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SUMMARY OF 1989
U.S. TUNA-DOLPHIN OBSERVER DATA

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SUMMARY OF 1989
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INTRODUCTION

Since 1971, the National Marine Fisheries Service's (NMFS) Tuna-Dolphin Observer Program has collected data on the mortality, life history, distribution and abundance of dolphins (historically referred to as "porpoise") 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 ETP yellowfin tuna purse seine fishery exploits the tuna-dolphin association 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, accounted for about 19% of the worldwide -yellowfin tuna catch in 1988, or about 4% of the worldwide catch of all tunas and tuna-like species (IATTC 1989, FAO 1990). Each year thousands of dolphins are killed 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),*** the eastern and whitebelly spinner dolphins (S. longirostris) and the common dolphin (Delphinus delphis).

The primary responsibility of the tuna-dolphin observer is to keep an accurate count of the number, the species and the stock of dolphins killed in each purse seine set. The observers are employees of the NMFS and collect data under the direction of either the NMFS's Marine Mammal Observer 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 trip , whether directed by the NMFS or the IATTC, slightly different sets of data are collected[2,3]. However, dolphin mortality information is collected by all observers.'

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[1] The estimated number of dolphins killed by the international fleet for 1989 was 96,979 (Hall and Boyer 1991). The annual allowable quota for certificated U.S. seiners from 1981-92 was 20,500 dolphins. The U.S. International Dolphin Conservation Act of 1992 reduced the quota for U.S. seiners to 800 dolphins for the period of January 1, 1993, to February 28, 1994.

[2] ***Tuna/Pmpoise Observer Field Manual.*** Marine Mammal Observer Branch, National Marine Fisheries Service. Long Beach, Calif.

[3] ***Field Manual.*** Tuna-Dolphin Program, Inter-American Tropical Tuna Commission. La Jolla, Calif.

This report is the third in a series of annual reports that summarizes U.S, tuna-dolphin 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 1989 calendar year.

SAMPLING COVERAGE

Beginning in 1989, U.S. regulations required the placement of an observer on every ETP fishing trip made by certificated U.S. purse seiners. Certificated U.S. seiners made 124 fishing trips entirely or partially within the 1989 calendar year, for a total of 6,708 fleet days! U.S. observers were aboard 123 of these trips (121 trips were observed in their entirety) for a total of. 6,664 days and an overall observer coverage rate of 99.3% of fleet days. The 44 unobserved fleet days resulted from three trips, that departed in late 1988 under no requirement to carry an observer and continued fishing into 1989. One of the three trips was completed on January 5, 1989, before it could be joined by an observer; however, observers were able-to join the other -two trips (on January 20 and 21, 1989). The 123. observed trips included one in which the vessel merely transited the permit area and conducted no fishing operations. The average length of an observed trip (excluding transit time outside the permit area and unloading time) was 59 days, shorter by 1 day than the average for 1988. Trips in 1989 ranged from 9 to 156 days in duration (Table 1).

There were 29 certificated US. purse seiners active in the ETP in 1989 (down from 37 in 1988), but by. year's end the number of active vessels stood at 26. The 3 vessels that left the U.S. fleet in 1989 were sold to interests in South Korea (2 vessels) and Vanuatu (1 vessel).

DOLPHIN SETS

The 123 trips observed in 1989 resulted in 3,484 intentional dolphin sets (setting the net in an attempt to capture dolphins) with a total catch of 66,200 short tons- (st) of yellowfin tuna[5] (catch estimated at sea; Table 2). The average observed yellowfin tuna catch-per-set on a school of dolphins was 19.0 st, up 10%- from the 1988 observed rate of 17.3 st and up 4% from the 1984-88 rate of 18.2 st (Figure 1). In addition to the 3,484 intentional dolphin sets, 7 accidental dolphin sets (sets -in which dolphins were captured merely by chance or without intention) were reported in 1989.

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[4] Ben S. Meyer, Marine Mammal Observer Branch, National-Marine Fisheries Service, Long Beach, Calif. pers: commun. September 1992.

[5] Although yellowfin tuna is the expected catch in dolphin sets, skipjack tuna ***(Katsuwonus pelamis)*** is also occasionally caught in these sets. In 1989, a total of 926 st of skipjack tuna was caught in the 3,484 observed intentional dolphin sets.

The geographic patterns of fishing on dolphins in 1989 differed somewhat from those of 1988 (Jackson 1990). There were concentrations of sets at 10°N and 125°W and 9°N and 134°W, two areas that were not fished as heavily during observed trips in 1988. Also, the fleet made a number of sets (59) in the area-bounded by 0°-4°s and 99°-113°W, an area in which no observed sets were made during the previous year (Figure 2a).

Dolphin fishing areas tended to change over the course of 1989, generally reflecting an established seasonal pattern (IATTC 1985). As in 1988; activity for the first quarter of the year was generally confined to an area east of 120°W between 5-20°N (Figure 2b). Within this area there were two concentrations of sets: one centered at about 12°N and 92°W; the other at 14°N between 100-105°W. Fishing effort shifted westward in the second quarter resulting in two major areas of activity: one between 5-15°N and 90-95°W; the other between 5-10°N and 120-140°W (Figure 2~). Unlike 1988, however, practically no sets were made between 10-15°N and 115-120°W. During the third quarter there was very little near-shore activity and sets were strung out between 7-10°N and 95-140°W (Figure 2d). There was an eastward shift in fishing activity in the fourth quarter, with the majority of sets located east of 115°W (Figure 2e). Unlike the previous year, however, there was some activity south of the equator. (62 sets).

DOLPHIN MORTALITY

A total of 12,560 dolphins[6] was killed in observed U.S. tuna purse seine trips in 1989 (Table 3). Of this, 12,548 were killed in intentional dolphin sets and 12 in accidental dolphin sets. The offshore spotted dolphin population sustained the most mortalities (6,513), followed by the whitebelly spinner dolphin (2,839), the eastern spinner dolphin (1,497) and the common dolphin (1,180). The geographic distributions of the total observed dolphin mortality, by population, are depicted in Figures 3a-e.

Because dolphins from different populations (especially spotted and spinner dolphins) often school together and, consequently, are often netted together, determining dolphin mortality rates (kill-per-set and kill-per-ton) by dolphin population is subjective. 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, or (2) divided by the total number of short tons of yellowfin tuna caught from intentional dolphin sets. Intentional dolphin sets include sets in which no dolphins were successfully captured. 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

[6] The estimated number of dolphins killed by the entire certificated U.S. fleet; including unobserved fishing trips, for 1989 was 12,643, based on the 12,560 observed mortalities and the observer coverage rate (Marine Mammal Commission 1991).

if more than one dolphin population was involved in the set; Examples of these methods are given by Jackson (1989).

The dolphin most frequently set on by observed US. seiners in 1989 was the offshore spotted dolphin (3,371 intentional sets), resulting in average kill-per-set and kill-per-ton rates of 1.93 and 0.10, respectively (Table 4). This was followed by the eastern spinner (1,169 sets), with rates of 1.28 and 0.08, and the whitebelly spinner (896 sets), with rates of 3.17 and 0.12. Characteristically, the common dolphin exhibited the highest kill rates: 96 sets resulting in kill-per-set and kill-per-ton rates of 12.29 and 0.58, respectively.

The 1989 overall dolphin kill-per-set and kill-per-ton rates of 3.60 and 0.19, respectively, were lower than the 1988 rates of 5.21 and 0.30 and the 1984-88 average rates of 4.55 and 0.25. Some of the factors that may have contributed to the lower kill rates were: the prohibition of sundown sets, effective January 1, 1989; lower percentage of sets on common dolphins in 1989 (2.8%) than in 1988 (4.4%); higher percentage of dolphin sets in an area (east of 132°W and north of 5°N) historically characterized by lower kill rates in 1989 (82.0%) than in 1988 (76.1%); higher percentage of no-kill sets in 1989 (59.7%) than in 1988 (55.0%); and lower percentage of very high kill sets (more than 50 dolphins killed) in 1989 (1.0%) than in 1988 (1.7%). After a dramatic improvement in dolphin kill-per-set and kill-per-ton rates in 1977, the performance of the U.S. fleet has since fluctuated at a lower level (Figures 4a,b).

Of the 3,484 intentional dolphin sets in 1989, 2,080 sets (59.7%) resulted in no dolphin mortality, and 171 (4.9.%) were sets in which more-than 15 dolphins were killed (Figure 5a). This compares favorably to 1988 when no-kill sets accounted for 55.0% and sets in which more than 15 dolphins were killed accounted for 6.9% of the total, and to the 1984-88 average rates of 59.0% and 5.8%. Nearly 65% of the dolphin mortality in 1989 occurred in sets in which more than 15 dolphins were killed (Figure 5b). The greatest number of dolphins killed in a -single set in 1989 was 806 (595 offshore -spotted, 199 whitebelly spinner and 12 unidentified dolphins).

The frequency distributions of dolphins killed per set were quite similar for the three most frequently set upon populations: offshore spotted, eastern spinner and whitebelly spinner dolphins. For the common dolphin, however, a much different pattern is evident, with no-kill sets accounting for only 27% of the total (Figure 6).

Geographically, areas of high dolphin kill-per-set and kill-per-ton in 1989 tended to be located along the southern and western periphery of the general fishing area, areas that historically have not been heavily fished, and off Costa Rica (Figures 7a,b). This situation is consistent with that of recent years (IATIC 1989). The dolphin most often involved in high-kill sets along the southern and western periphery was the offshore spotted dolphin; the high-kill sets off Costa Rica involved the common dolphin, almost 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 1989, U.S. observers logged 26,962 hours of watch effort, during which 527,566 kilometers were traveled. There were 4,538 sightings reported by observers of offshore spotted dolphins, the population normally sought by the fishery, with an estimated average school size of 691 dolphins (Table 5). Also frequently sighted, and often in association with spotted dolphins, were eastern spinner dolphins (1,677 sightings, average school size 442) and whitebelly spinner dolphins (1,093 sightings, average school size 265). Other cetaceans quite frequently encountered, yet not normally associated with yellowfin tuna, were bottlenose dolphins (540 sightings), short-finned pilot whales ***(Globicephala macrorhynchus,*** 275 sightings) and sperm whales ***(Physeter macrocephalus,*** 133 sightings). .Locations of dolphin sightings, by population, are depicted in Figures 8a-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 Science 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 laboratory examination of teeth, fetuses and testes or ovaries collected in the field.

Complete life history data were collected for 2,460 dolphin specimens, or 20% of the animals that were observed to be taken in the fishery in 1989; minimum data were collected for 3,164 specimens (Table 6).

SUMMARY

In 1989, 123 of the 124 fishing trips in the ETP made entirely or partially within the calendar year by certificated U.S. tuna purse seiners carried observers. The overall coverage rate was 99.3% of fleet days. On these 123 observed trips, 3,484 intentional dolphin sets were made, resulting in a yellowfin tuna catch of 66,200 st and 12,548 dolphins killed. The observed dolphin kill-per-set and kill-per-ton of yellowfin tuna were 3.60 and 0.19, respectively, lower than the 1988 rates of 5.21 and 0.30 and the 1984-88 average rates of 4.55 and 0.25. Of all intentional dolphin sets, 59.7% resulted in no dolphin mortality, while 64.7% of all dolphin mortality occurred in the 171 sets in which more than 15 dolphins were

killed. The greatest number of dolphins killed in a single set was 806. Geographic areas of high dolphin kill-per-set and kill-per-ton tended to be located along the southern and western periphery of the traditional fishing grounds and off Costa Rica. Observers logged 26,962 hours of marine mammal watch effort and collected complete life history data for 2,460 dolphin specimens.

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, M. Trianni and D. Logan 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 the IATTC data I required. R. Allen enhanced the appearance of the figures. D. Bratten, A. Coan, E. Edwards, B. Meyer and R. Salomons 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.*** NOM Tech. Rep. NMFS 28,28 p.

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Table 1. Trip length (in days) for observed U.S. tuna purse seine trips in the eastern tropical Pacific Ocean, 1989.

Trip Length	Trip Departing Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Total
Average	57	54	68	60	59
Maximum	93	117	156	113	156
Minimum	9	9	26	15	9
Number of departures	33	33	28	23	117

(This table excludes 4 cruises that departed in 1988 and continued fishing into 1989 and 2 cruises that were only partially observed.)

Table 2. Number of sets and tuna catch for tuna-dolphin sets made on observed U.S. tuna purse seine trips in the eastern tropical Pacific Ocean, 1989.

Set type	Number Sets	Catch (st) Yellowfin	Skipjack
Intentional	3,484	66,200	926
Accidental	7	70	59
Total	3,491	66,270	985

Table 3. Observed incidental dolphin mortality for U.S. tuna purse seine trips in. the eastern tropical Pacific Ocean and estimated total incidental mortality for the entire U.S. fleet, 1989.

Population	Sex				Estimated
	Male	Female	Unknown	Total	Total
Offshore spotted	1,307	1,726	3,480	6,513	6,557
Whitebelly spinner	527	568	1,744	2,839	2,931
Eastern spinner	353	384	760	1,497	1,468[2]
Common	152	167	861	1,180	1,188
Costa Rican spinner	4	6	218	228	*
Unidentified	0	0	170	170	*
Striped	19	14	23	56	56
Unidentified spinner	16	15	4	35	*
Bottlenose	8	6	14	28	*
Rough-toothed	0	0	13	13	*
Short-finned pilot whale	0	0	1	1	*
Total	2,386	2,886	7,288	12,560	12,643

[1] Porpoise Mortality Status Report No. 89-22. Marine Mammal Observer Branch, National Marine Fisheries Service. 501 West Ocean Boulevard, Suite 4200, Long Beach, Calif.

[2] Estimated mortality is less than actual observed mortality due to the reassignation of some observed mortality based on a later review of the data.

* No estimation was made for this category.

Table 4. Dolphin kill-per-set and dolphin kill-per-ton. (st) of yellowfin tuna- from intentional dolphin sets for observed U.S. tuna purse seine-trips in the eastern tropical Pacific Ocean, 1989.

Population	Sets	Kill	Catch (st)	Kill /Set	Kill /st
Offshore spotted	3,371	6,513	64,213	1.93	0.10
Eastern spinner	1,169	1,497	19,400	1.28	0.08
Whitebelly spinner	896	2,839	22,943	3.17	0.12
Common	96	1,180	2,035	12.29	0.58
All Dolphin Sets	3,484	12,548	66,200	3.60	0.19

(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. Number of marine mammal school sightings and average size of schools sighted by observers during U.S. tuna purse seine trips in the eastern tropical Pacific Ocean, 1989.

Population	Sightings	School Size
Offshore spotted dolphin	4,538	691
Eastern spinner dolphin	1,677	442
Whitebelly spinner dolphin	1,093	265
Bottlenose dolphin	540	42
Common dolphin	379	720
Short-finned pilot whale	275	27
Unidentified spinner dolphin	225	242
Striped dolphin	141	175
Sperm whale	133	9
Killer whale	41	4
False killer whale	34	18
Unidentified beaked whale	30	3
Risso's dolphin	27	22
Coastal spotted dolphin	24	138
Unidentified rorqual	23	2
Rough-toothed dolphin	18	18
Unidentified spotted dolphin	18	464
Blue whale	16	1
Humpback whale	8	3
Cuvier's beaked whale	7	2
Fraser's dolphin	6	269
Pygmy killer whale	6	20
Minke whale	6	2
Pacific white-sided dolphin	5	31
Unidentified mesoplodon	5	2
Gray whale	4	6
Costa Rican spinner dolphin	4	1,102
Melon-headed whale	3	1,000
Unidentified pilot whale	3	36
Bryde's whale	1	1
Fin whale	1	1

Table 6. Number of dolphin life history specimens collected during U.S. tuna purse seine trips in the eastern tropical Pacific Ocean, 1989.

Population	Complete Data			Partial Data		
	Male	Female	Total	Male	Female	Total
Offshore spotted	551	774	1,325	732	1,011	1,743
Whitebelly spinner	260	315	575	341	379	720
Eastern spinner	132	149	281	182	201	383
Common	99	116	215	110	132	242
Spinner, stock unknown	12	16	28	16	18	34
Striped	17	7	24	18	12	30
Costa Rican spinner	4	6	10	4	6	10
Bottlenose	0	2	2	0	2	2
Total	1,075	1,385	2,460	1,403	1,761	3,164

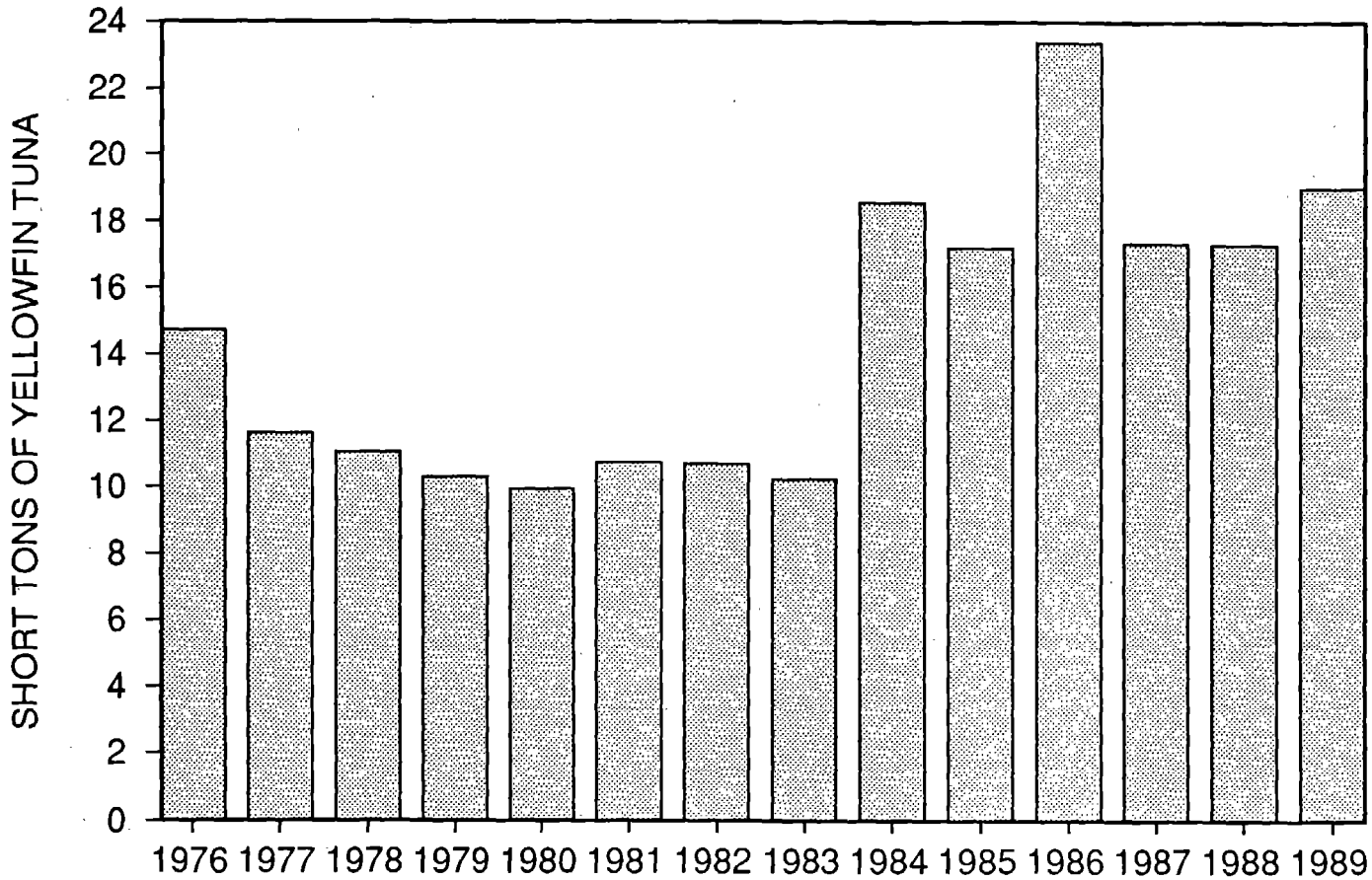

Figure 1. Average catch (short tons) of yellowfin tuna per observed set on dolphins by U.S. tuna purse seiners in the eastern tropical Pacific Ocean, by year, for 1976 to 1989.

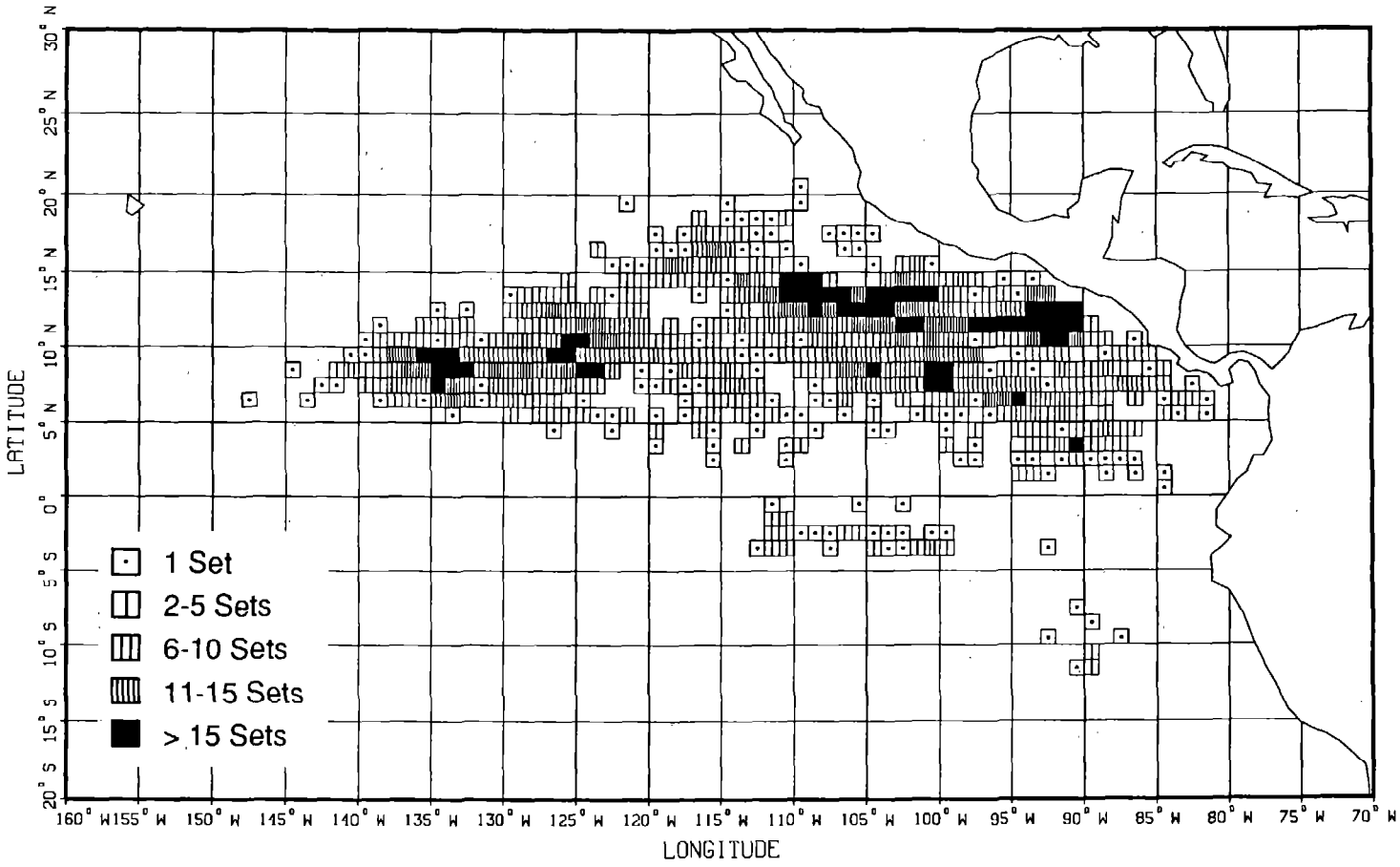

Figure 2a. Number of intentional dolphin sets, by 1° quadrat, made on observed U.S. tuna purse seine trips in 1989.

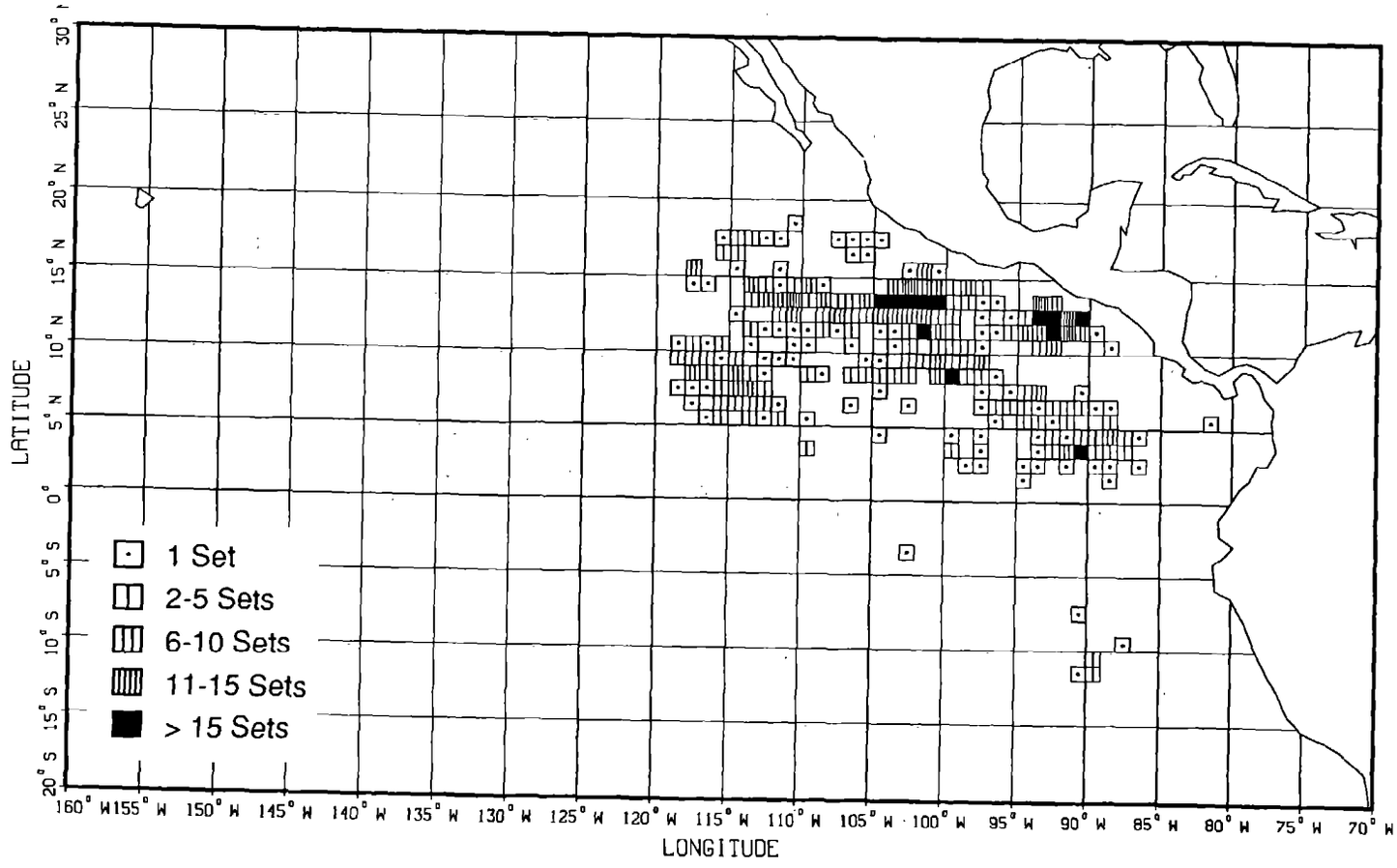

Figure 2b. Number of intentional dolphin sets, by 1° quadrat, made on observed U.S. tuna purse seine trips in the first quarter of 1989.

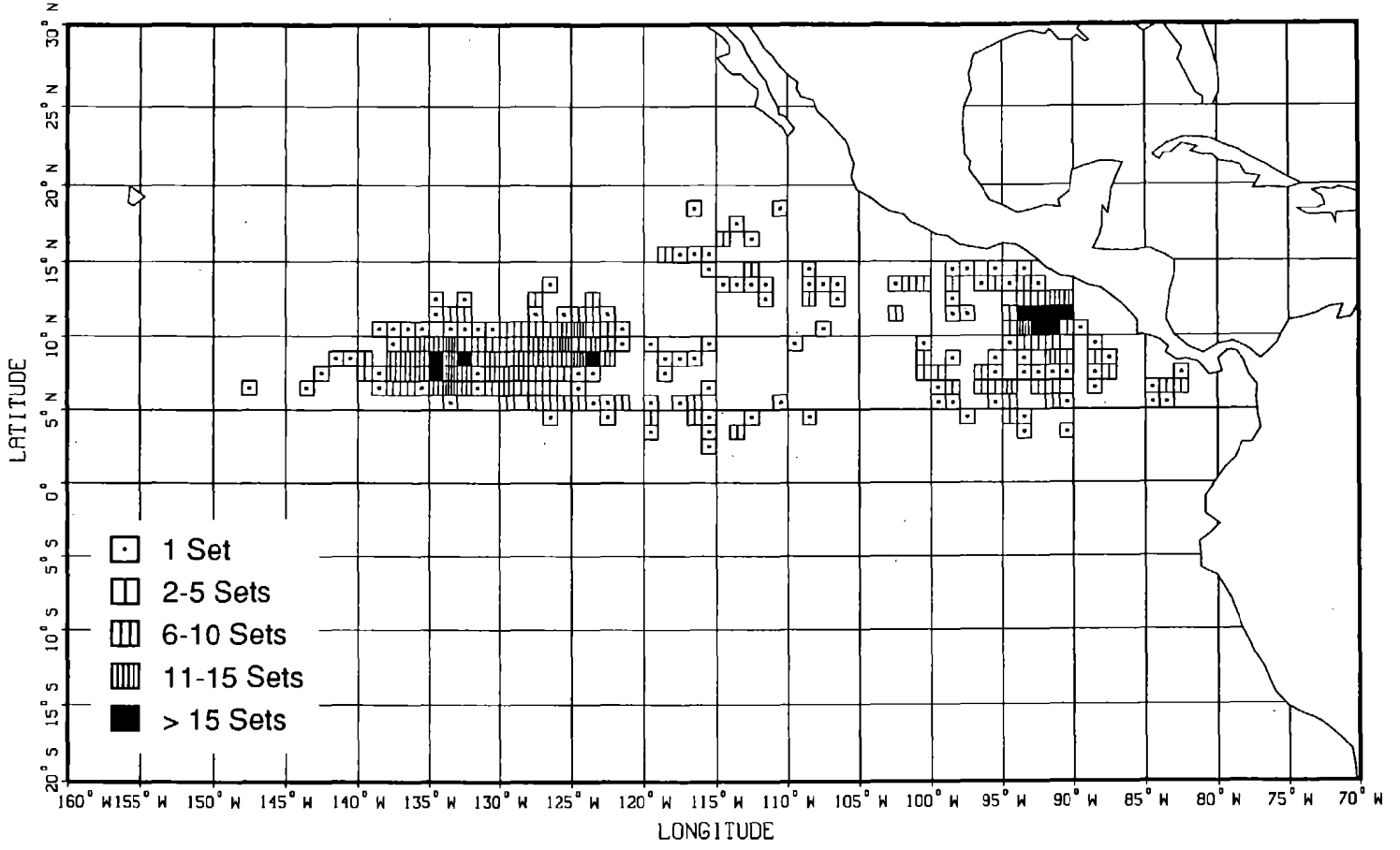

Figure 2c. Number of intentional dolphin sets, by 1° quadrat, made on observed U.S. tuna purse purse trips in the second quarter of 1989.

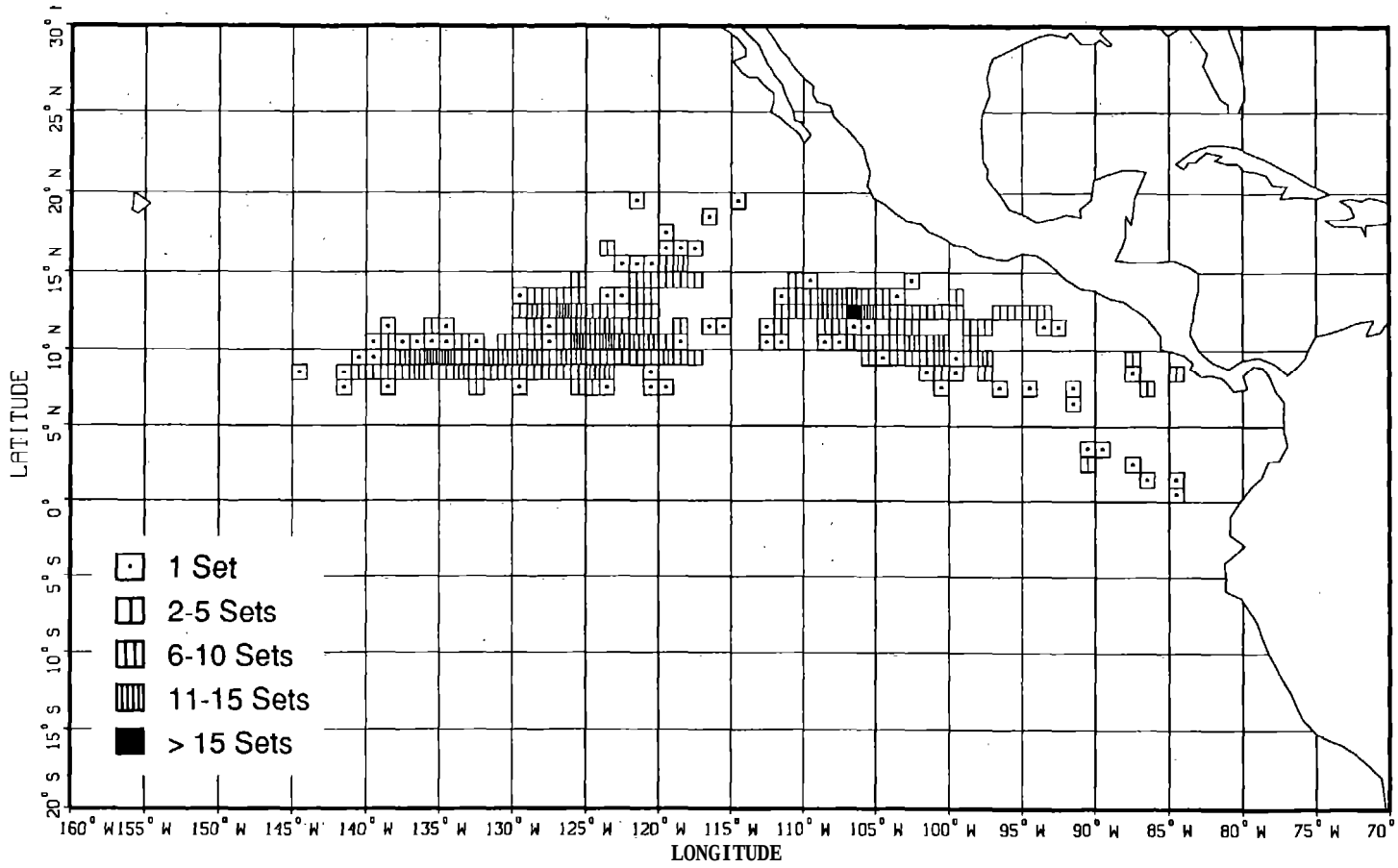

Figure 2d. Number of intentional dolphin sets, by 1° quadrat, made on observed U.S. tuna purse seine trips in the third quarter of 1989.

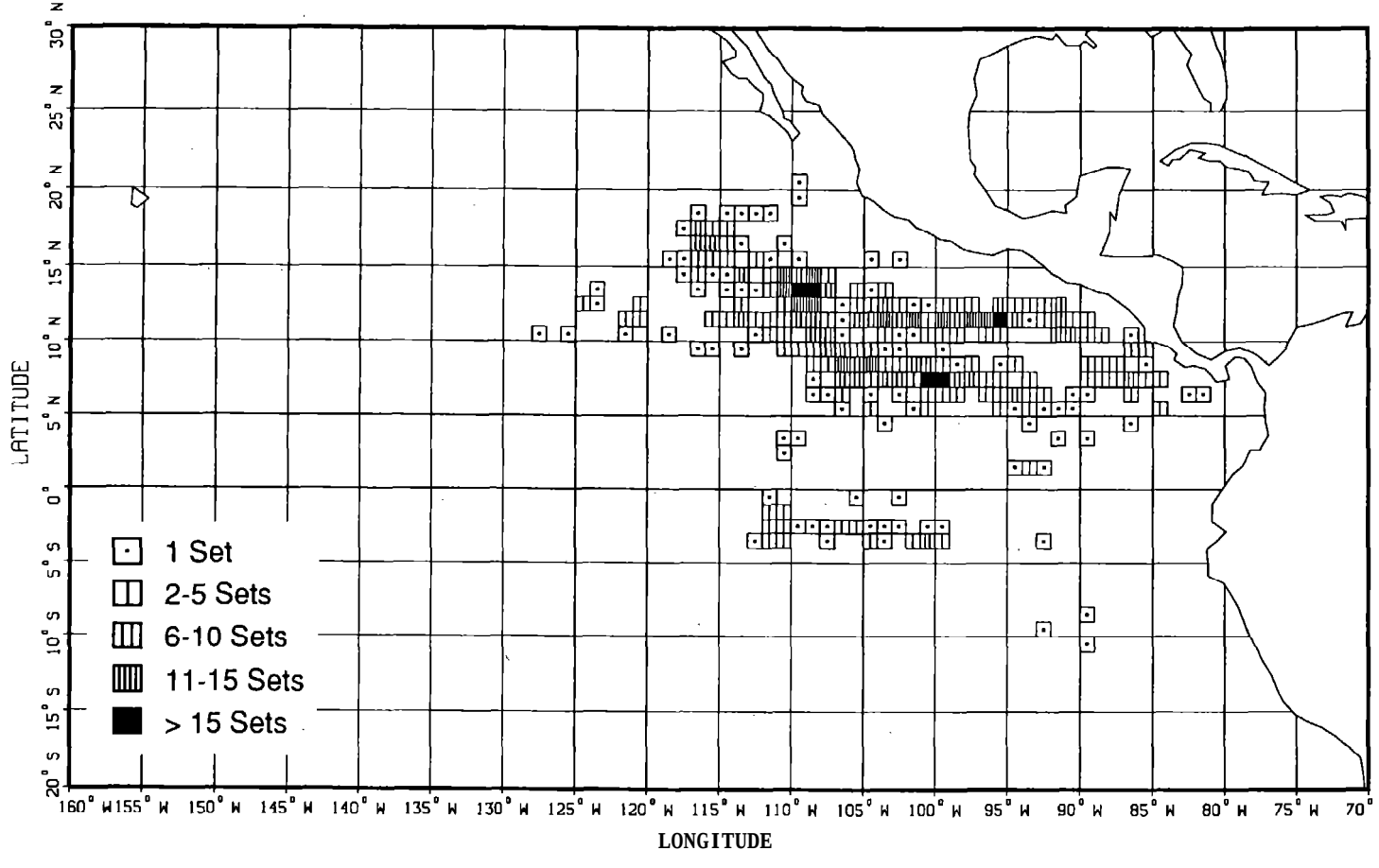

Figure 2e. Number of intentional dolphin sets, by 1° quadrat, made on observed U.S. tuna purse seine trips in the fourth quarter of 1989.

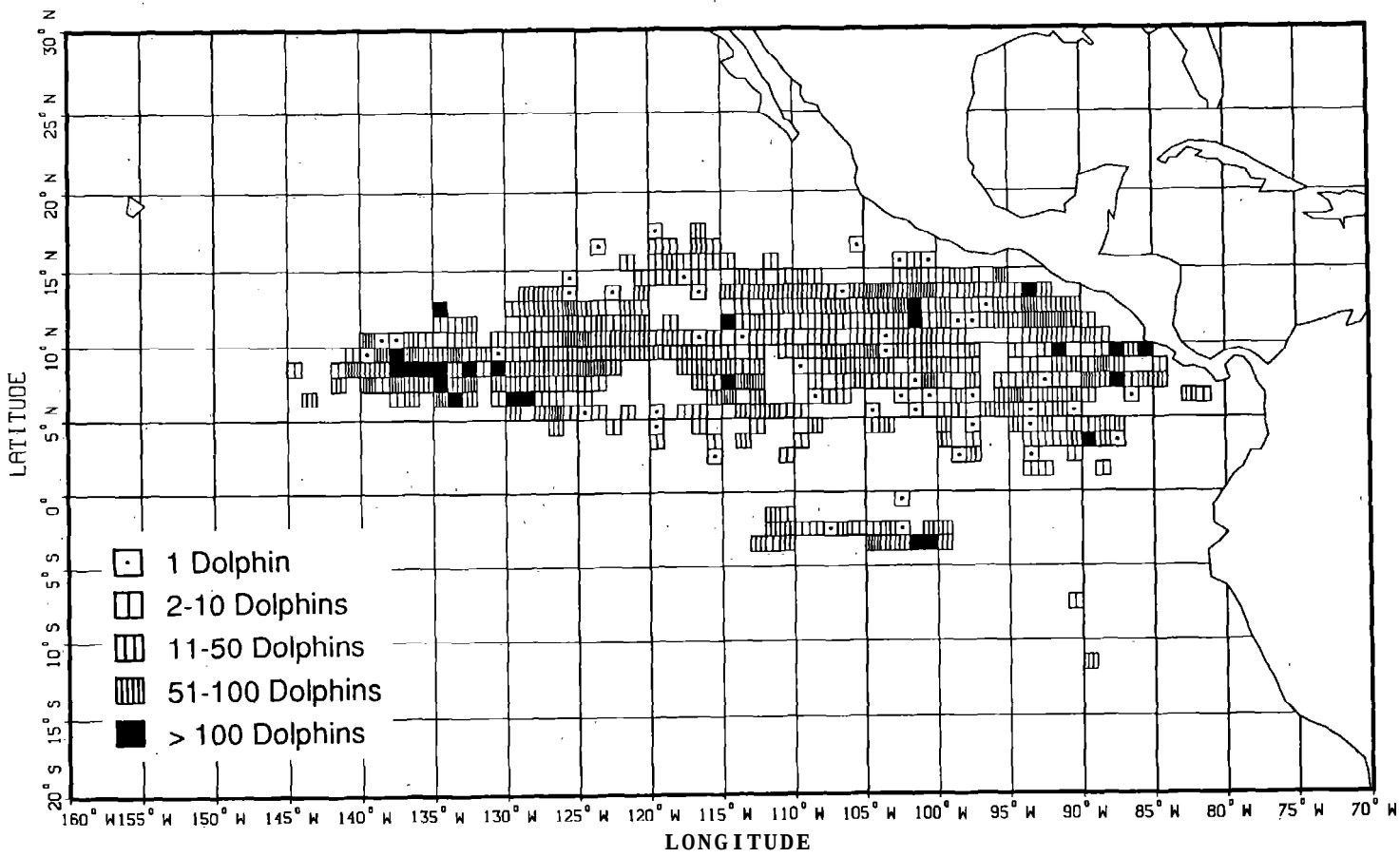

Figure 3a. Total number of dolphins, by 1° quadrat, killed on observed U.S. tuna purse seine trips in 1989.

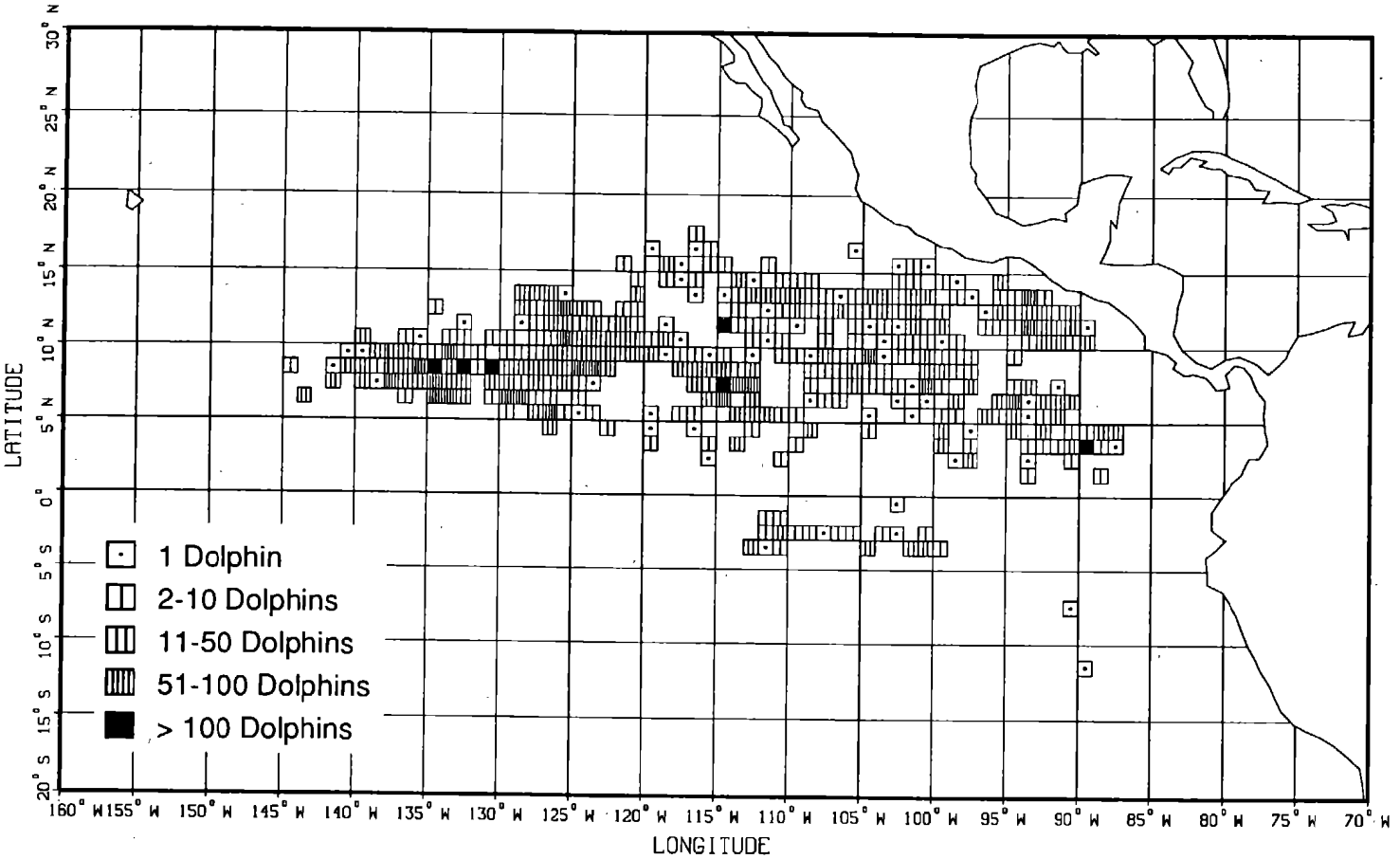

Figure 3b. Total number of offshore spotted dolphins, by 1° quadrat, killed on observed U.S. tuna purse seine trips in 1989.

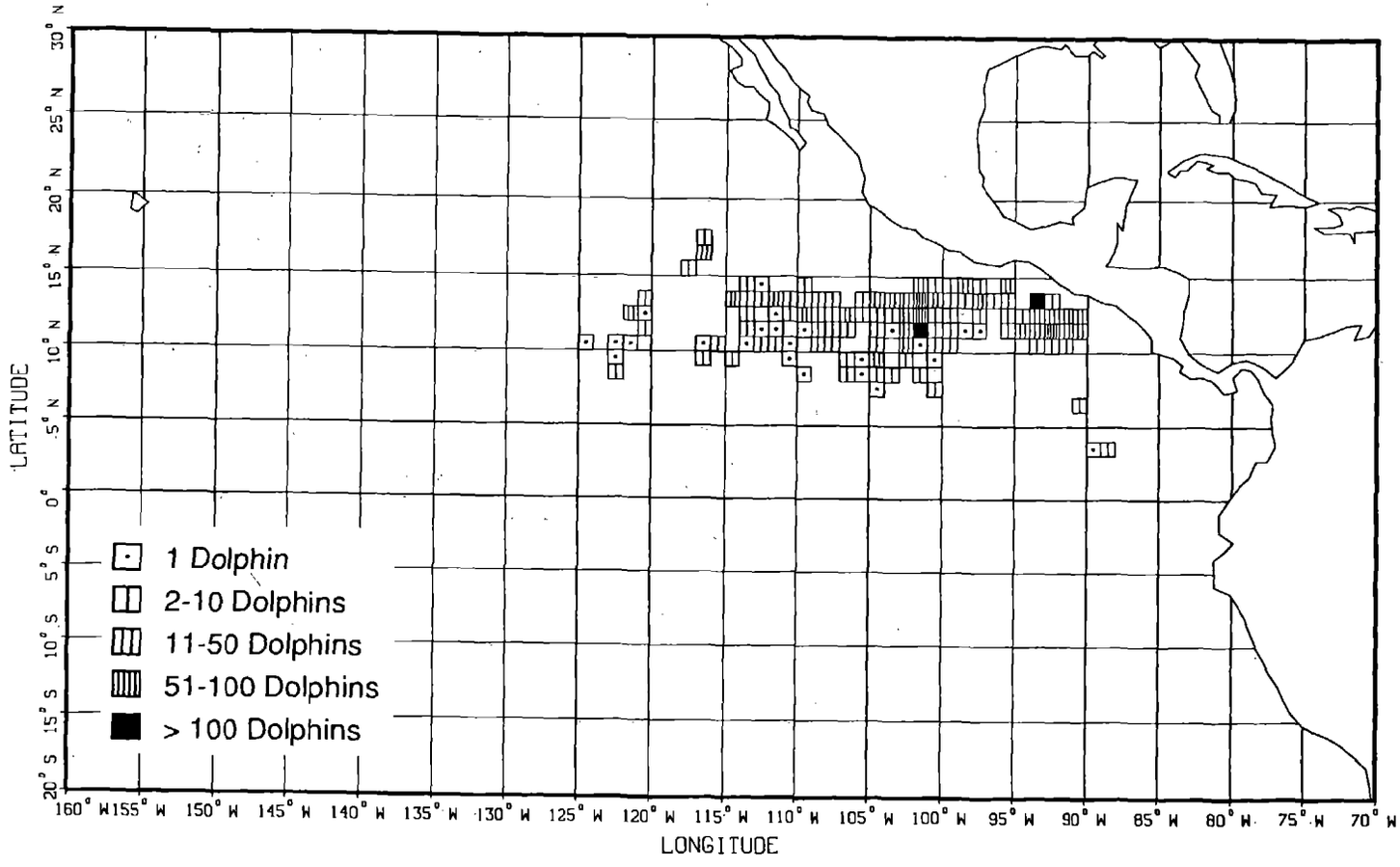

Figure 3c. Total number of easter spinner dolphins, by 1°quadrat, killed on observed U.S. tuna purse seine trips in 1989.

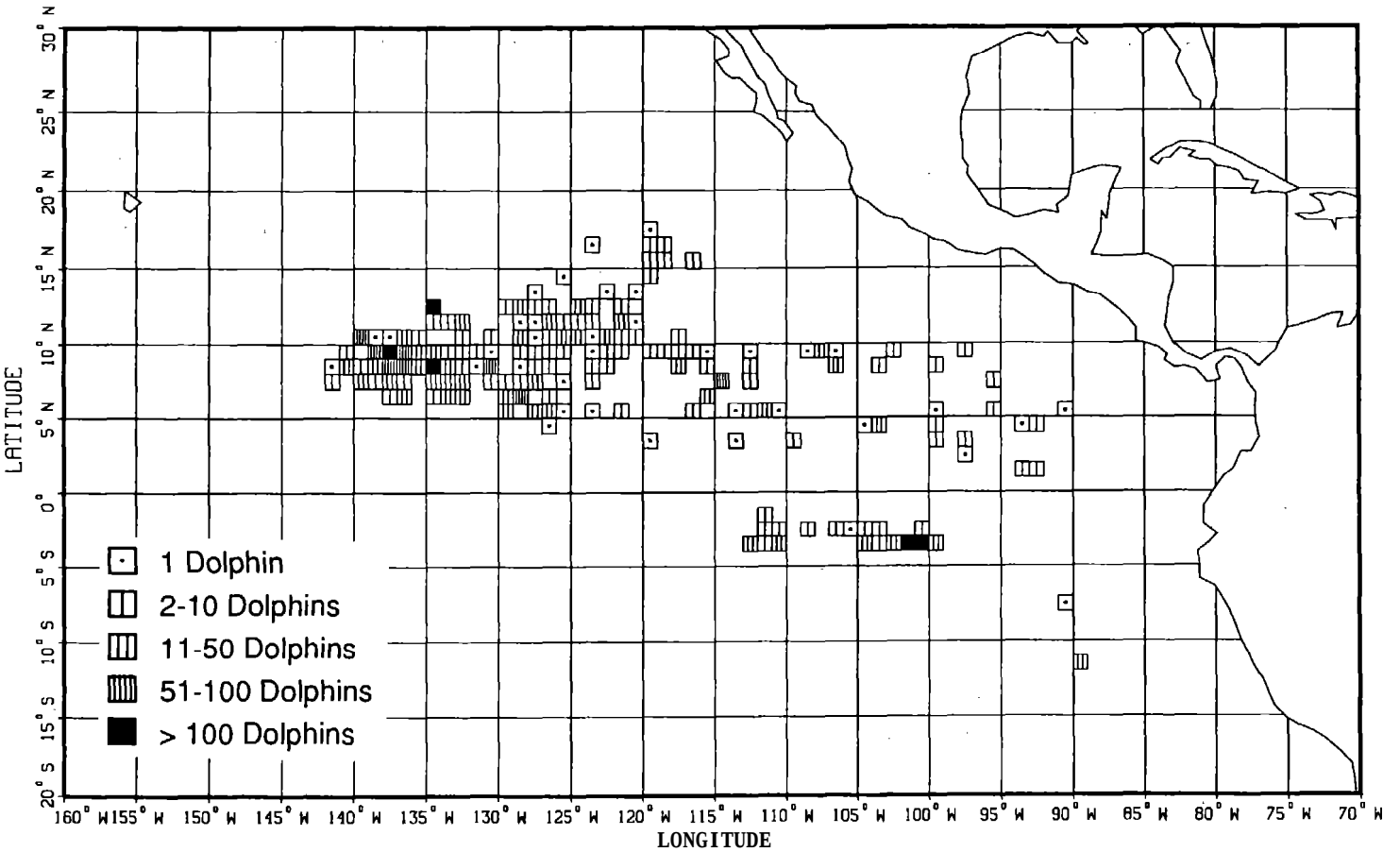

Figure 3d. Total number of whitebelly spinner dolphins, by 1° quadrat, killed on observed U.S. tuna purse seine trips in 1989.

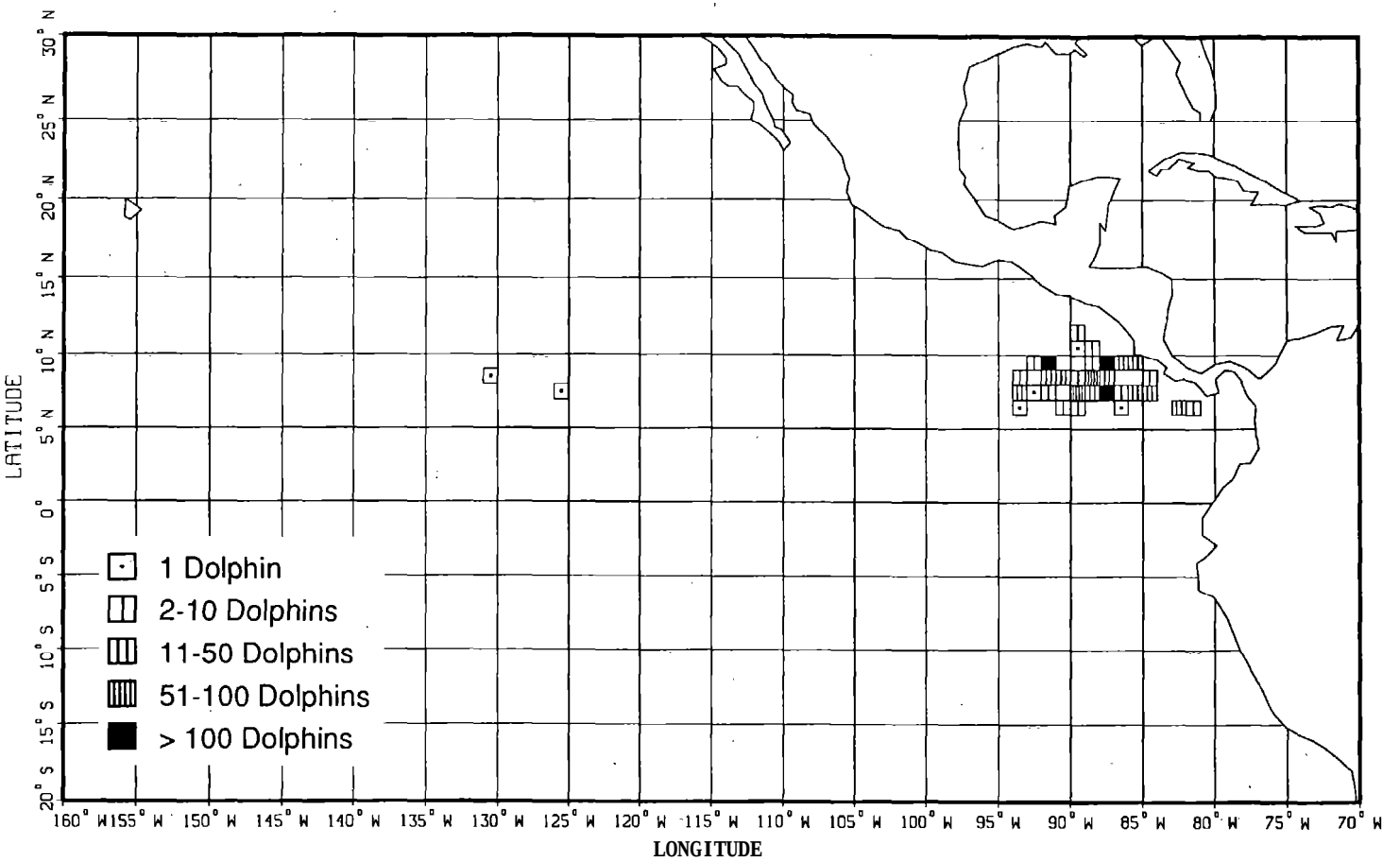

Figure 3e. Total number of common dolphins, by 1° quadrat, killed on observed U.S. tuna purse seine trips in 1989.

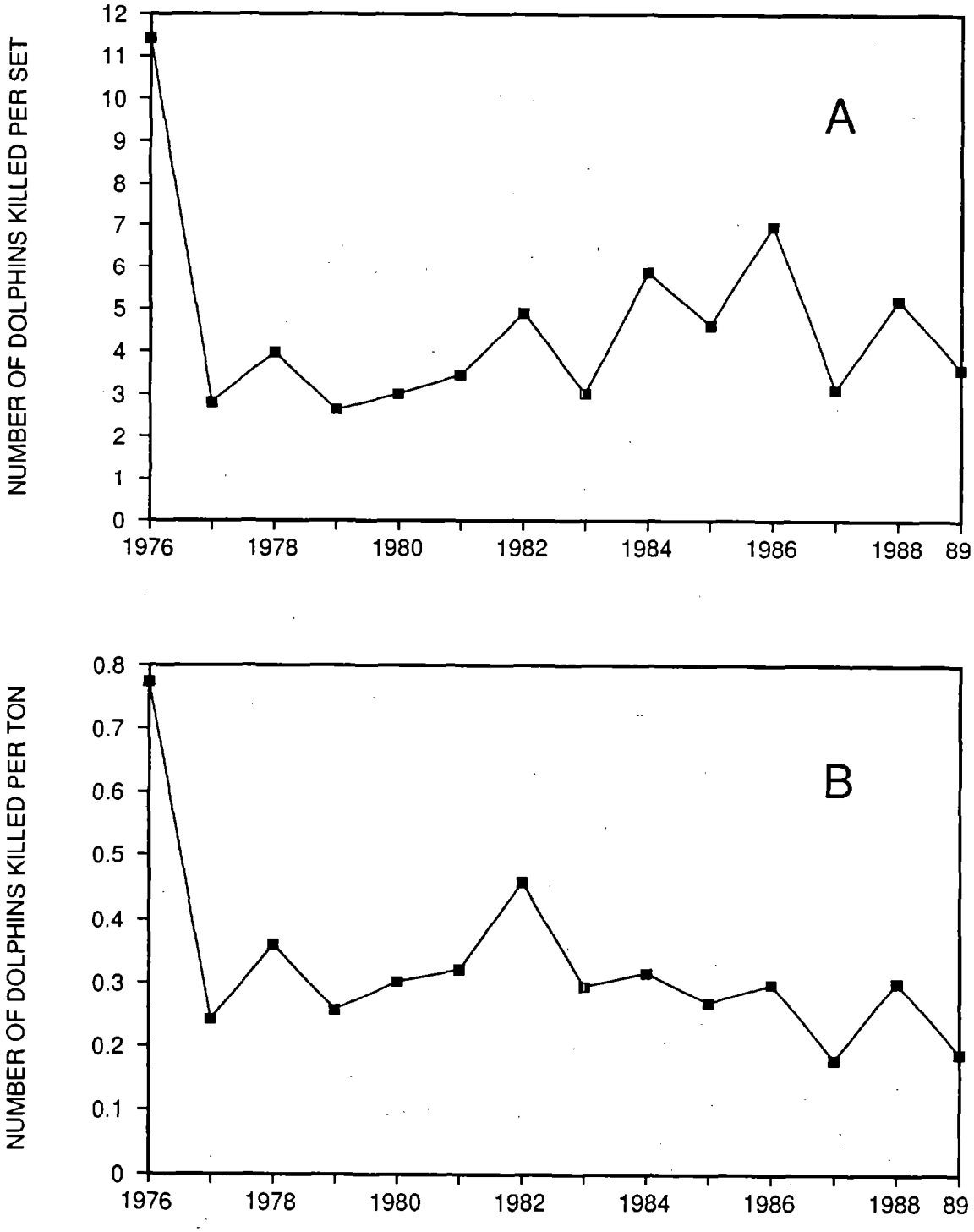

Figure 4 a: Dolphin kill-per-set, and b: dolphin kill-per-ton for U.S. tuna purse seine trips in the eastern tropical Pacific Ocean from 1976 to 1989.

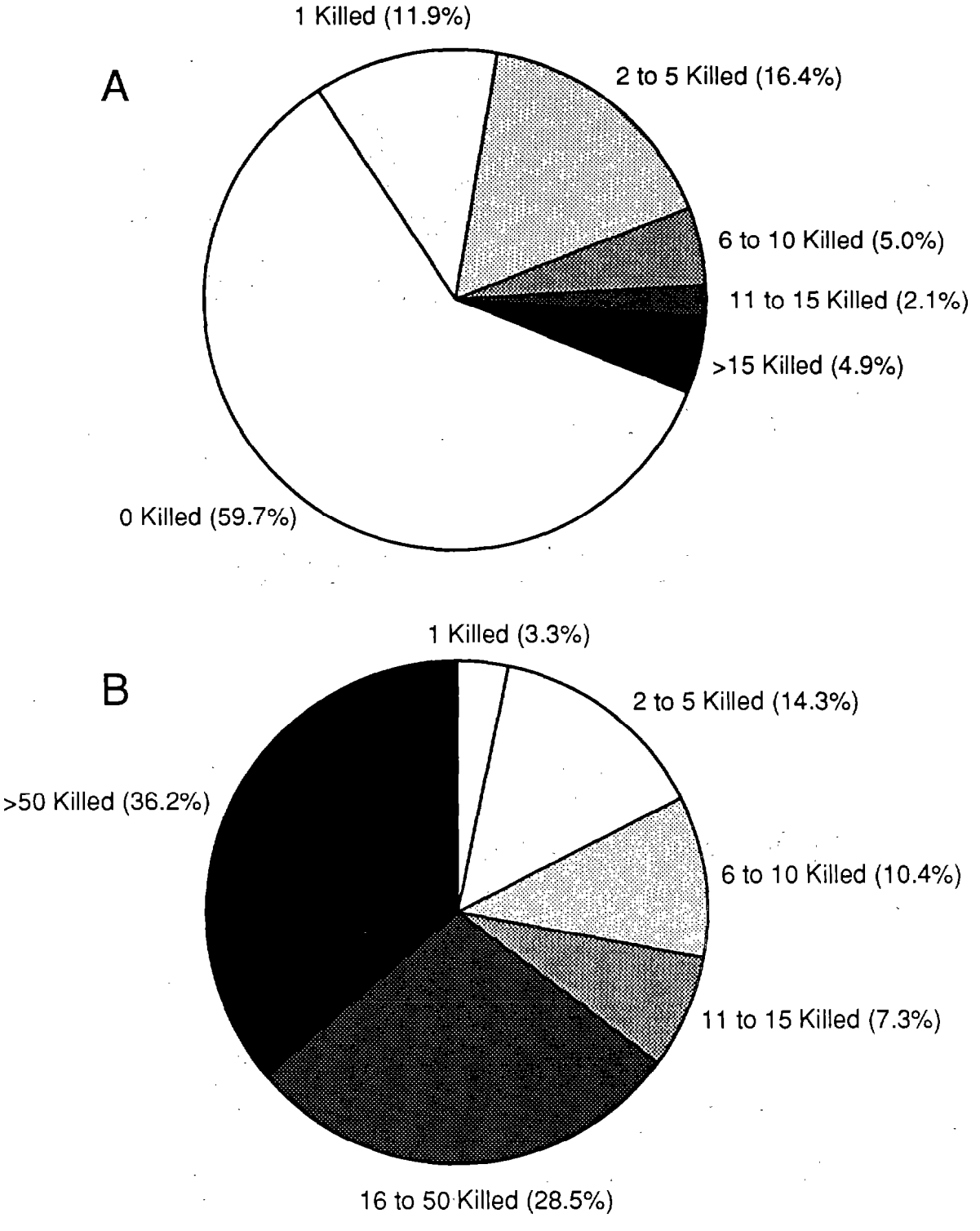

Figure 5 a: Proportion of dolphin sets that resulted in dolphin mortalities of 0, 1, 2-5, 6-10, 11-15 and more than 15 animals; and b: proportion of total dolphin mortality that resulted from sets with dolphin mortalities of 1, 2-5, 6-10, 11-15, 16-50 and more than 50 animals, for observed U.S. tuna purse seine trips in the eastern tropical Pacific Ocean in 1989.

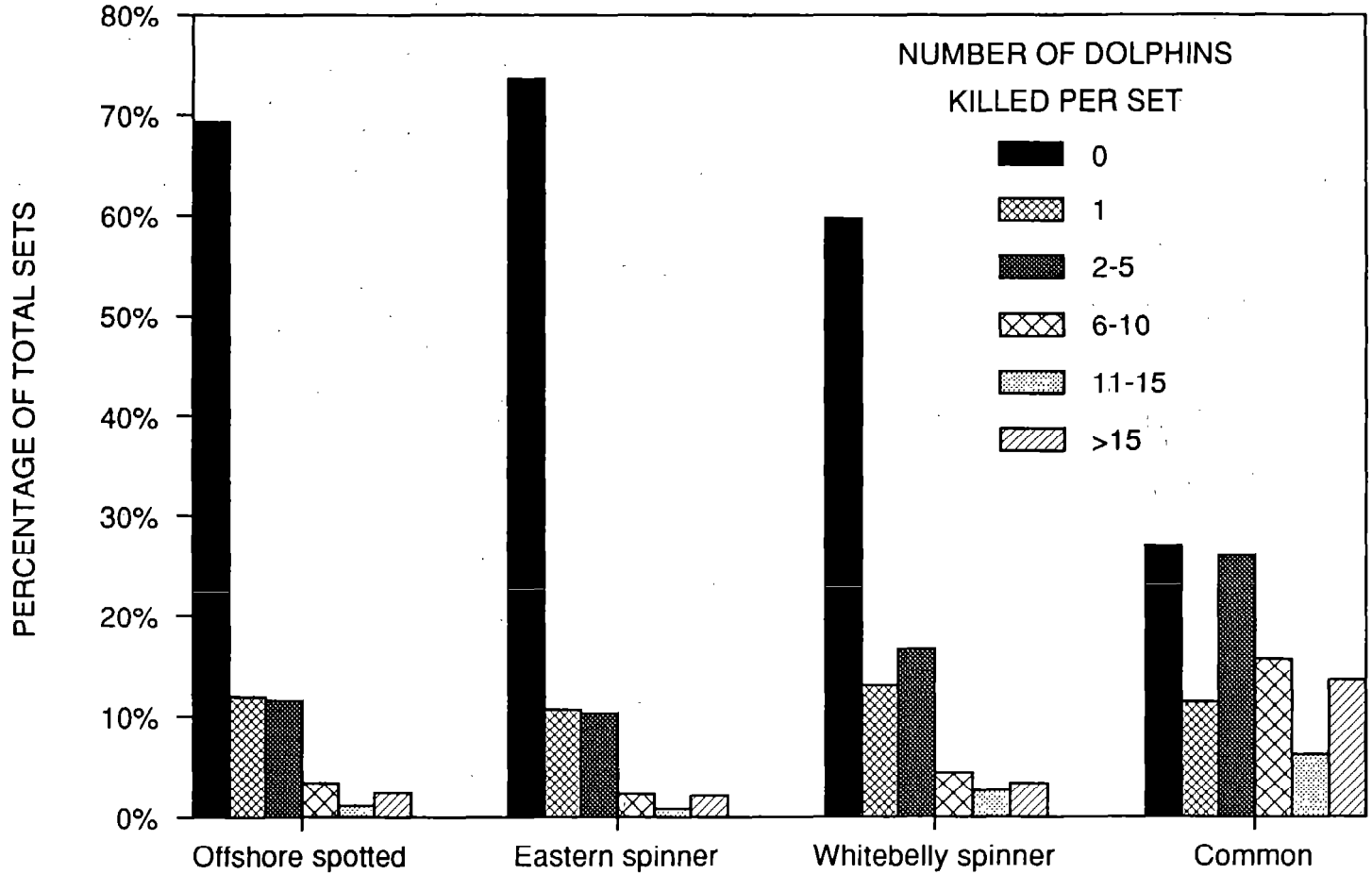

Figure 6. Relative frequencies of dolphin kill-per-set, by population, for observed U.S. tuna purse seine trips in the eastern tropical Pacific Ocean, 1989.

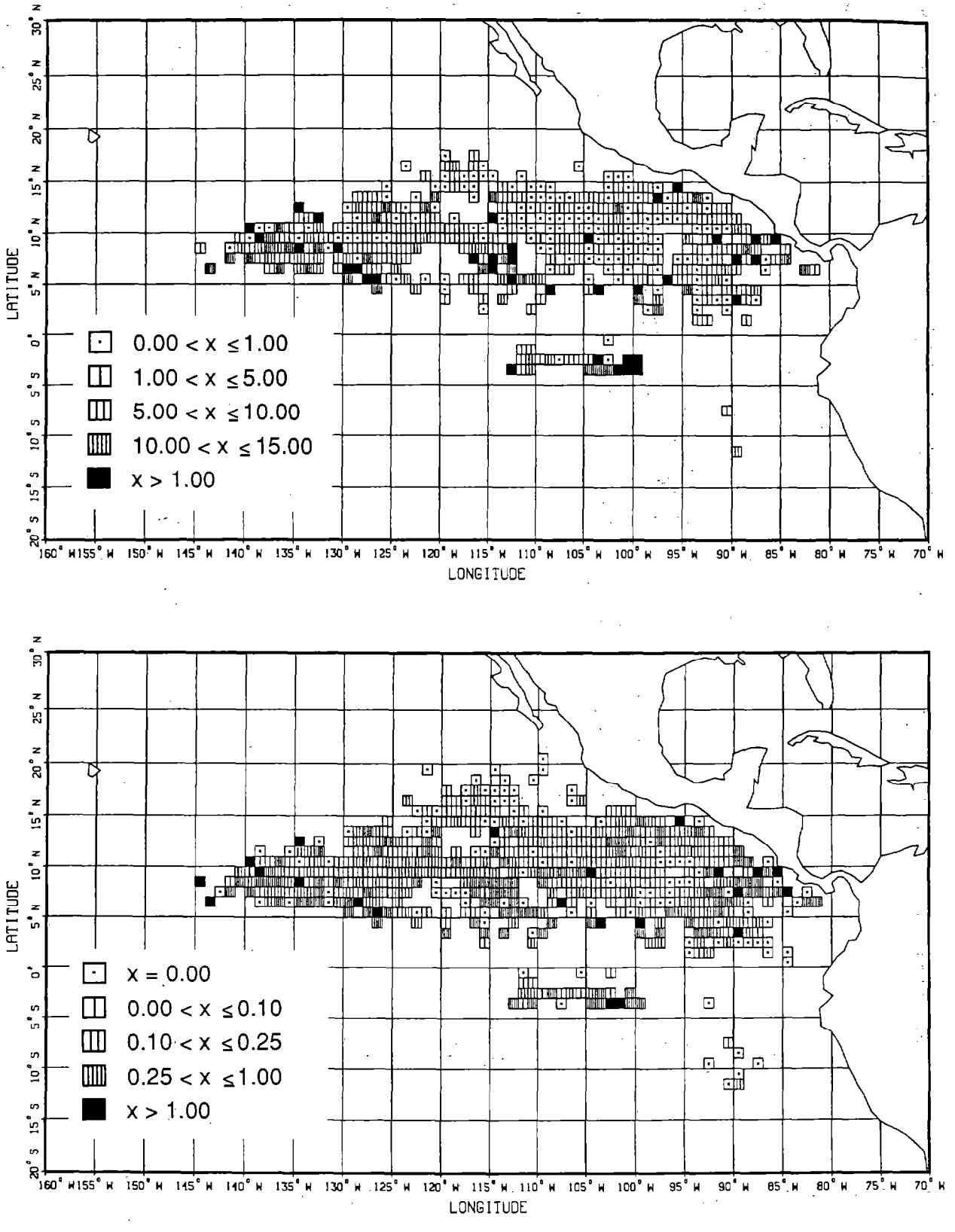

Figure 7. a: Dolphin kill-per-set, and b: Dolphin kill-per-ton, by 1^{o} quadrat, for observed U.S. tuna purse seine trips in 1989.

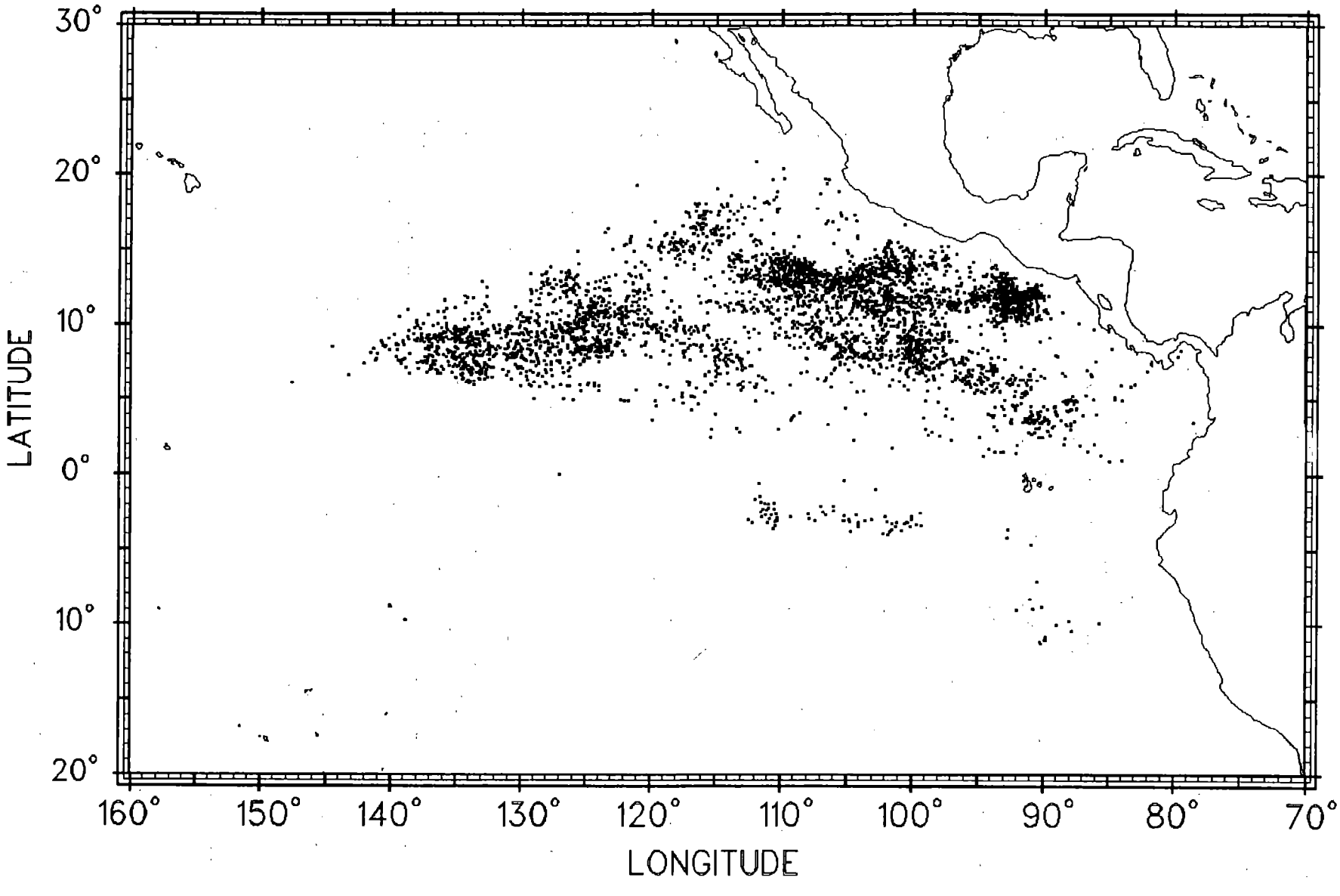

Figure 8a. Location of offshore spotted dolphin sightings by observers aboard U.S. tuna purse seiners in 1989 dolphins.

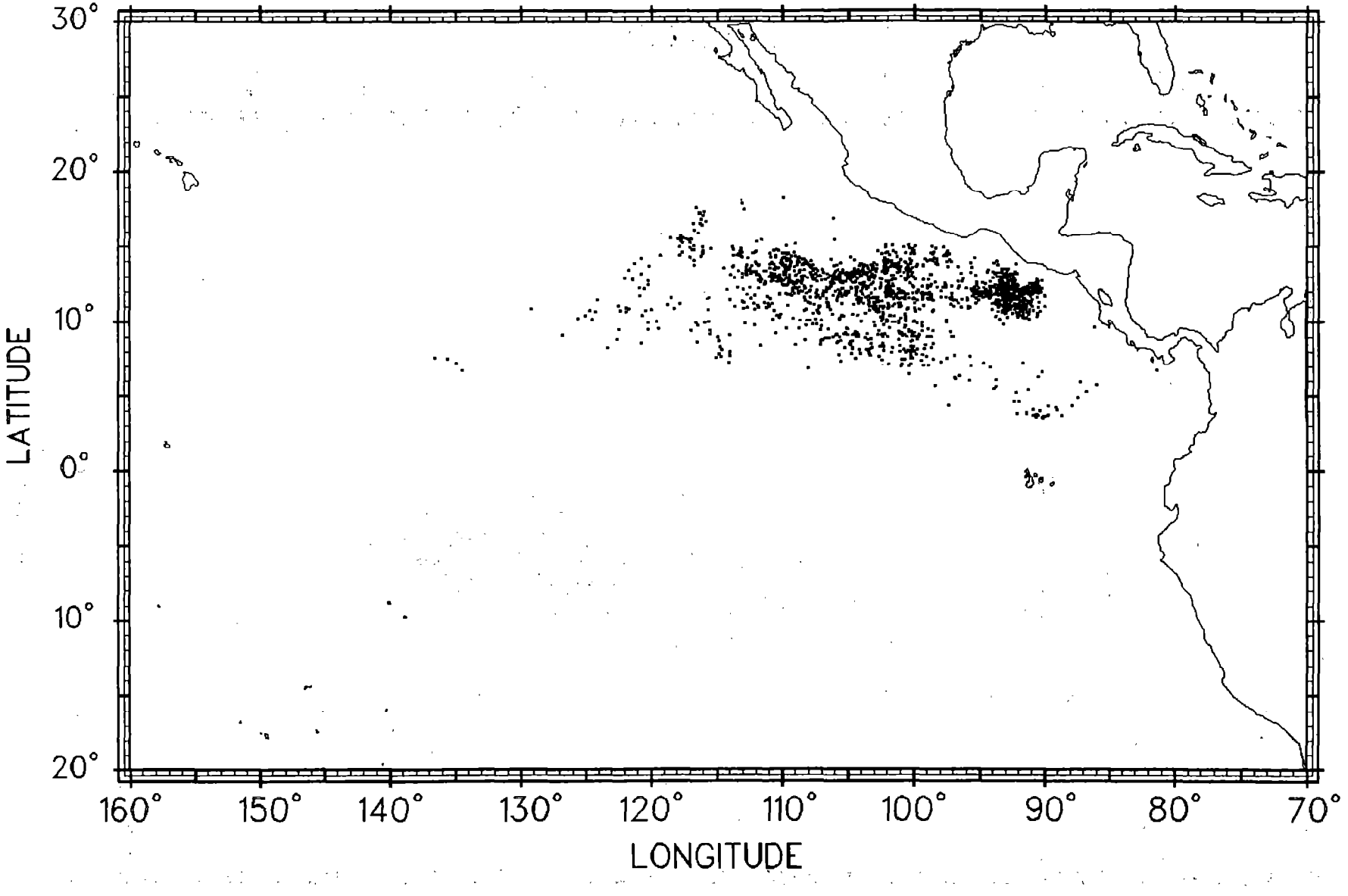

Figure 8b. Location of eastern spinner dolphin sightings by observers aboard U.S. tuna purse seiners in 1989.

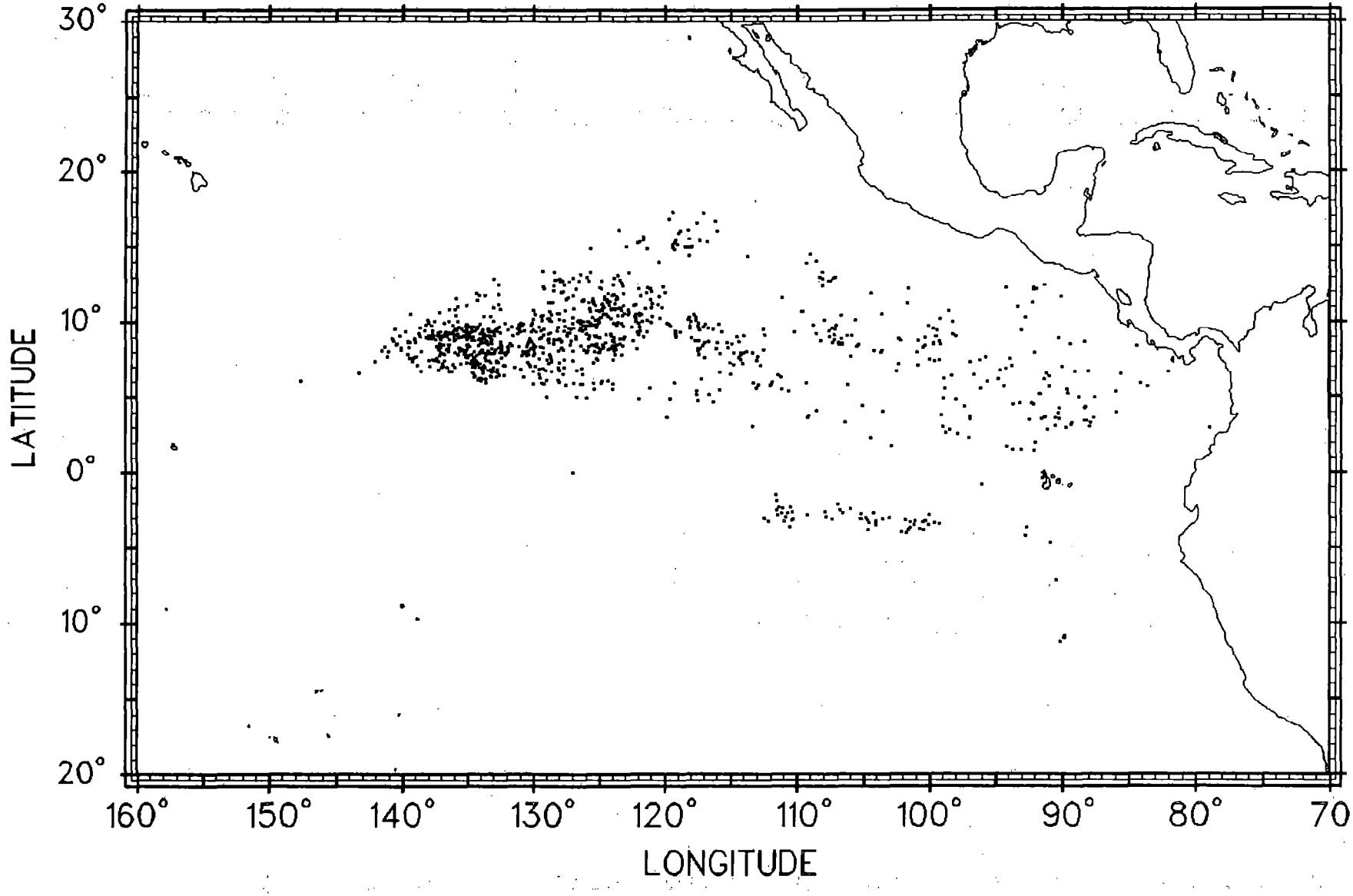

Figure 8c. Location of whitebelly spinner dolphin sightings by observers aboard U.S. tuna purse seiners in 1989.

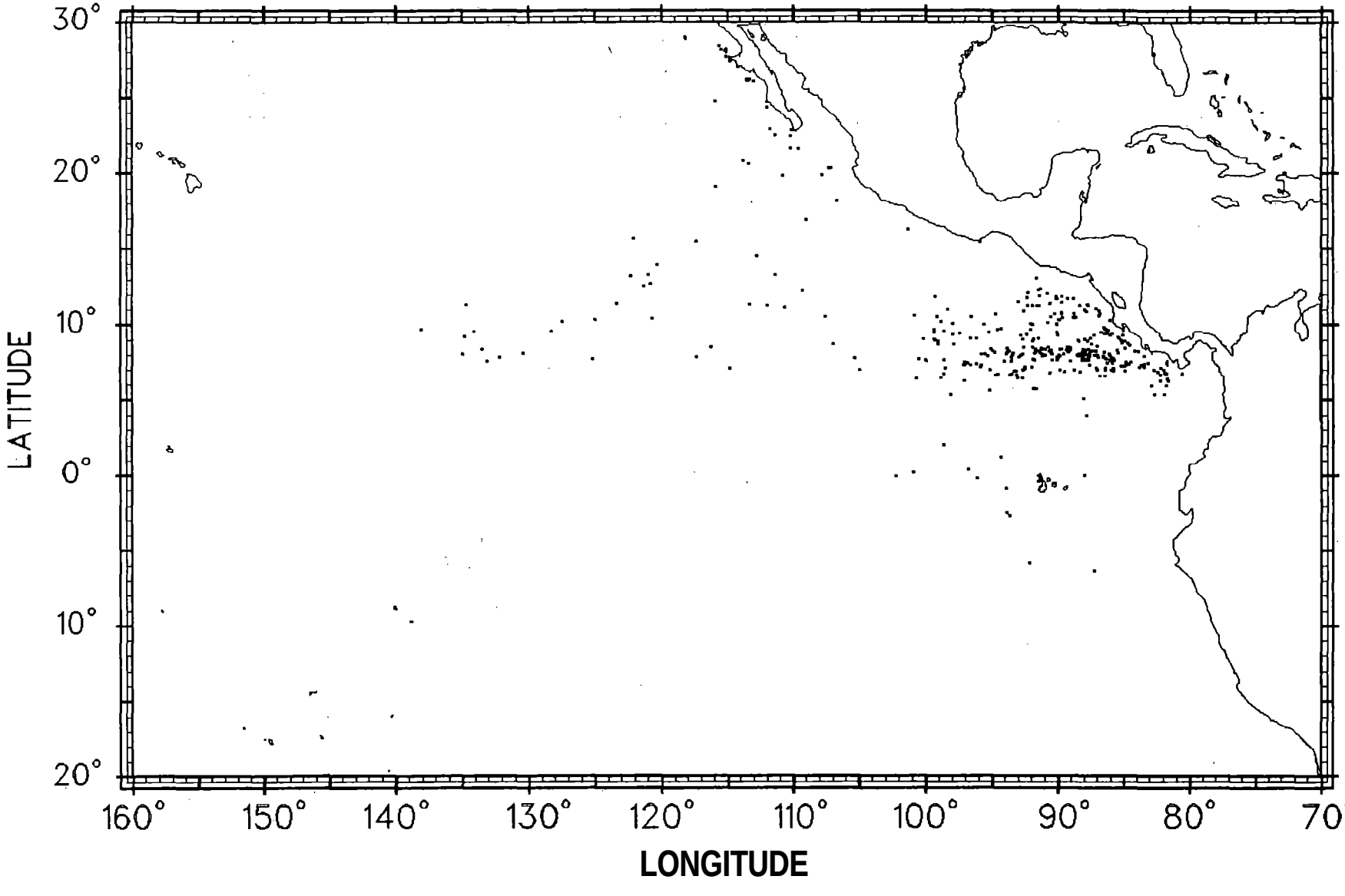

Figure 8d. Location of common dolphin sightings by observers aboard U.S. tuna purse seiners in 1989.