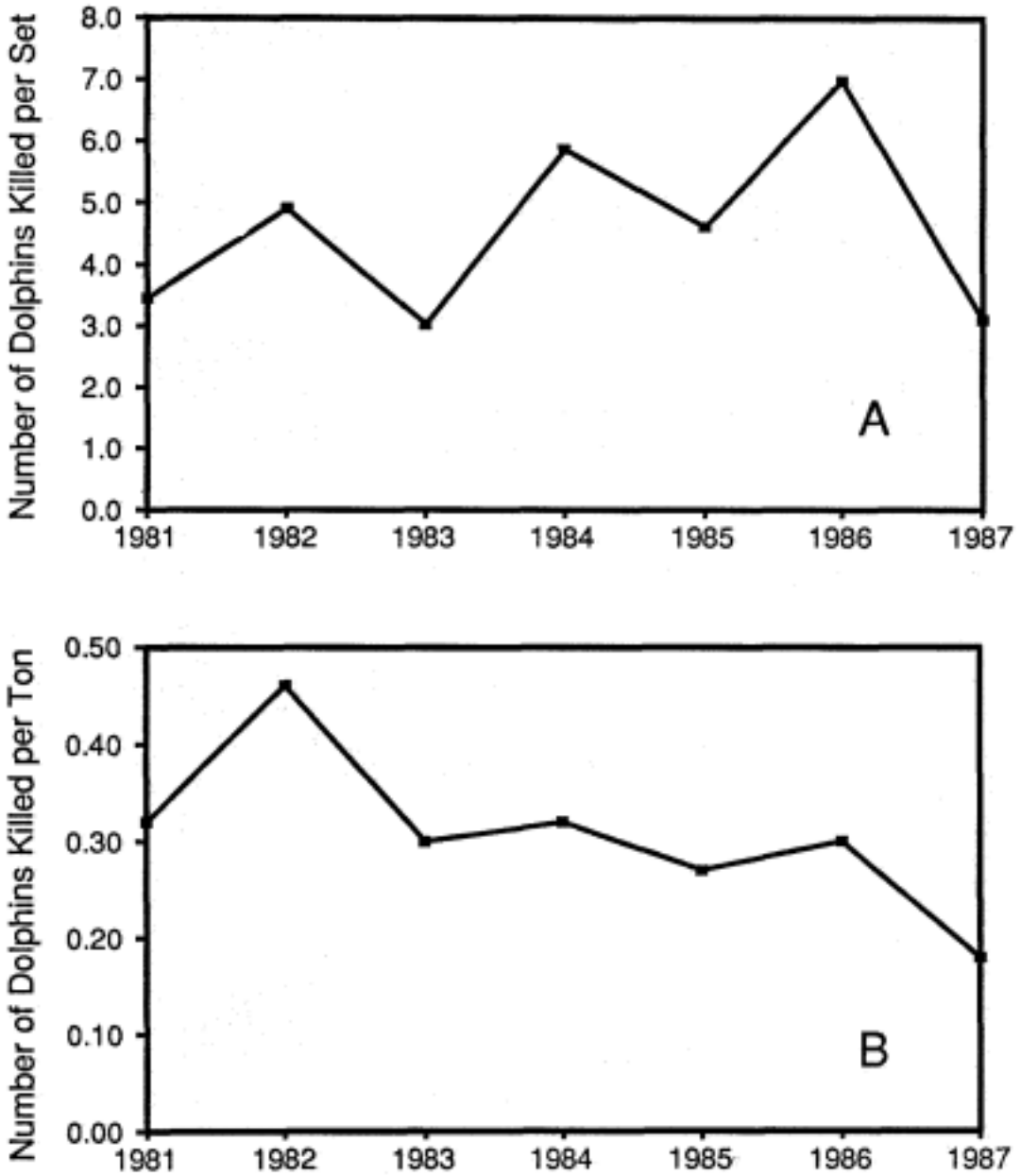


Figure 3. A: The dolphin kill-per-set rates, and B: kill-per-ton rates for observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean from 1981 to 1987.

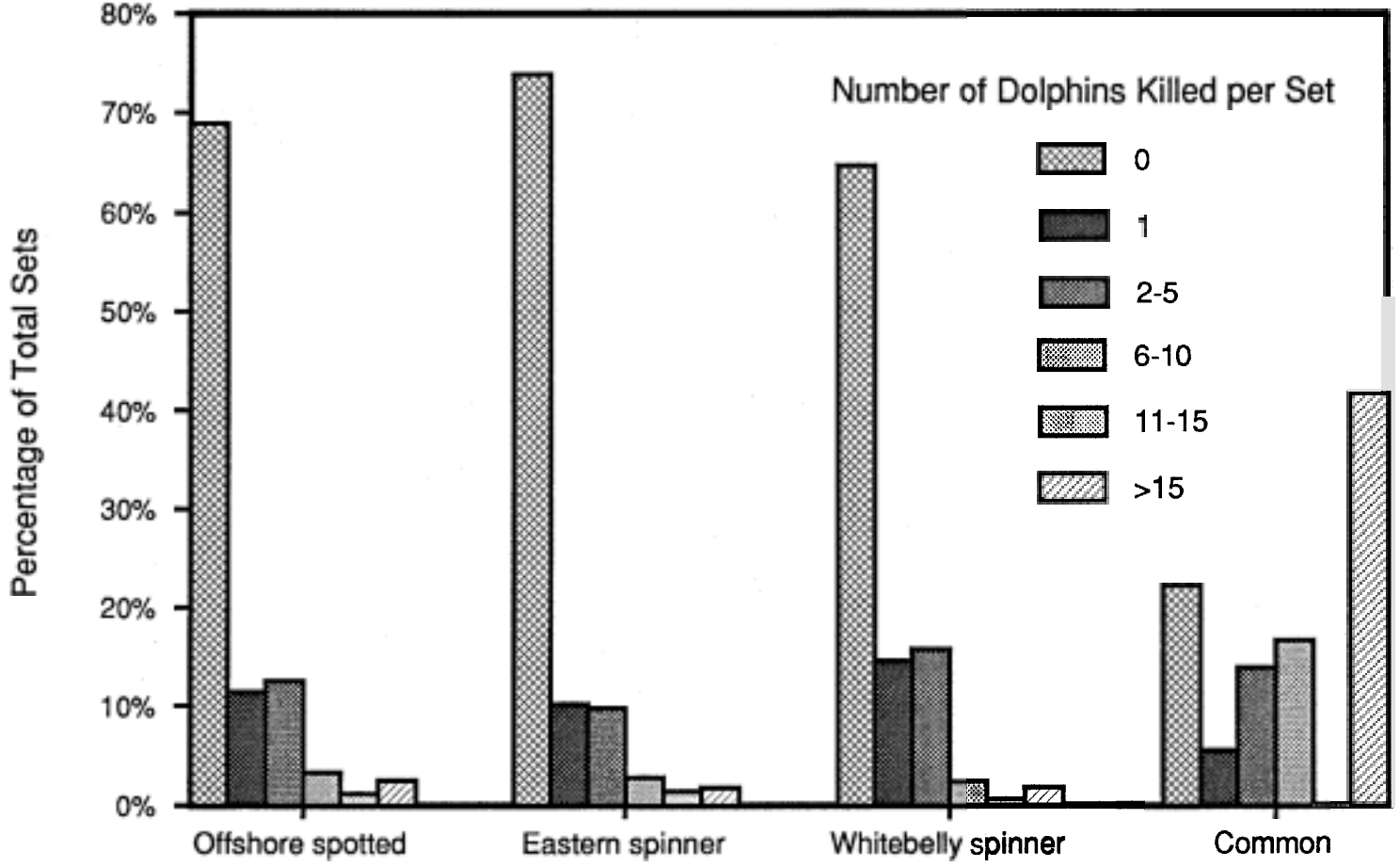


Figure 4. The relative frequencies of dolphin kill-per-set rates, by population, for observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean, 1987.

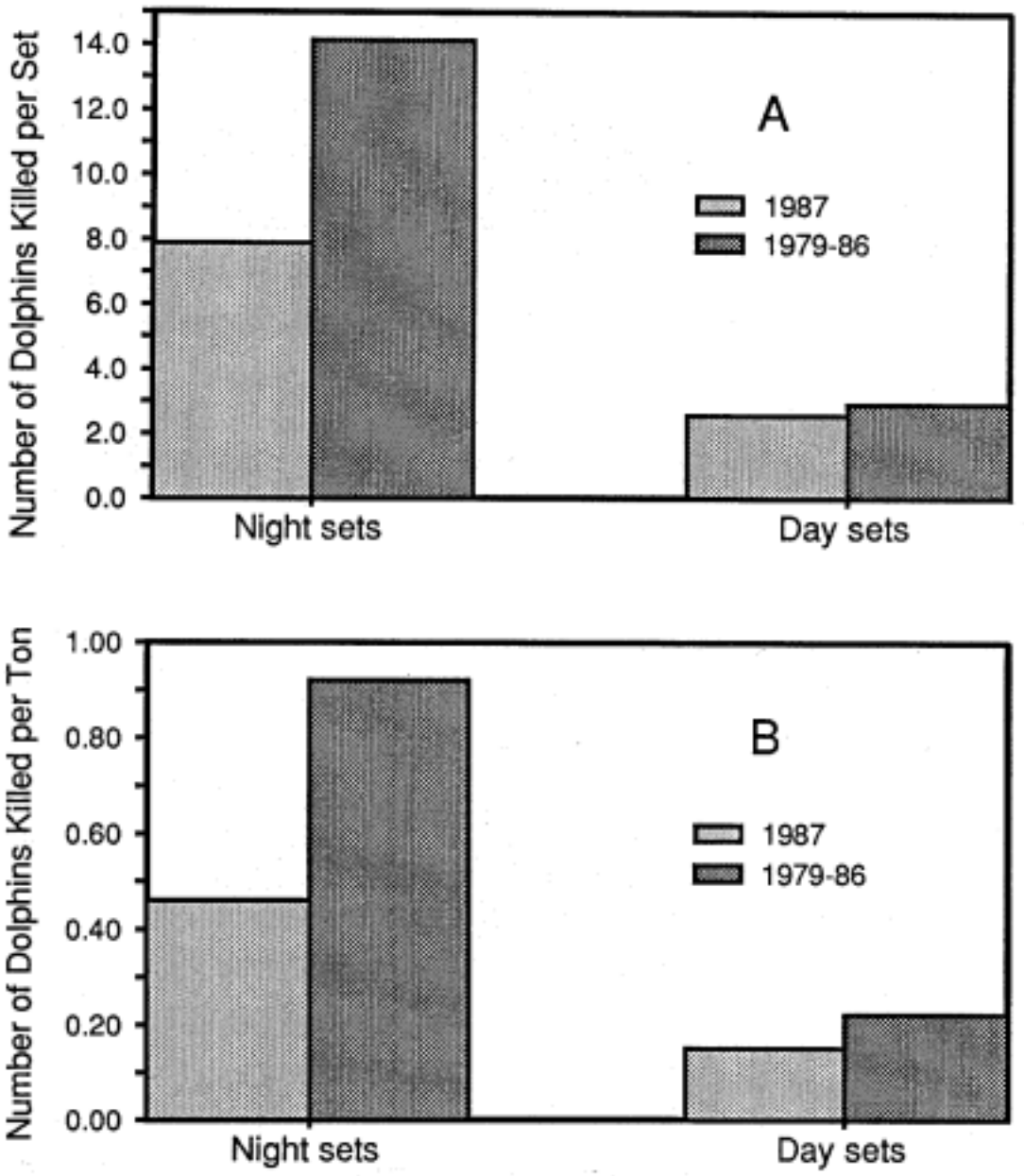
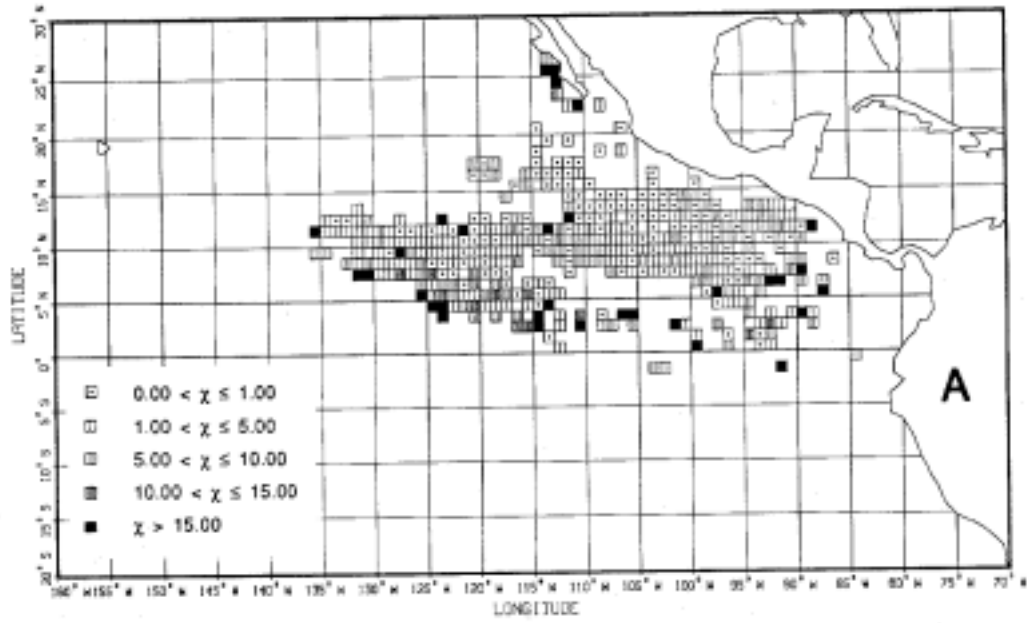


Figure 5. A: The dolphin kill-per-set rates, and B: kill-per-ton rates, by night sets versus day sets, for observed U.S. tuna purse seiners in the eastern tropical Pacific Ocean in 1987 compared to 1979-86.



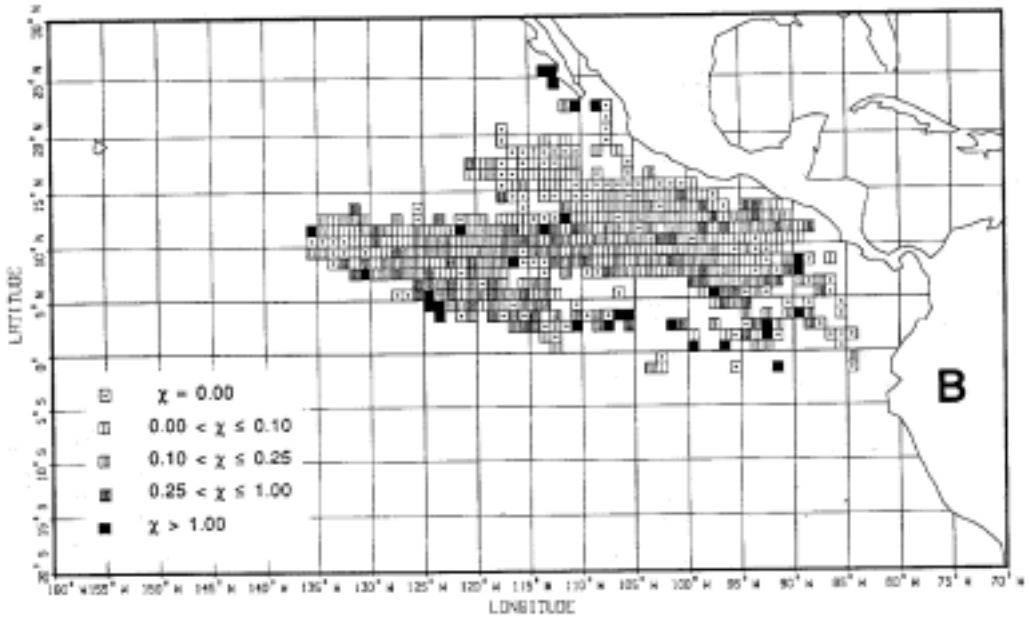


Figure 6. A: The dolphin kill-per-set rates, and B: kill-per-ton rates, by 1^{o} quadrats, for observed U.S. tuna purse seiners in 1987.

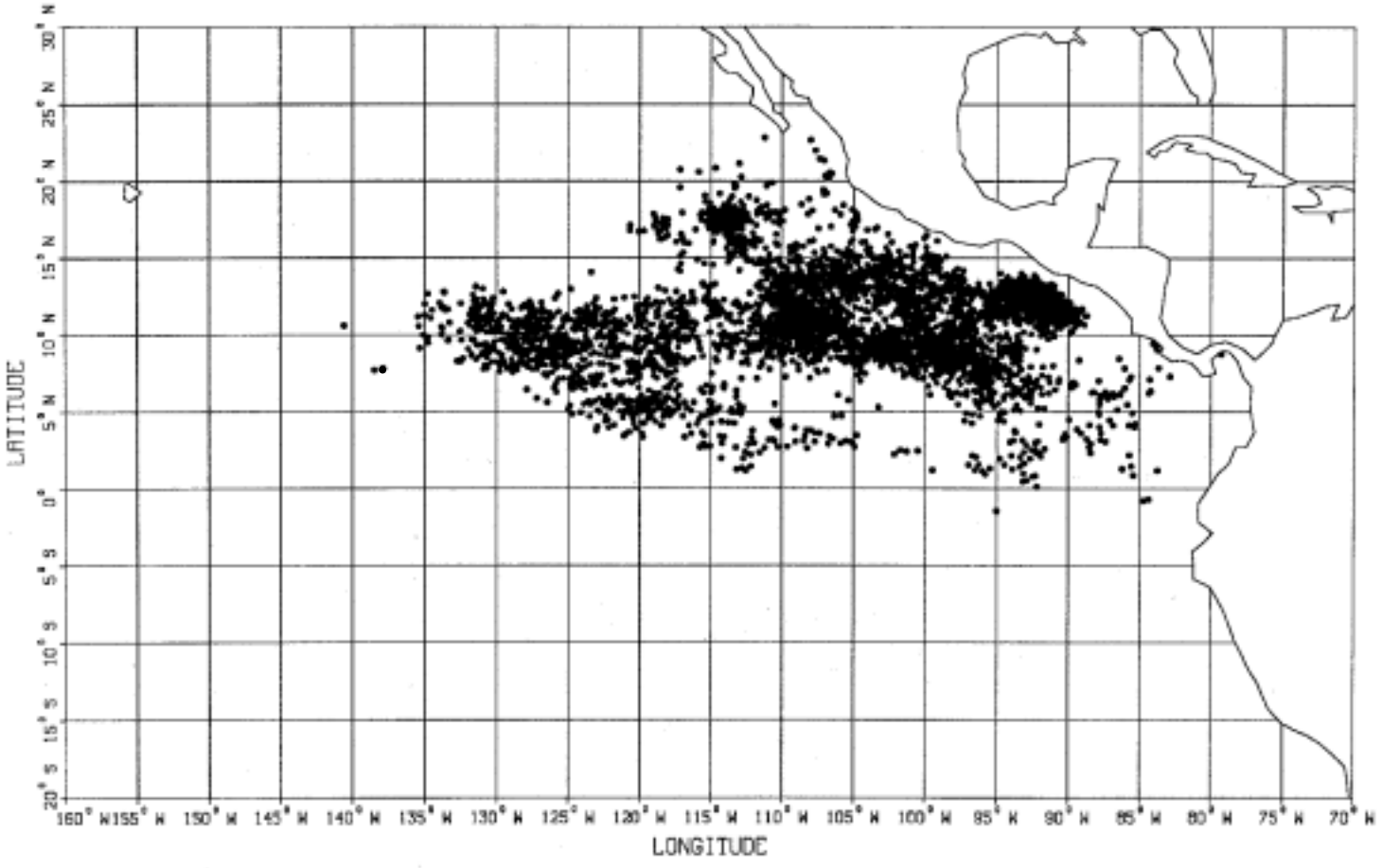


Figure 7A. Locations of offshore spotted dolphin sightings reported by observers aboard U.S. tuna purse seiners in 1987.

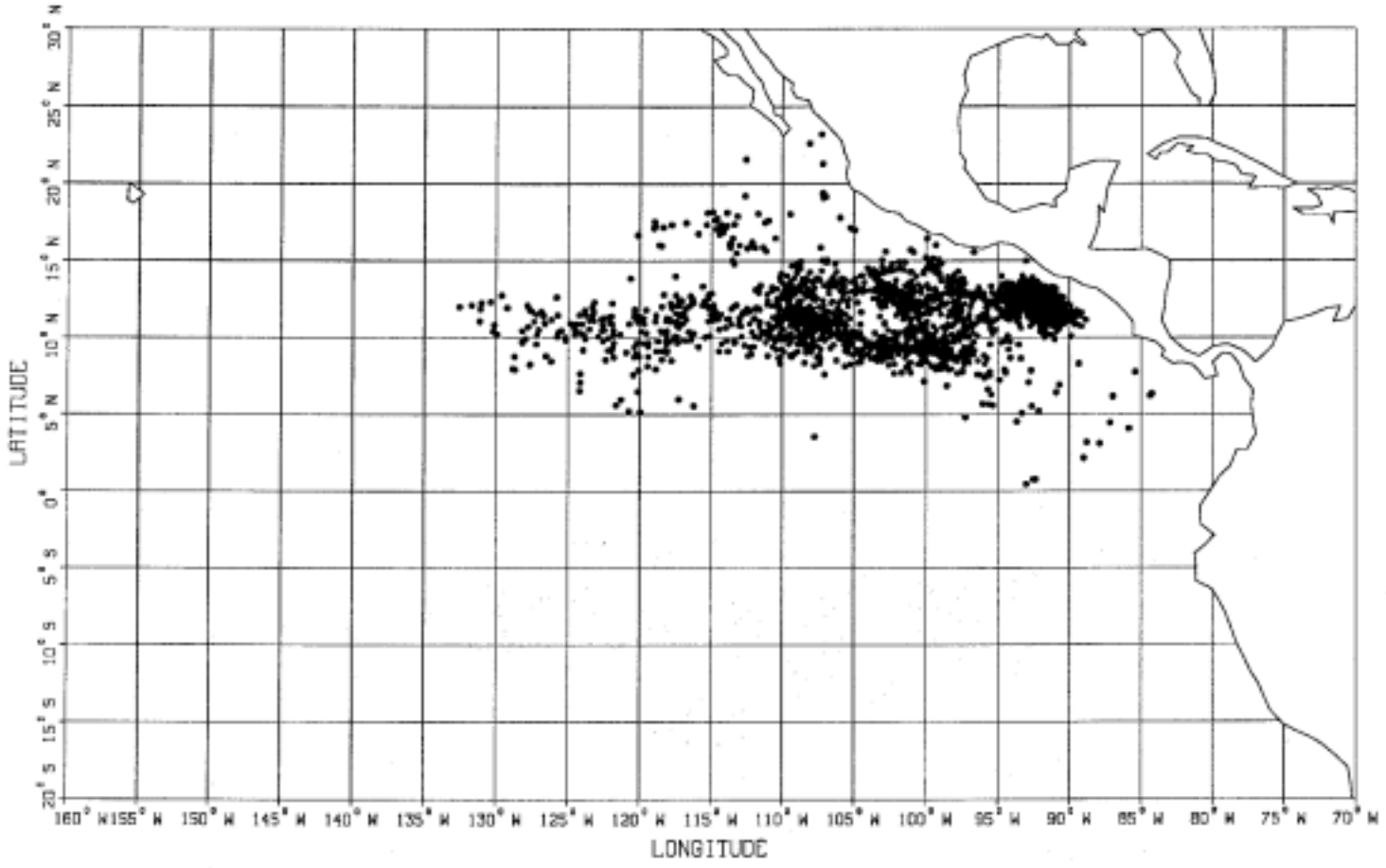


Figure 7B. Locations of eastern spinner dolphin sightings reported by observers aboard U.S. tuna purse seiners in 1987.

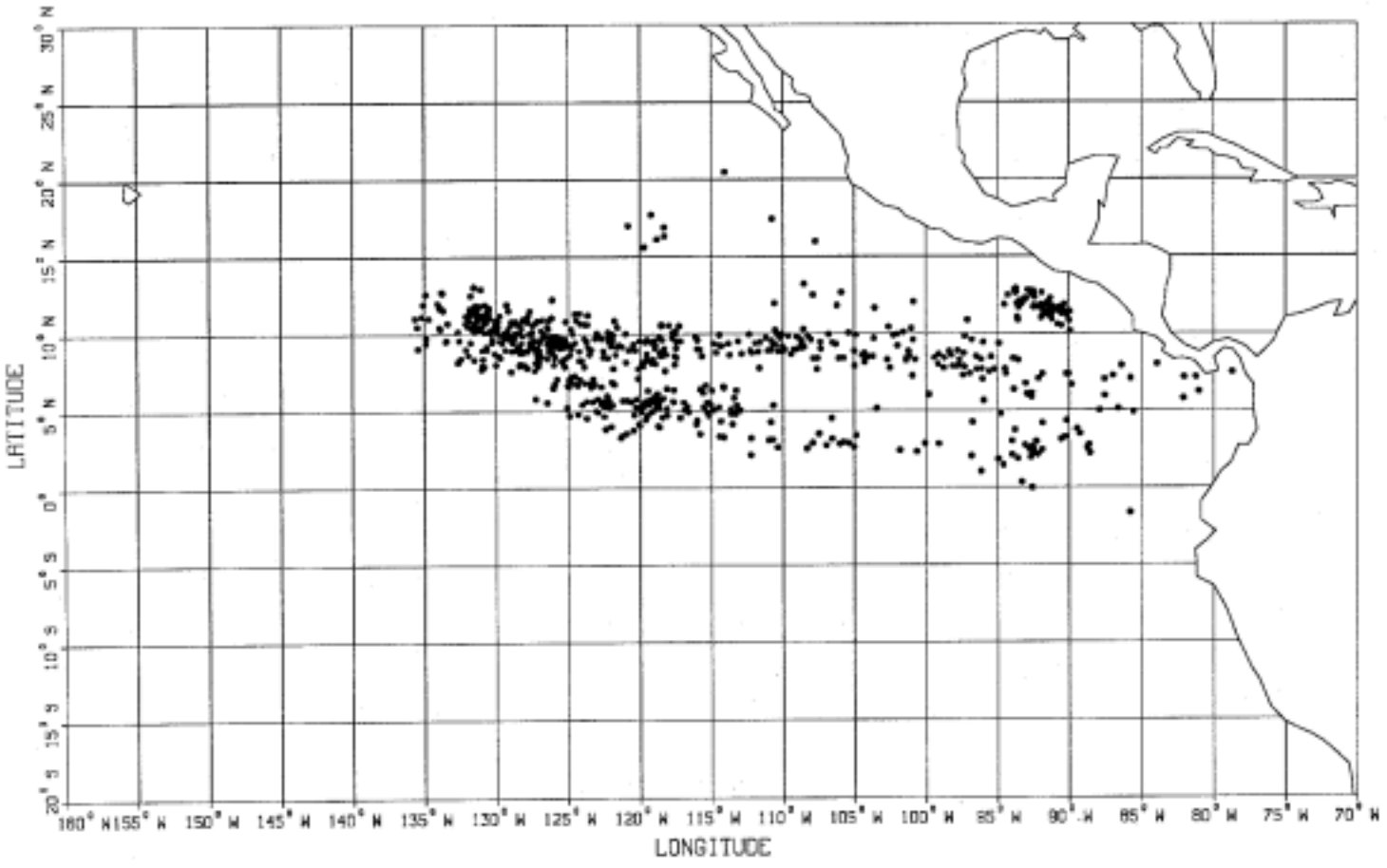


Figure 7C. Locations of whitebelly spinner dolphin sightings reported by observers aboard U.S. tuna purse seiners in 1987.

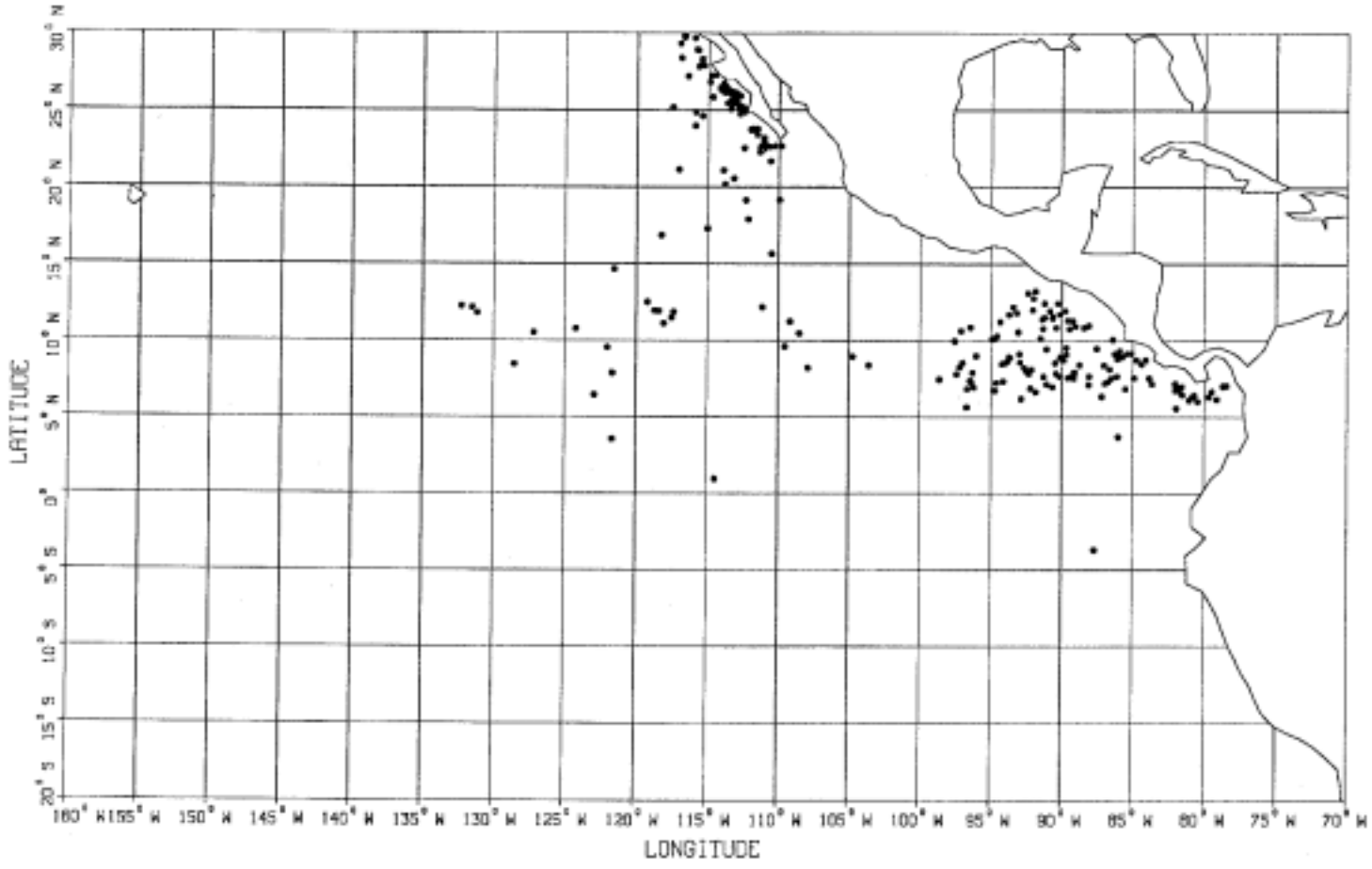


Figure 7D. Locations of common dolphin sightings reported by observers aboard U.S. tuna purse seiners in 1987.

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