

BIOLOGICAL INVESTIGATIONS ON THE WHALING SEASONS 1960-1963, OFF NORTHEASTERN COAST OF BRAZIL (1)

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Whales are one of the basic marine fishery resources of Northeastern Brazil (Paiva, 1961).

Whaling off Northeastern coast of Brazil is seasonal, and comprises tropical waters of Western South Atlantic (whaling area ASW).

The "Companhia de Pesca Norte do Brasil", based at Costinha (Lucena, State of Paraíba, Brazil), is the only whaling enterprise in the Northeastern Brazil.

This paper deals with some biological investigations on the whaling seasons 1960 — 1963, off Northeastern coast of Brazil.

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SPECIES CAUGHT

Considering only the families *Balaenopteridae* and *Physeteridae*, the whales occurring along the coast of Brazil (Vieira, 1955; Rosa Jr., 1957; Slijper, 1962; Omura, 1962) are the following: *Balaenoptera musculus* (Linnaeus), *Balaenoptera physalus* (Linnaeus), *Balaenoptera borealis* (Lesson), *Balaenoptera edeni* Anderson, *Balaenoptera acutorostrata* Lacépède, *Megaptera novaeangliae* (Borowsky), *Physeter catodon* Linnaeus, and *Kogia breviceps* (Blainville). Thus, at present, all known species of those families make up the Brazilian marine fauna.

During the whaling seasons 1960 — 1963 off Northeastern coast of Brazil, only the following species were caught: *Balaenop-*

tera borealis (Lesson), *Megaptera novaeangliae* (Borowski), *Balaenoptera acutorostrata* Lacépède, and *Physeter catodon* Linnaeus. Common names of these species, in English and Portuguese, are listed in table I.

It is possible that some specimen of *Balaenoptera edeni* Anderson has been recorded as *Balaenoptera borealis* (Lesson), as occurred in the whaling station of "Sociedade de Pesca Taiyo Ltda." (Omura, 1962), at Cabo Frio (Cabo Frio, State of Rio de Janeiro, Brazil).

WHALING SEASONS

Whaling has a seasonal character, as already referred to. The seasons coincide with the occurrence of herds in the area studied.

During the Southern winter the baleen whales migrate from Antarctic waters to sub-tropical and tropical waters for purposes of reproduction. The opposite occurs with the sperm whales. These are inhabitants of warm tropical waters and migrate to sub-tropical and temperate waters, including also Antarctic waters, for purposes of reproduction, during the Southern summer (Rosa Jr., 1957; Slijper, 1962).

In Northeastern Brazil the whaling seasons normally begin in June and finish in October.

Costinha's base (latitude 6° 57' 45" S — longitude 34° 51' 28" W) is placed at the left margin of the mouth of Paraíba do Norte River, in front of Cabedêlo's port. During the whaling seasons, the whaler(s) stays

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(stay) overnight at this port, going out to sea for the whaling ground by dawn, returning only at night, bringing the killed whale(s) to Costinha's base. Detailed information on the whaling routine and its methods are presented by Grangeiro (1962).

In 1960 the following whalers were in operation: "Cabo Branco", "Daishin Maru 1", and "Daishin Maru 2"; in 1961, the whalers "Daishin Maru 1" and "Daishin Maru 2"; in 1962 and 1963, only the whaler "Daishin Maru 1". The most important characteristics of these whalers are presented in table II.

The main data concerning the whaling seasons studied are presented in tables III to VII.

Decrease in effort justifies completely the smaller number of killings recorded in 1962 and 1963, when compared with those of 1960 and 1961. In all years the percentage of killings was superior to 40.0%, but it did not reach 45.0%, except for 1961, when the highest index of 47.2% was recorded. The ratio individuals caught per voyage varied, for all years, between 2.1 and 2.4, except again for 1961, when the mark of 2.9 was reached. Expressed in B. W. U. (blue whale unity) this ratio was 0.4, except once more for 1961, when it reached 0.5. The highest percentage of killings recorded for 1961, was not harmful to captures in subsequent years.

Considering the several months of each whaling season, there were large variations in the percentage of killings and in the ratio individuals caught per voyage, regarding the operations of each whaler. No uniformity was found in the monthly variation of killings' percentage. There is a tendency of the values expressing the catches per voyage to increase, with the maximum value in August and/or September, decreasing in October.

The catches of whales expressed in B.W.U. was somewhat superior to 90.0 for 1960 and 1961, falling to 50.0 approximately in 1962 and 1963, due to decrease of effort employed.

In each whaling season sei whale was predominant, accounting for more than 90.0% of the individuals caught and almost all the B. W. U. recorded. Figure 1 gives a better representation of percentages and B.W.U.'s distribution, regarding the several

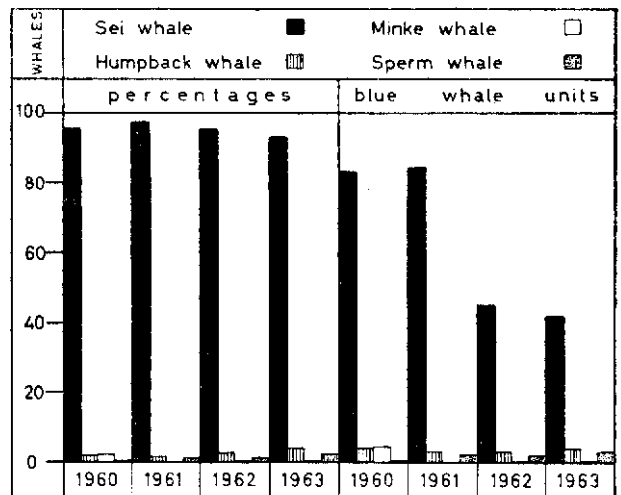


Figure 1 — Percentages and B. W. U.'s distribution regarding the several whale species caught during the whaling seasons 1960 — 1963, off Northeastern coast of Brazil.

species caught in each whaling season.

Largest monthly catches were recorded in August 1960 and 1961, and in September 1962 and 1963.

From July to September 1960, 1961, and 1962 there were large concentration of catches, extending to October in 1963. It is likely that in 1963 whale herds remained longer in the whaling ground.

The distribution of catches were made by square rectangles of 10 minutes of side. Whaling ground is not very large, and is located near Costinha's base.

The whaling ground was comprised between latitudes 6° 20' S and 7° 30' S, and longitudes 34° 00' W and 34° 50' W (figure 2) in 1960; between latitudes 6° 10' S and 7° 30' S, and longitudes 34° 00' W and 34° 50' W (figure 3) in 1961; between latitudes 6° 20' S and 7° 20' S, and longitudes 34° 00' W and 34° 50' W (figure 4) in 1962; between latitudes 6° 30' S and 7° 30' S, and longitudes 34° 00' W and 34° 50' W (figure 5) in 1963. In each whaling season large part of the catches was concentrated in the center of the respective whaling ground. During the four years analysed the general whaling ground was comprised between latitudes 6° 10' S and 7° 30' S, and longitudes 34° 00' W and 34° 50' W.

TABLE I

Common and scientific names of whales caught off Northeastern coast of Brazil, during the whaling seasons 1960 — 1963

Common names		Scientific names
English	Portuguese	
sei whale	baleia-espadarte	<i>Balaenoptera borealis</i> (Lesson)
humpback whale	baleia-preta	<i>Megaptera novaeangliae</i> (Borowski)
minke whale	baleia-anã	<i>Balaenoptera acutorostrata</i> Lacépède
sperm whale	cachalote	<i>Physeter catodon</i> Linnaeus

T A B L E I I
 Characteristics of the whalers that operated during the whaling seasons 1960 — 1963, based in Northeastern Brazil

Whalers	length (m)	extreme breath (m)	depth (m)	girth (m)	gross tonnage (t)	net tonnage (t)	dead weight (t)	net weight (t)	moving power (H.P.)	full speed (miles)	cruising speed (miles)	hull	year of building
Cabo Branco	37.50	7.03	4.27	13.30	251.000	138.000	—	—	800	14	—	—	1929
Daislin Maru 1	47.95	8.69	5.19	—	1,540.791	543.900	514.485	181.610	1,750	14	10	steel	1943
Daislin Maru 2	47.95	8.69	5.19	—	1,540.791	543.900	514.485	181.610	1,750	14	10	steel	1943

T A B L E I I I
 Data concerning the whaling seasons 1960 — 1963, off Northeastern coast of Brazil

Years	Whaling seasons		Whalers in operation	Daily whaler(s) voyages		Whales		Percentage of the catches	Catch per voyage	
	beginning	ending		total	no catch	with catch(es)	seen			caught
1960	June, 23rd	October, 31st	3	248	30	218	1,272	522	41.0	2.1
1961	June, 24th	October, 10th	2	178	11	167	1,103	521	47.2	2.9
1962	June, 3rd	October, 23rd	1	119	11	108	653	285	43.6	2.4
1963	June, 24th	October, 31st	1	124	15	109	648	272	42.0	2.2

CONDITIONS OF THE GENERAL WHALING GROUND

Waters along the east coast of North-eastern Brazil are influenced by the Current of Brazil, which carries warm and saline waters, but with reduced content of nutritive salts and anti-hourly circulation. These waters are tropical, with temperature and salinity above 25.0°C and 36.5‰ respectively, in the first 150 meters of depth (Emilson, 1959).

In that region the water temperature at the sea surface, as well as in the upper mixed layer, is primarily affected by such meteorological conditions (heating, cooling, evaporation, and local wind), showing properties of surface water masses in the equatorial area (Okuda, 1960).

According to data obtained during the period August-October 1959 (Okuda, 1960), the surface waters presented temperatures above 26.0°C and salinity of 36.0‰ in the general whaling ground.

Available information on the conditions of the general whaling ground (seasons 1961 — 1963) are shown in tables VIII to X. These data were obtained by the whalers, during the killing of whales.

In general, the monthly means of surface water temperatures were superior to 25.0°C, often reaching values superior to 26.0°C.

The extent of the monthly variation of surface water temperatures is small, not reaching 3.0°C. Total variation was from 24.0°C to 27.0°C in 1961 and 1963, and from 25.5°C to 28.0°C in 1962.

The distribution of monthly means of surface water temperatures does not present a well-defined characteristic through the months comprised by the whaling seasons. However, there was a tendency of decreasing the monthly mean temperature in 1961 and 1962, through the consecutive months of the respective whaling season.

Monthly means of air temperatures were superior to 26.0°C, reaching even 29.0°C.

The extent of the monthly variation of air temperatures is small, not reaching 5.0°C. Total variation was from 25.0°C to 29.0°C in 1961 and 1963, and from 25.0°C to 30.0°C in 1962.

The distribution of monthly means of air temperatures does not present a well-defined characteristic through the months comprised by the whaling seasons. However, there was a tendency of increasing the monthly mean temperature through the consecutive months of each whaling season.

Records relative to wind speeds, expressed in Beaufort's scale, show the predominance of numbers 2 to 4 (2.4 — 8.9 meters per second), number 3 (4.5 — 6.6 meters per second) being more frequent in each whal-

T A B L E I V
Data concerning the operations of whaler(s), based in Northeastern Brazil, in each month of the whaling seasons 1960 — 1963

Years	Whalers	Months	Daily whaler(s) voyages		Whales		Percentage of the catches	Catch per voyage	
			total	no catch	with catch(es)	seen			caught
1960	Cabo Branco	June	—	—	—	—	—	—	
		July	—	—	—	—	—	—	
		August	19	6	13	78	27	34.6	1.4
		September	24	3	21	93	39	41.9	1.6
	October	—	—	—	—	—	—	—	
	Daishin Maru 1	June	8	—	8	27	16	59.3	2.0
		July	26	5	21	137	50	36.5	1.9
		August	27	3	24	159	69	43.4	2.6
		September	22	—	22	102	65	63.7	3.0
	October	21	3	18	45	30	66.7	1.4	
	Daishin Maru 2	June	8	1	7	31	17	54.8	2.1
		July	26	1	25	171	53	31.0	2.0
August		27	2	25	202	72	35.6	2.7	
September		22	1	21	163	60	36.8	2.7	
October	18	5	13	64	24	37.5	1.3		
1961	Daishin Maru 1	June	2	1	1	17	5	29.4	2.5
		July	28	2	26	171	71	41.5	2.5
		August	28	—	28	219	101	46.1	3.6
		September	28	2	26	167	87	52.1	3.1
October	2	1	1	3	1	33.3	0.5		
1962	Daishin Maru 2	June	2	1	1	10	3	30.0	1.5
		July	28	—	28	141	64	45.4	2.3
		August	29	—	29	204	103	50.5	3.6
		September	29	3	26	170	85	50.0	2.9
October	2	1	1	1	1	100.0	0.5		
1962	Daishin Maru 1	June	14	4	10	35	17	48.6	1.2
		July	28	1	27	196	84	42.9	3.0
		August	28	1	27	166	70	42.2	2.5
		September	28	1	27	204	87	42.6	3.1
October	21	4	17	52	27	51.9	1.3		
1963	Daishin Maru 1	June	6	2	4	21	7	33.3	1.2
		July	29	4	25	131	49	37.4	1.7
		August	29	2	27	172	76	44.2	2.6
		September	29	3	26	174	78	44.8	2.7
October	31	4	27	150	62	41.3	2.0		

T A B L E V
Data concerning the whaling seasons 1960 — 1963 off Northeastern coast of Brazil, considering isolately each species caught

Years	S p e c i e s										
	Total catch by whaling seasons				sei whale			humpback whale			
	whales	B.W.U.	catch per voyage		catches by seasons		catch per voyage		catches by seasons		
		whales	B.W.U.	n	%	B.W.U.	n	B.W.U.	n	%	B.W.U.
1960	522*	92.2	2.1	500	95.8	83.3	2.02	0.34	10	1.9	4.0
1961	521	90.4	2.9	508	97.5	84.7	2.85	0.48	8	1.5	3.2
1962	285	50.9	2.4	272	95.4	45.3	2.28	0.37	8	2.8	3.2
1963	272	50.5	2.2	253	93.0	42.2	2.04	0.34	11	4.0	4.4

humpback whale catch per voyage	S p e c i e s											
	minke whale				sperm whale			humpback whale				
	catches by seasons		catch per voyage		catches by seasons		catch per voyage		catches by seasons		catch per voyage	
n	B.W.U.	n	%	B.W.U.	n	%	B.W.U.	n	%	B.W.U.	n	B.W.U.
0.04	0.02	11**	2.1	4.4	1	0.2	0.5	1	0.2	0.00	0.00	0.01
0.03	0.01	—	—	—	5	1.0	2.5	5	1.0	0.02	2.5	0.01
0.07	0.02	1	0.4	0.4	4	1.4	2.0	4	1.4	0.04	2.0	0.01
0.09	0.03	1	0.4	0.4	7	2.6	3.5	7	2.6	0.06	3.5	0.03

*) Really, 522 whales were caught, but only 511 were officially registered.

**) These whales were caught in October, but were not officially registered.

T A B L E V I
Distribution of several whale species caught during the months of the whaling seasons 1960 — 1963 off the Northeastern coast of Brazil

Years	Months	Numbers of whales caught	S p e c i e s															
			sei whale		humpback whale		minke whale *		sperm whale		females		males		females		males	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1960	June	33	17	51.5	16	48.5	—	—	—	—	—	—	—	—	—	—	—	—
	July	103	73	70.8	27	26.2	1	1.0	—	—	—	—	—	—	—	—	—	—
	August	168	108	64.3	56	33.3	2	1.2	—	—	—	—	—	—	—	—	—	—
	September	164	90	54.9	70	42.7	3	1.8	—	—	—	—	—	—	—	—	—	—
	October	54	17	31.5	26	48.1	—	—	2	3.7	9	16.7	—	—	—	—	—	—
	Total	522	305	58.4	195	37.4	7	1.3	3	0.6	2	0.4	9	1.7	1	0.2	—	—
1961	June	8	4	50.0	2	25.0	—	—	—	—	—	—	—	—	—	—	—	—
	July	135	88	65.2	42	31.1	1	0.7	3	2.3	—	—	—	—	—	—	—	25.0
	August	204	135	66.2	65	31.8	1	0.5	1	0.5	—	—	—	—	—	—	—	1.0
	September	172	117	68.0	53	30.8	1	0.6	1	0.6	—	—	—	—	—	—	—	—
	October	2	—	—	2	100.0	—	—	—	—	—	—	—	—	—	—	—	—
	Total	521	344	66.1	164	31.4	3	0.6	5	0.9	—	—	—	—	—	—	1	0.2
1962	June	17	10	58.8	6	35.3	—	—	1	5.9	—	—	—	—	—	—	—	—
	July	84	55	65.5	29	34.5	—	—	—	—	—	—	—	—	—	—	—	—
	August	70	43	61.4	22	31.4	1	1.4	2	3.0	—	—	—	—	—	—	—	1.4
	September	87	57	65.5	25	28.7	1	1.2	3	3.4	—	—	—	—	—	—	—	1.2
	October	27	8	29.6	17	63.0	—	—	—	—	—	—	—	—	1	3.7	—	—
	Total	285	173	60.7	99	34.7	2	0.7	6	2.1	—	—	—	—	1	0.4	3	1.0
1963	June	7	4	57.1	3	42.9	—	—	—	—	—	—	—	—	—	—	—	—
	July	49	34	69.4	14	28.6	1	2.0	—	—	—	—	—	—	—	—	—	—
	August	76	40	52.7	30	39.5	2	2.6	2	2.6	—	—	—	—	—	—	—	2.6
	September	78	46	59.0	28	35.8	2	2.6	1	1.3	—	—	—	—	—	—	—	—
	October	62	28	45.2	26	42.0	1	1.6	2	3.2	—	—	—	—	1	1.6	3	4.8
	Total	272	152	55.9	101	37.1	6	2.2	5	1.8	—	—	—	—	1	0.4	4	1.5

*) The 11 minke whales caught in 1960 were not officially registered.

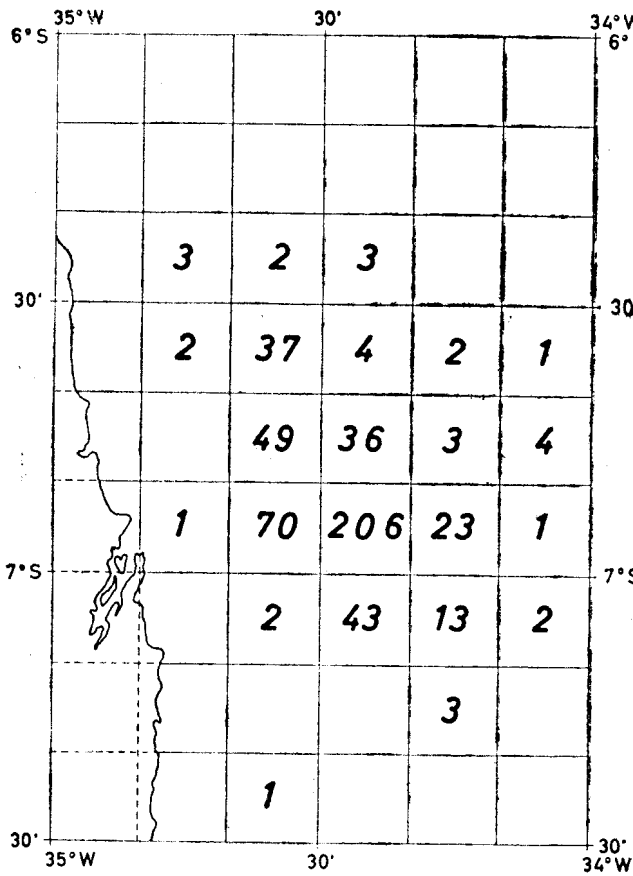


Figure 2 — Distribution of whale catches off North-eastern coast of Brazil during the whaling season of 1960, excluding 11 minke whales not officially registered.

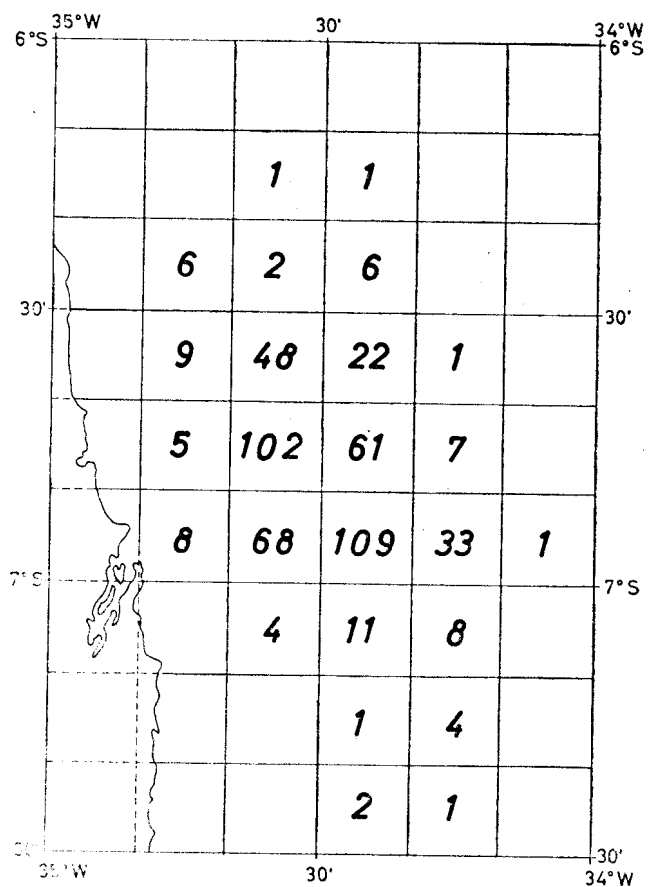


Figure 3 — Distribution of whale catches off North-eastern coast of Brazil during the whaling season of 1961.

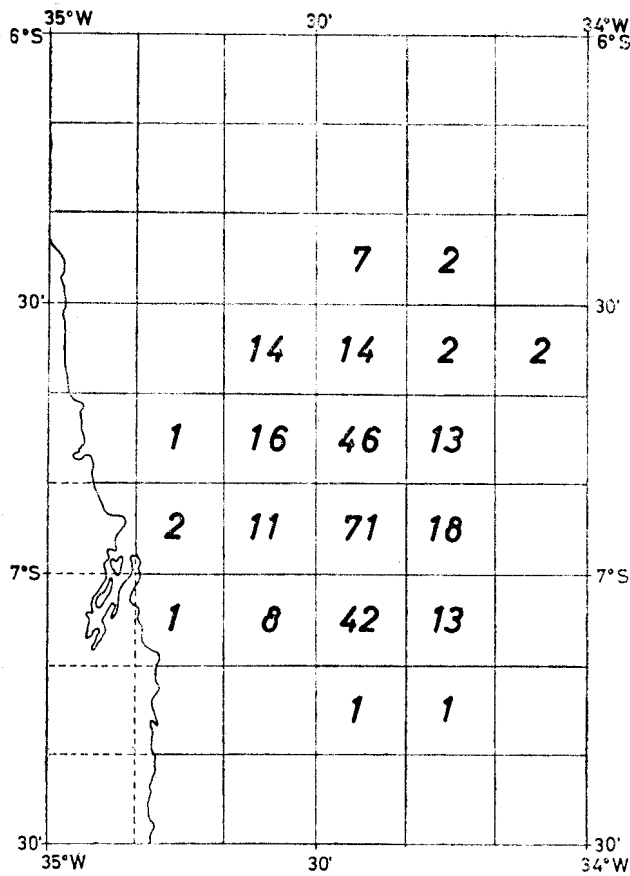


Figure 4 — Distribution of whale catches off North-eastern coast of Brazil during the whaling season of 1962.

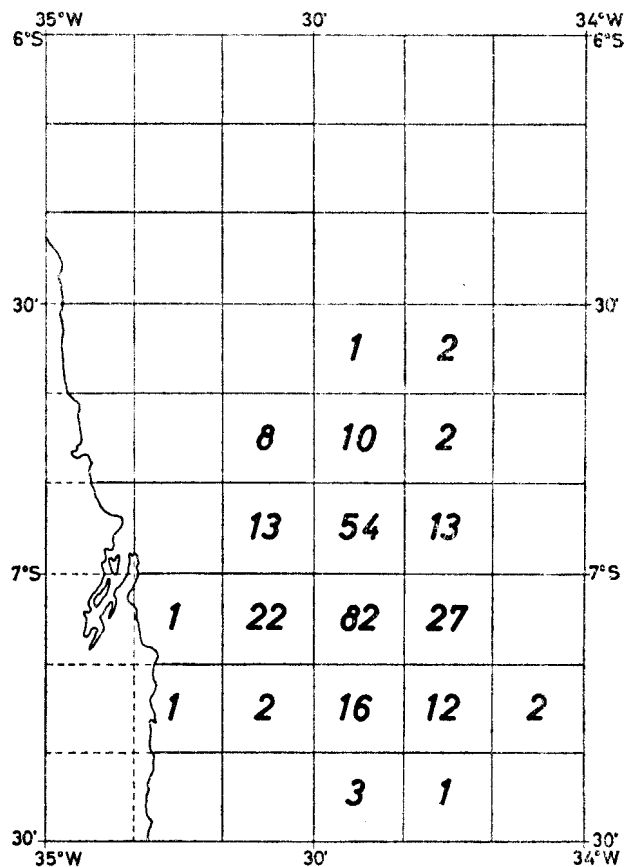


Figure 5 — Distribution of whale catches off North-eastern coast of Brazil during the whaling season of 1963.

TABLE VII

Index of relative abundance of whales caught off Northeastern coast of Brazil, during the months of the whaling seasons 1960 — 1963

Years	Months	Catch per voyage				
		sei whale	humpback whale	minke whale	sperm whale	total
1960	June	2.06	—	—	—	2.06
	July	1.92	0.06	—	—	1.98
	August	2.25	0.05	—	—	2.30
	September	2.35	0.05	—	0.01	2.41
	October	1.10	—	0.28	—	1.38
1961	June	1.50	—	—	0.50	2.00
	July	2.32	0.07	—	0.02	2.41
	August	3.50	0.04	—	0.04	3.58
	September	2.98	0.04	—	—	3.02
	October	0.50	—	—	—	0.50
1962	June	1.14	0.07	—	—	1.21
	July	3.00	—	—	—	3.00
	August	2.32	0.11	—	0.07	2.50
	September	2.93	0.14	—	0.04	3.11
	October	1.19	—	0.05	0.05	1.29
1963	June	1.17	—	—	—	1.17
	July	1.66	0.03	—	—	1.69
	August	2.41	0.14	—	0.07	2.62
	September	2.55	0.10	—	0.04	2.69
	October	1.74	0.10	0.03	0.13	2.00

TABLE VIII

Sea surface water and air temperatures recorded during the catches of whales off Northeastern coast of Brazil in the months comprised by the whaling seasons 1961 — 1963

Years	Months	Temperatures (°C)					
		sea surface			air		
		minimum	mean	maximum	minimum	mean	maximum
1961	June	26.0	26.4	27.0	25.0	25.4	26.0
	July	24.0	25.6	27.0	27.0	27.9	29.0
	August	24.0	25.4	26.0	26.0	27.8	29.0
	September	25.0	25.2	26.0	26.0	27.7	29.0
	October	—	25.0	—	—	28.0	—
1962	June	25.5	26.4	27.0	26.5	27.2	28.0
	July	25.5	26.1	26.5	25.5	26.9	30.0
	August	25.5	26.1	28.0	25.0	27.1	29.0
	September	25.5	25.9	26.5	26.5	28.2	30.0
	October	26.0	26.3	26.5	27.0	29.0	30.0
1963	June	24.5	24.9	25.0	26.0	26.9	27.5
	July	24.0	26.1	27.0	25.0	26.9	29.0
	August	25.0	26.0	26.5	25.0	26.7	28.0
	September	26.0	26.1	26.5	26.0	27.1	28.0
	October	26.0	26.3	27.0	27.0	27.9	29.0

ing season. Wind speed varied from numbers 1 to 6 (0.7 — 13.8 meters per second) in 1961; from numbers 1 to 8 (0.7 — 19.0 meters per second) in 1962; and from numbers 2 to 4 (2.4 — 8.9 meters per second) in 1963.

According to those records, it can be seen that in the first and fourth quadrants winds were absent. Wind directions varied from ESE to W in 1961, i.e., winds of the

second and third quadrants, predominating the winds SE and SW in each quadrant, more frequently the SW winds. Wind directions varied from E to SW in 1962, i.e., winds of the second and third quadrants, predominating the winds SE and SW in each quadrant, more frequently the SE winds. Wind directions varied from E to S in 1963, i.e., winds of the second quadrant, more frequently the SE winds.

OBSERVATIONS ON SEI WHALE

Among the baleen whales, the species sei whale and Bryde's whale (*Balaenoptera edeni* Anderson) are predominantly tropical (Rosa Jr., 1957; Slijper, 1962).

Sei whale occupies always the first place in number of individuals caught along the coast of Northeastern Brazil, during the whaling seasons (Paiva, 1961). At Cabo Frio whaling ground, situated in the mid-South region of Brazil, sei whale was predominant in the catches during 1960's whaling season (Watase, 1961).

There is no doubt that sei whale is the most tropical of baleen whales occurring in Western South Atlantic (whaling area ASW).

Sei whale was predominant during the several months of each whaling season. Largest catches of this species occurred from July to September of 1960, 1961, and 1962; and from July to October of 1963. Maximum catches occurred in August 1960 and 1961, July 1962 and September 1963 (table VI).

Available data (table VI; figure 6) do not permit to draw the sex-ratio in the stock of this species, because the killings were selected due to the prohibition of hunting females accompanied by their calves.

However, if only the catches are considered, it can be seen that an instability occurred among the killings of each sex. In June, of all whaling seasons, the number of males killed was little higher than that of females; from July to September of all whaling seasons males were killed in much higher number than females; from 1960 to 1962, during October, the number of females killed was little higher than that of males, but it did not occurred in 1963. Sex-ratio in the total number of sei whale killed (1.6: 1.0 in 1960; 2.1: 1.0 in 1961; 1.7: 1.0 in 1962; 1.5: 1.0 in 1963) during each whaling season was always unfavorable for males.

These information do not allow to conclude whether males reach the whaling ground before the females, when migrating northward, due to killing selection already referred to. However, it is almost certain that they return to south before the females do. It is unlikely that the simple sexual selection in the killings, for the protection of females accompanied by their calves, has been responsible for the large instability among males and females caught from July to September. It is more reasonable to admit that a large abundance of males exists in the area and months considered.

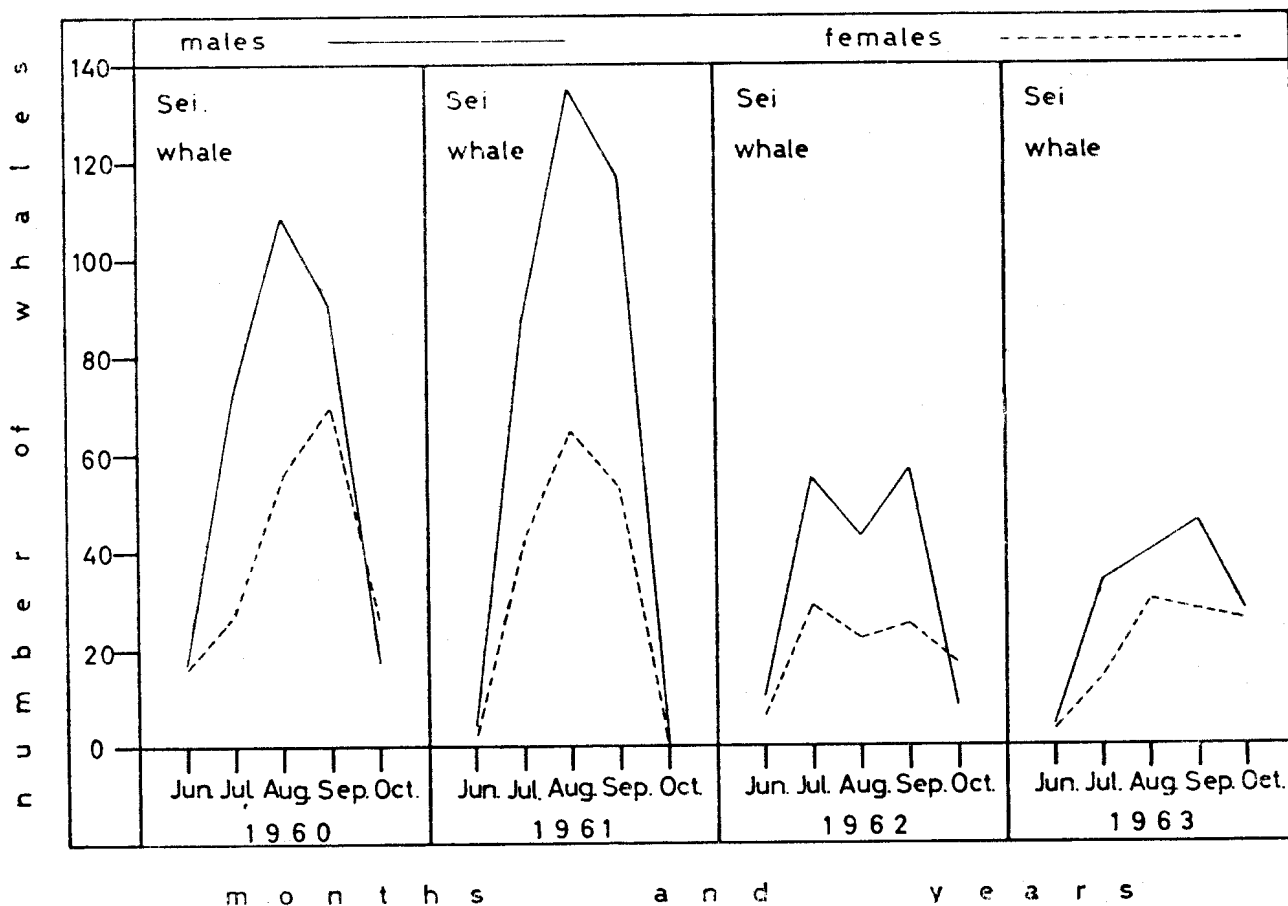


Figure 6 — Distribution of sei whales caught off Northeastern coast of Brazil, by sexes and months of the whaling seasons 1960 — 1963.

In each whaling season (figures 7 to 10) sei whale's killing area coincided with the corresponding annual whaling ground (figures 2 to 5), with concentration of killings in its central part, independently of sexes.

Figures 11 to 30 show the distribution of males and females of sei whale killed during several months of each whaling season. Putting aside the differences already referred as to the number of males and females caught in each whaling season, it can be seen that both sexes have common occurrence in time and space, within the limits of the killing area of sei whale. However, monthly variations in concentration of catches were recorded, with the tendency of shifting from east to west, from the beginning to the end of each whaling season. In 1960 a slight tendency of shifting from east to northwest occurred; in 1961 the same occurred, being clear the shifting in September; in 1962 the tendency of shifting was from east to southwest, especially in October; in 1963 the tendency was from east to northwest, though this has not been clearly recorded in September. It is possible to conclude that the individuals of this species arrive to the whaling ground by its east side and leave it by its west side, making use of a route close to the coast.

Length distribution (*) of sei whale, by months and sexes, killed in each whaling season, is shown in figures 31 to 34.

Arithmetic means of sei whale lengths caught in the whaling seasons 1960 — 1963 were calculated, with their respective standard deviations and coefficients of variation (table XI). Figure 35 shows the distribution of these means.

Mean lengths of sei whale females were larger than that of males during all whaling seasons analysed. Increase or decrease of mean length of each sex is followed by the opposite sex, in direct proportion, being the difference more or less stabilized around 1.0 meter.

It is interesting to observe the alternation found between the mean lengths by sexes and considering all individuals of sei whale caught, through the whaling seasons analysed. Larger means were recorded in 1960 and 1962, and smaller ones in 1961 and 1963. This alternation does not seem to depend on the whaling intensity in the area studied, in the previous year to any season considered.

The large intensity of sei whale killings recorded during the whaling seasons of 1960 and 1961 (table V) did not reduce the value of mean length of each sex and for both grouped, in the whaling season of 1962, as it could be supposed.

The intensity of sei whale hunting, in the area studied, and in a certain whaling season, does not explain the mean lengths of each sex and both grouped, in the following whaling season.

Arithmetic means of sei whale lengths caught, with their respective standard deviations and coefficients of variation, regarding each sex and both grouped, during the several months of each whaling season, are shown in table XII. The distribution of these means is shown in figure 36.

During all whaling seasons the same patterns in the distribution of the arithmetic means of sei whale lengths were not observed, but it can be said that females present larger mean lengths than those recorded for males, during the several months of each whaling season.

At Cabo Frio area, during the whaling season of 1960, it has been observed that the mean length of sei whale was directly proportional to the distance between the place of killing and the coast (Watase, 1961). Calculations have been made in order to find out whether the same has occurred in Northeastern Brazil during the whaling seasons 1960 — 1963. If the position of the coast in relation to the areas of sei whale killings is considered (figures 7 to 10), it can be seen that the distance between the place of killing and the coast is inversely proportional to longitude. Thus, the arithmetic means of sei whale lengths, with their respective standard deviations and coefficients of variation, were calculated by longitudes of 10 minutes of extent and in each whaling season, regarding each sex and both grouped (table XIII). General analysis of data does not show a rigid dependence between size of individuals caught and the distance to the coast. During the several whaling seasons it was found a direct and inverse dependence between size and longitude, or else, none dependence was recorded, in respect to each sex and both grouped.

All sei whales caught during the whaling seasons 1960 — 1963 had empty stomachs. This confirms that the migration to tropical waters is made for purposes of reproduction.

Only seven pregnant sei whales were caught during the whaling seasons studied. The data regarding these females and its foetuses are shown in table XIV.

In all years sei whale killing per voyage was superior to 2.00, not reaching 2.30, except in 1961, when the maximum recorded was 2.85 (table V). Regarding this species,

(*) — The length measure considered in this paper was taken in the plane of symmetry, from the most anterior part of the head to the fork of the caudal fin.

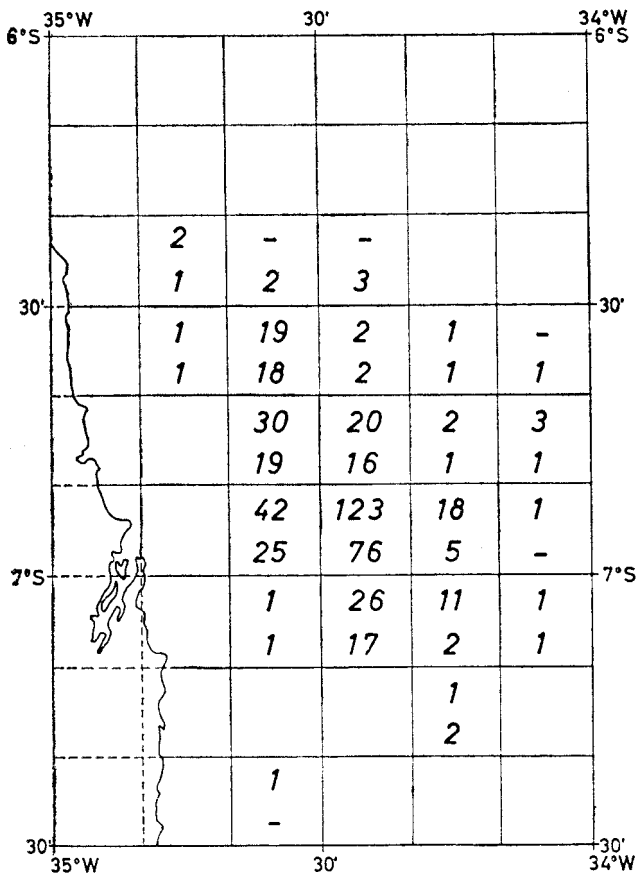


Figure 7 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the whaling season of 1960.

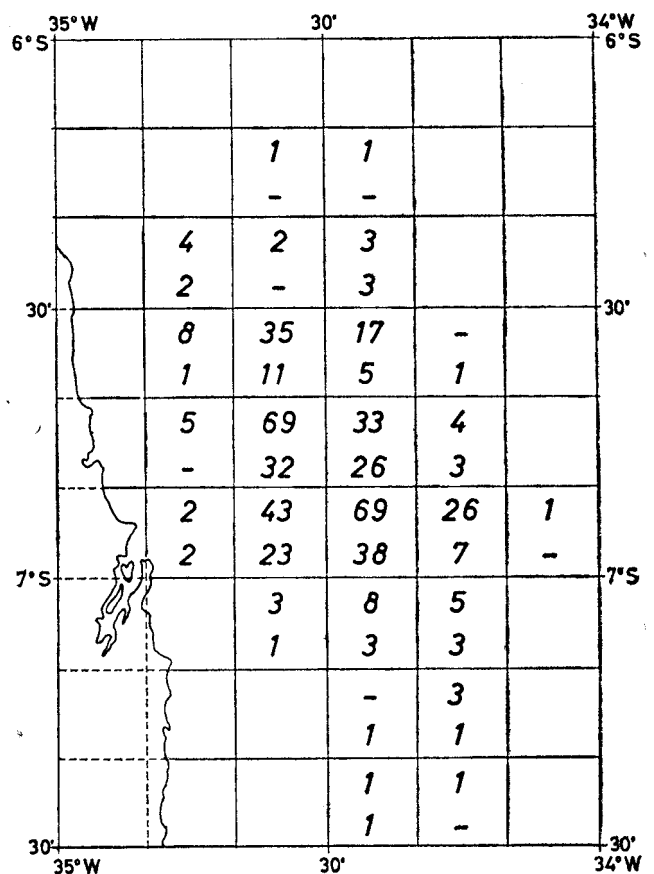


Figure 8 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the whaling season of 1961.

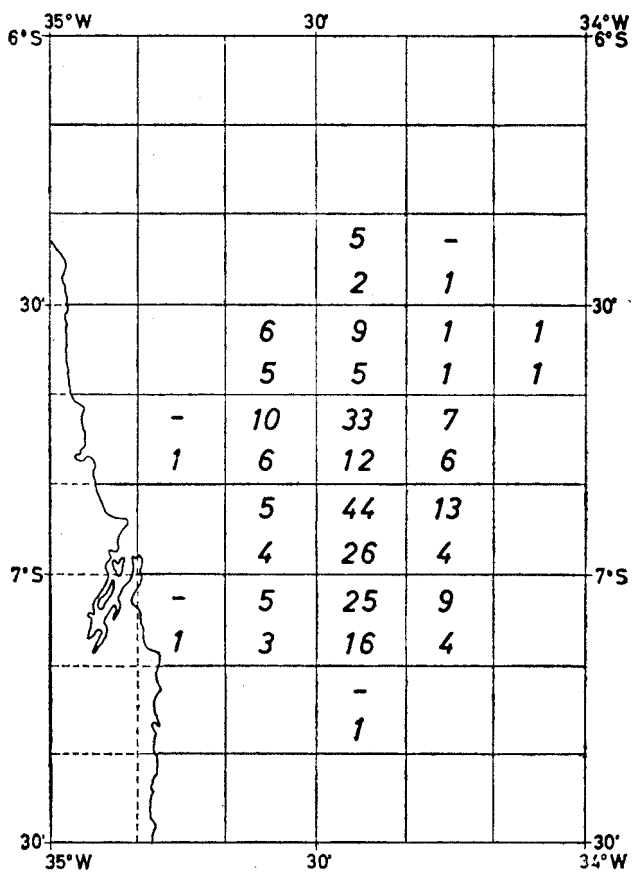


Figure 9 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the whaling season of 1962.

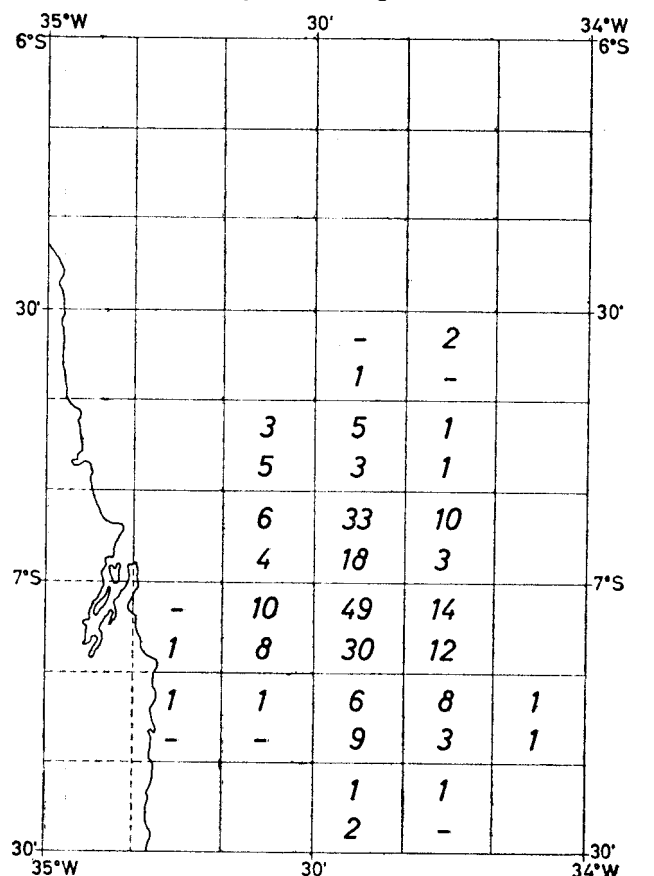


Figure 10 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the whaling season of 1963.

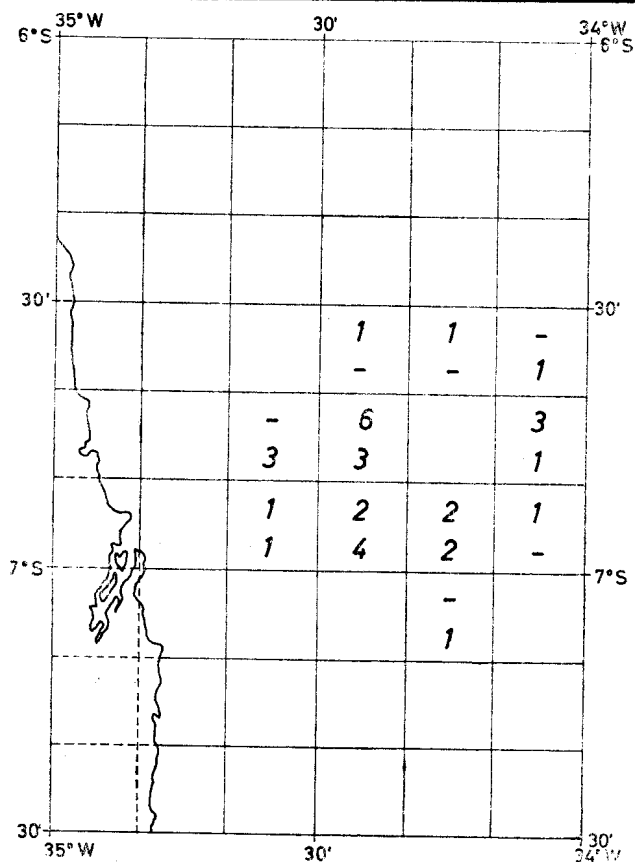


Figure 11 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of June, 1960.

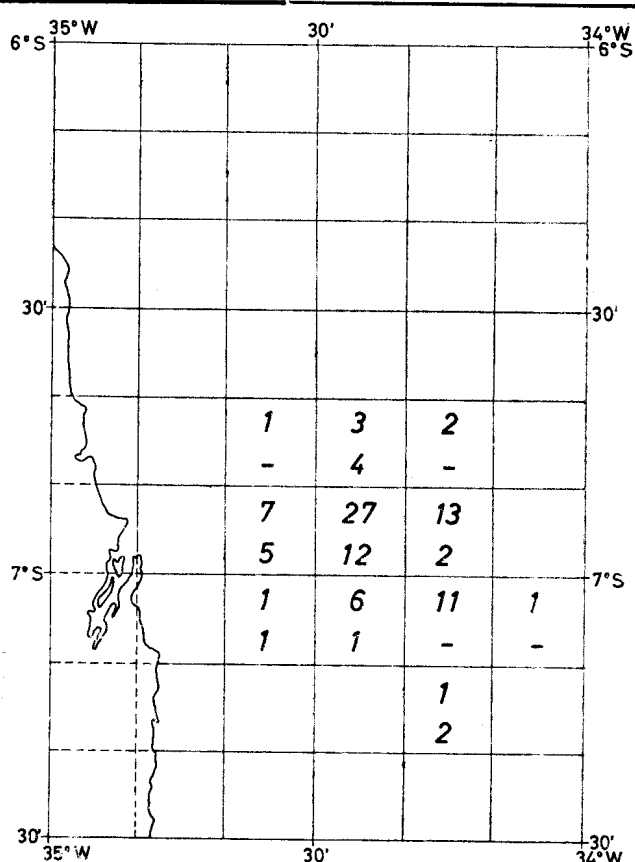


Figure 12 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of July, 1960.

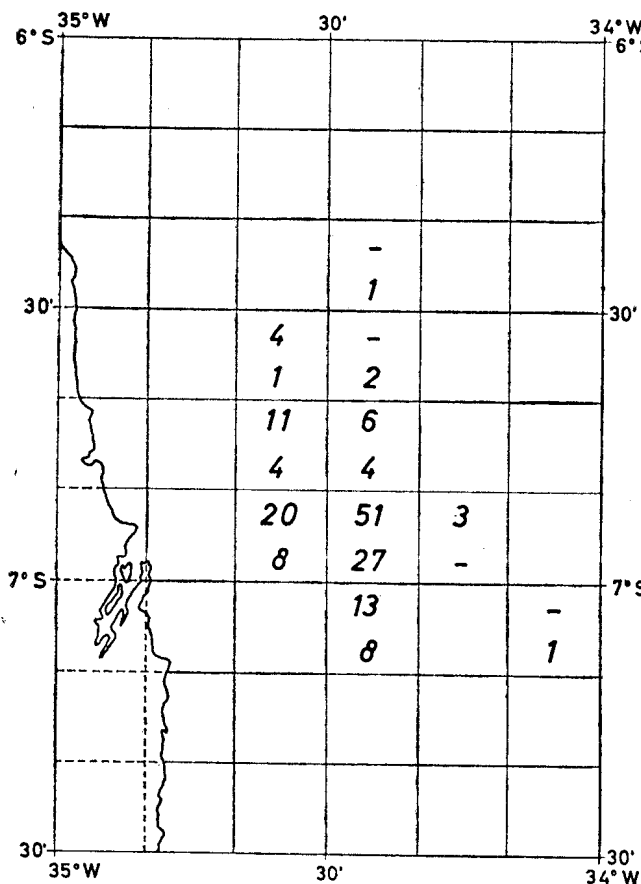


Figure 13 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of August, 1960.

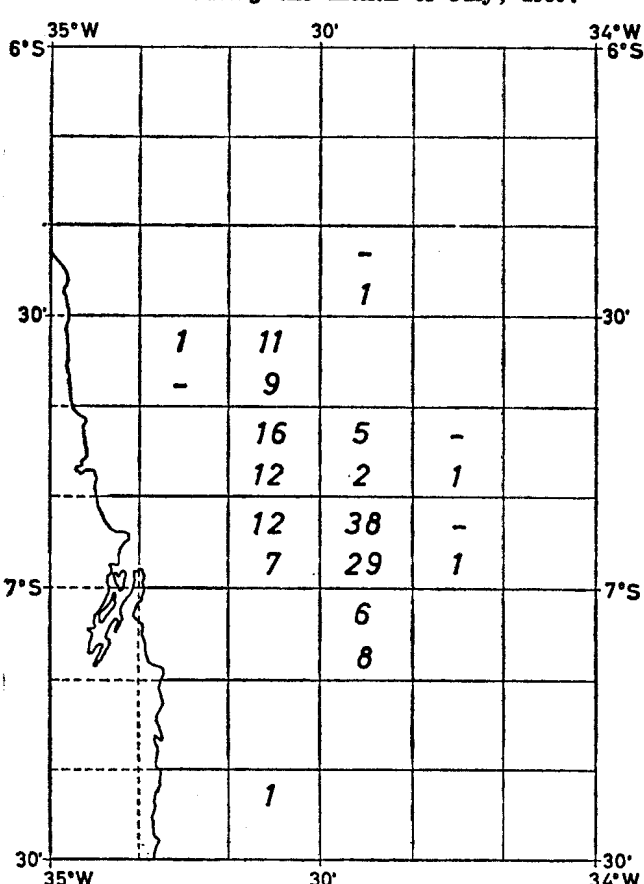


Figure 14 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of September, 1960.

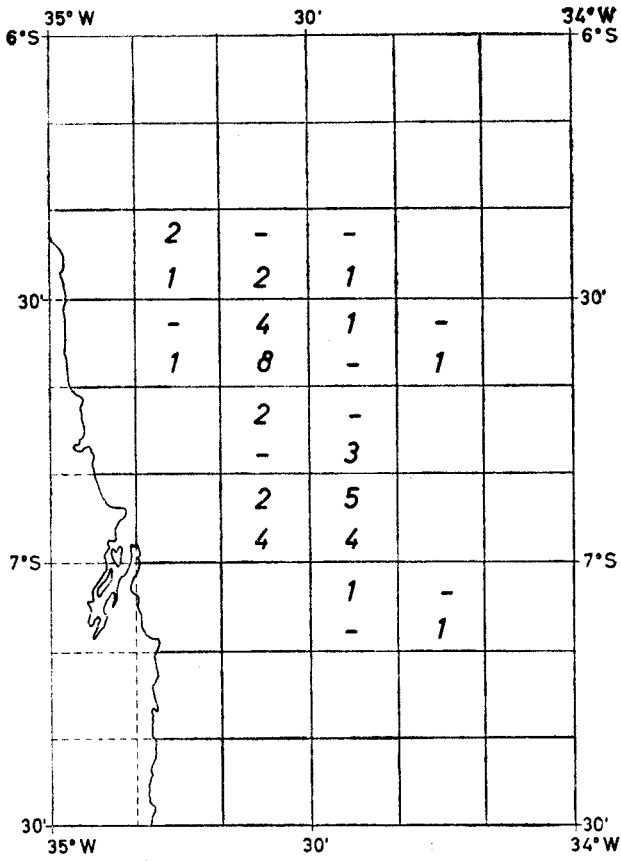


Figure 15 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of October, 1960.

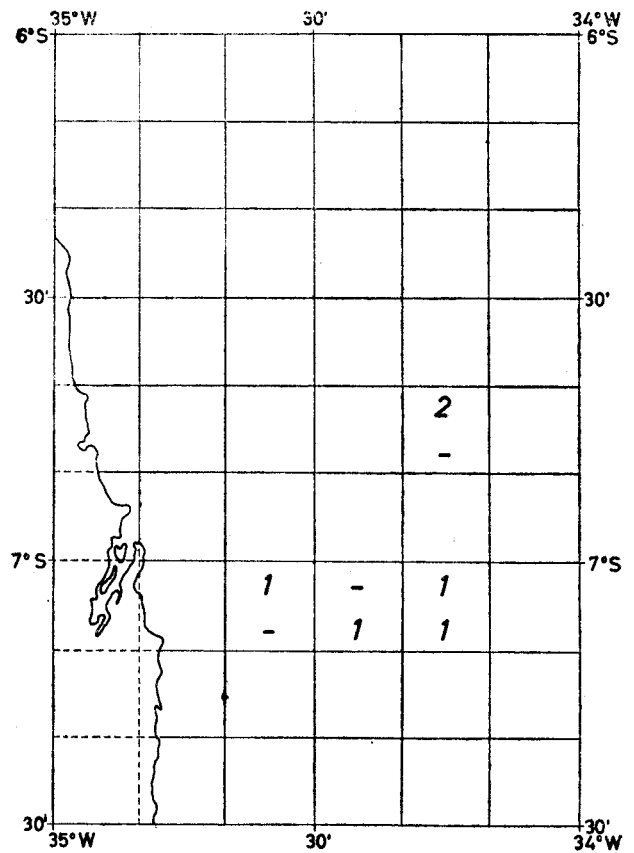


Figure 16 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of June, 1961.

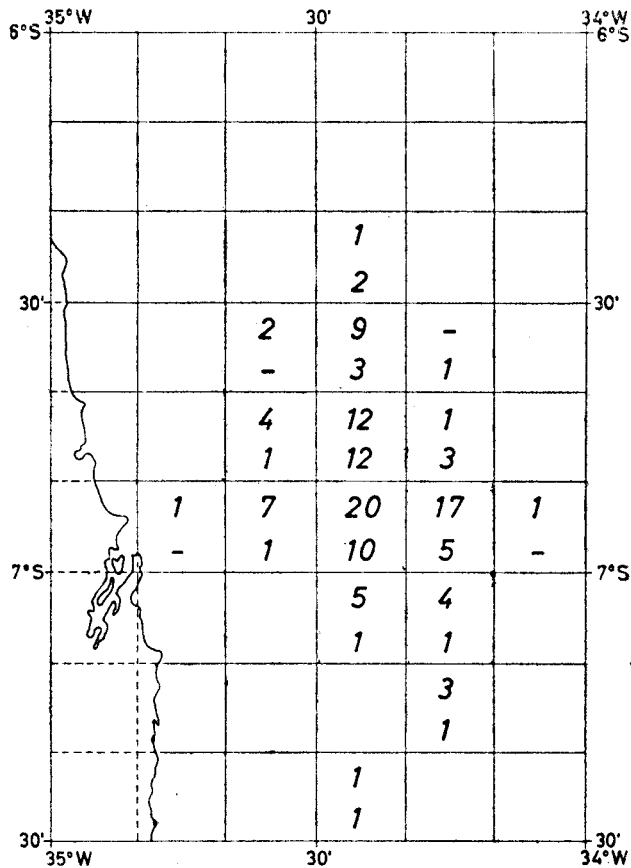


Figure 17 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of July, 1961.

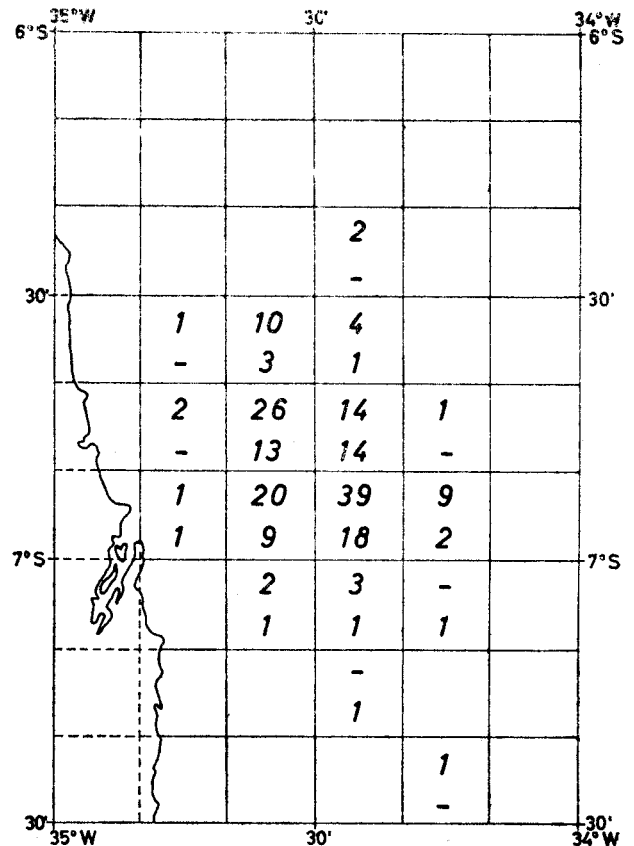


Figure 18 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of August, 1961.

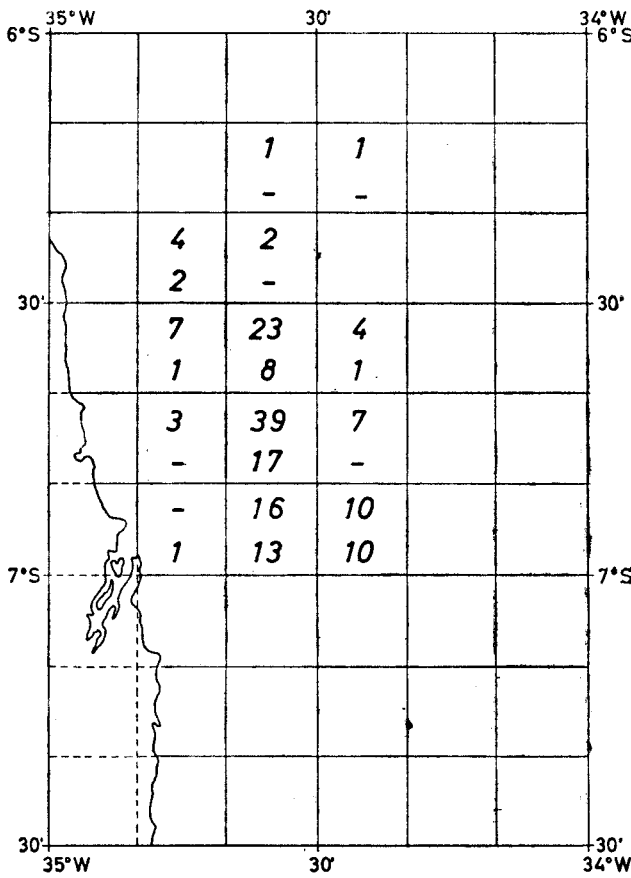


Figure 19 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of September, 1961.

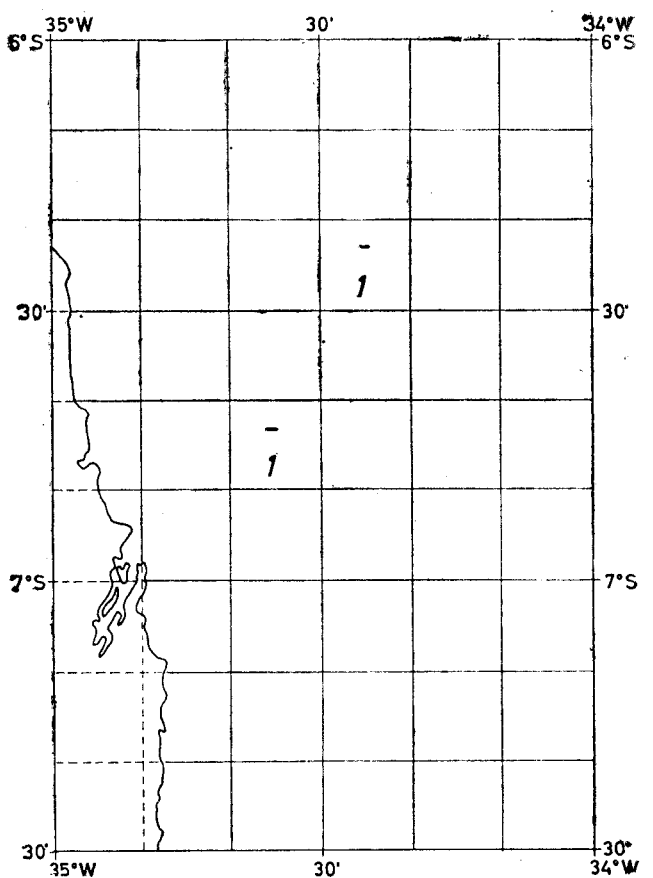


Figure 20 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of October, 1961.

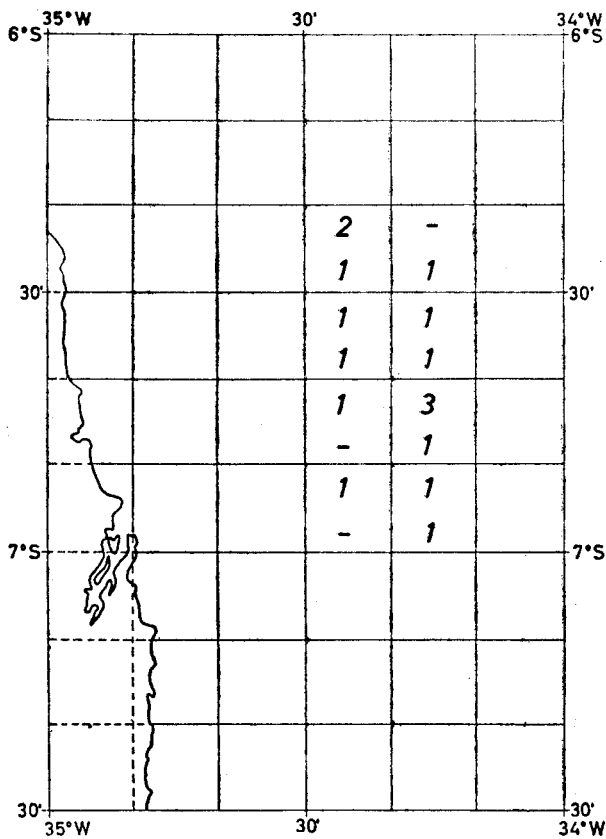


Figure 21 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of June, 1962.

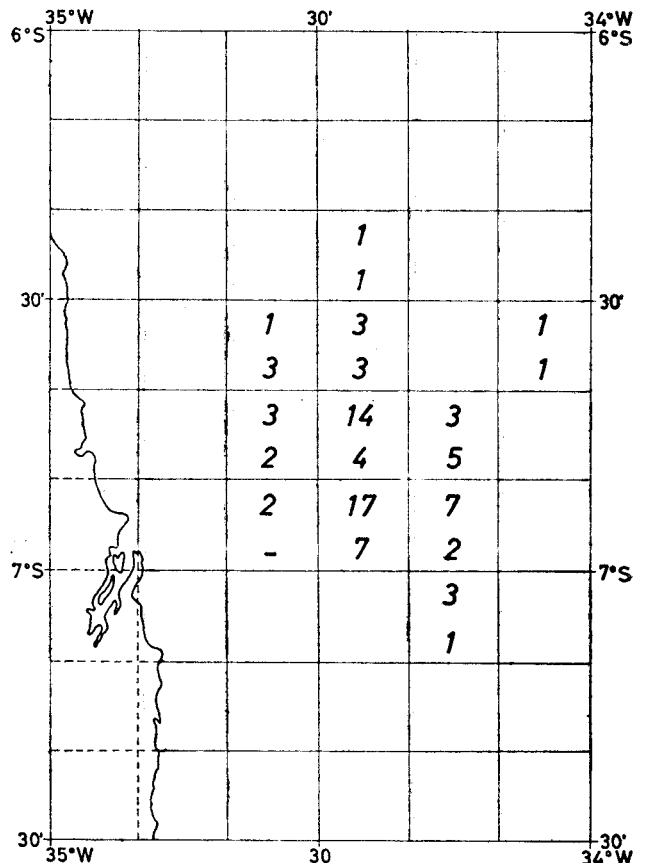


Figure 22 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of July, 1962.

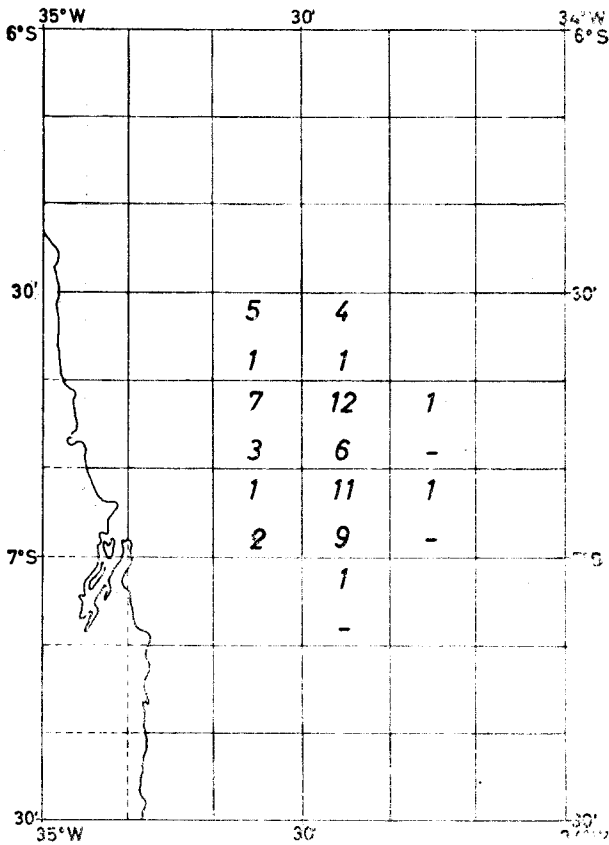


Figure 23 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of August, 1962.

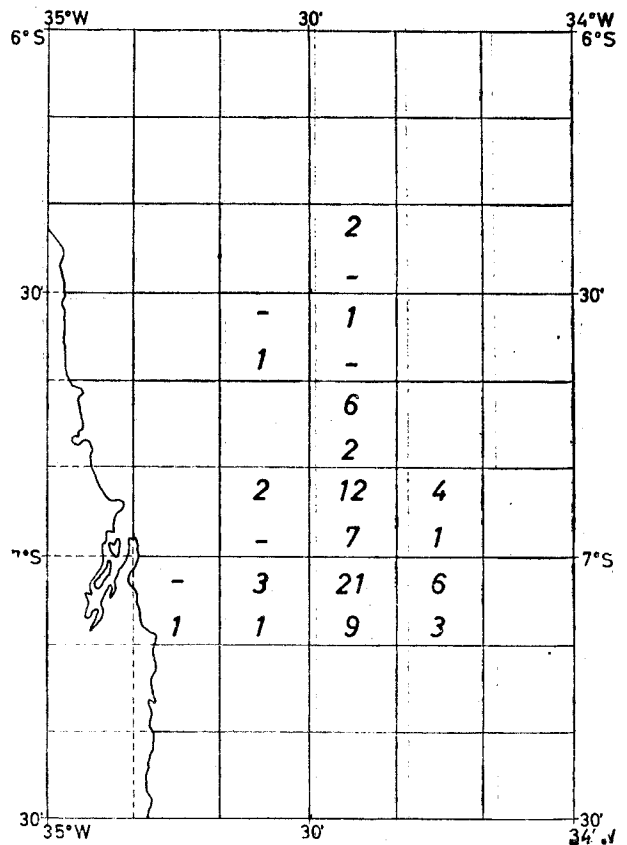


Figure 24 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of September, 1962.

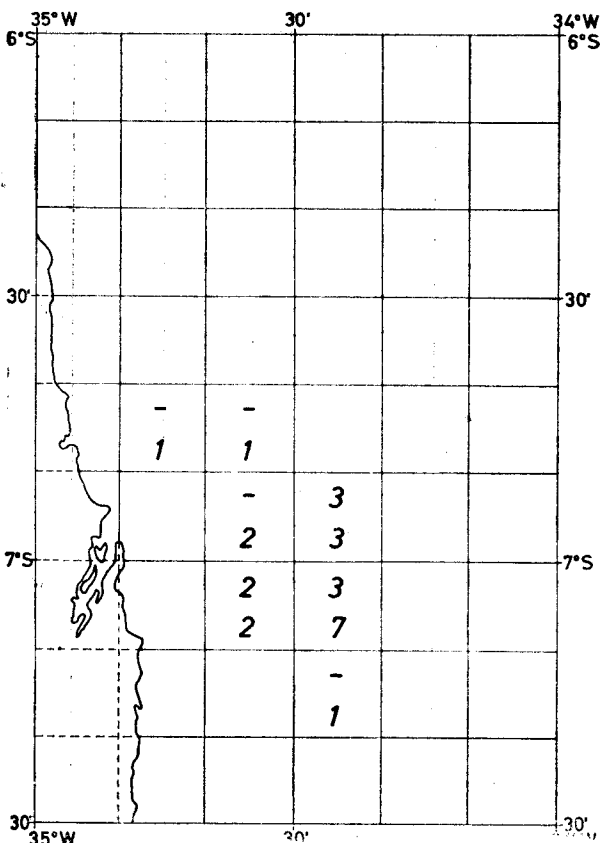


Figure 25 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of October, 1962.

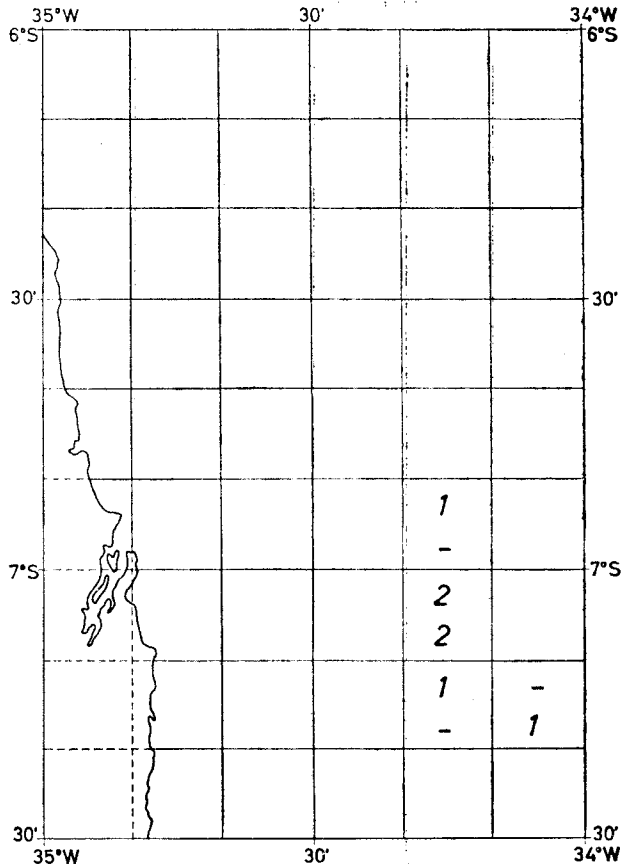


Figure 26 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of June, 1963.

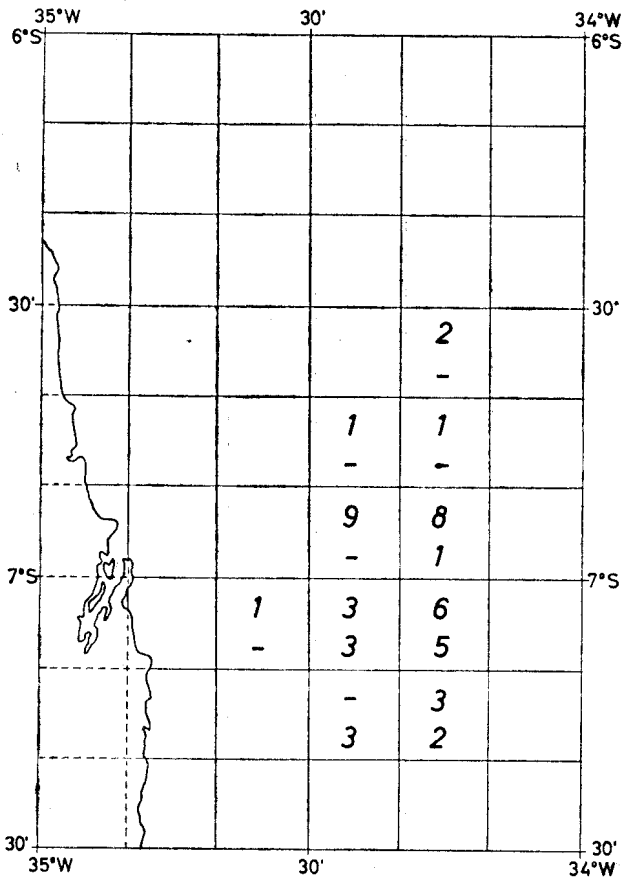


Figure 27 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of July, 1963.

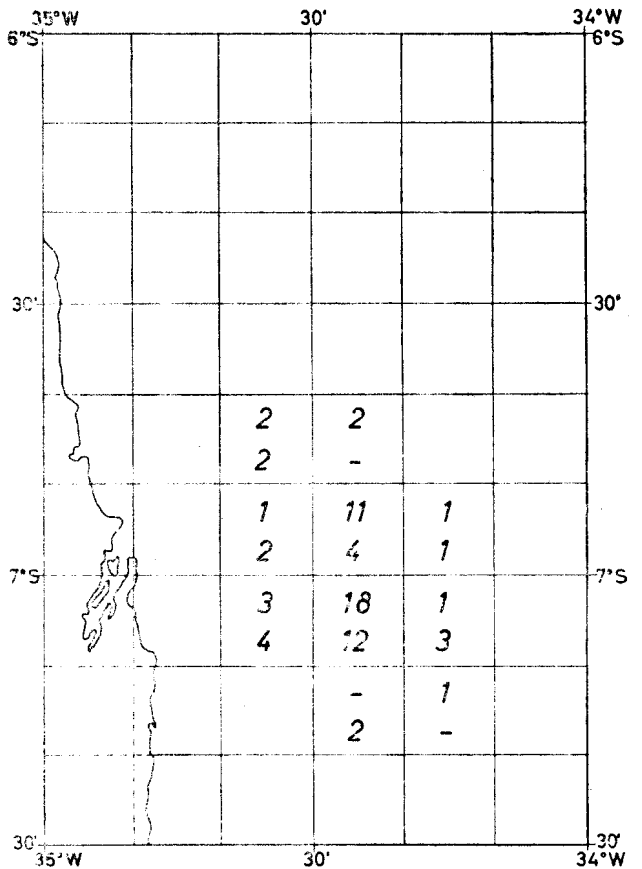


Figure 28 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of August, 1963.

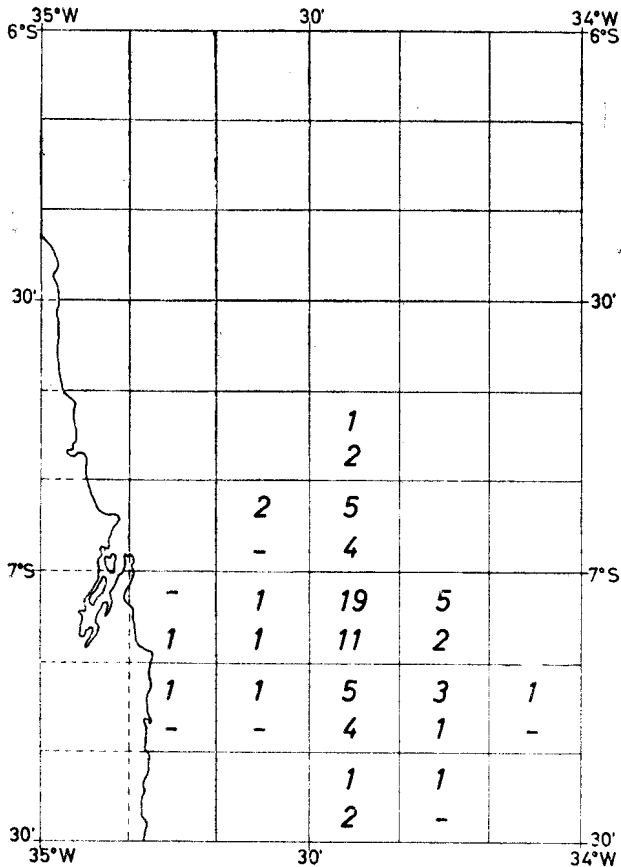


Figure 29 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of September, 1963.

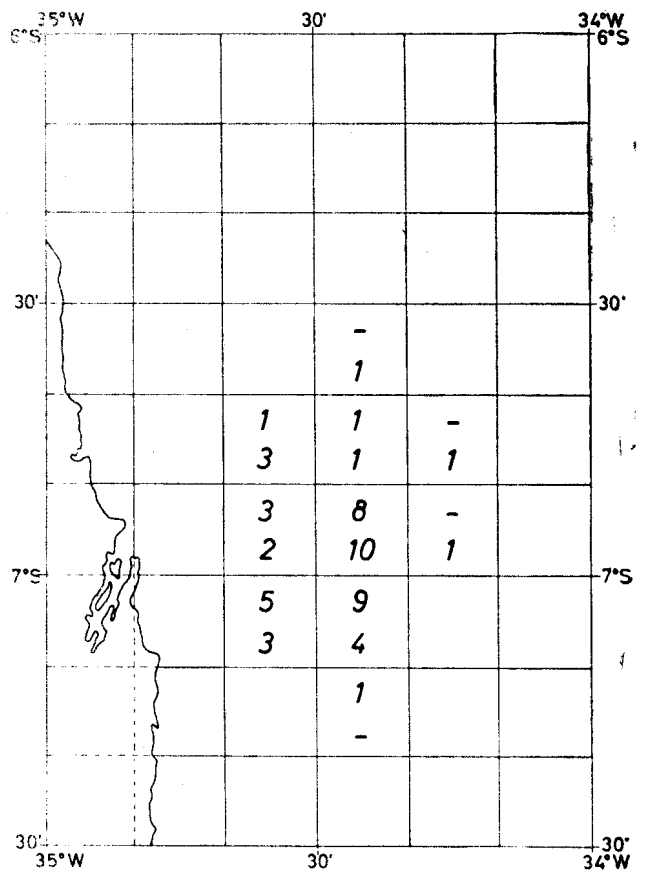


Figure 30 — Distribution of males (above) and females (below) of sei whale caught off Northeastern coast of Brazil during the month of October, 1963.

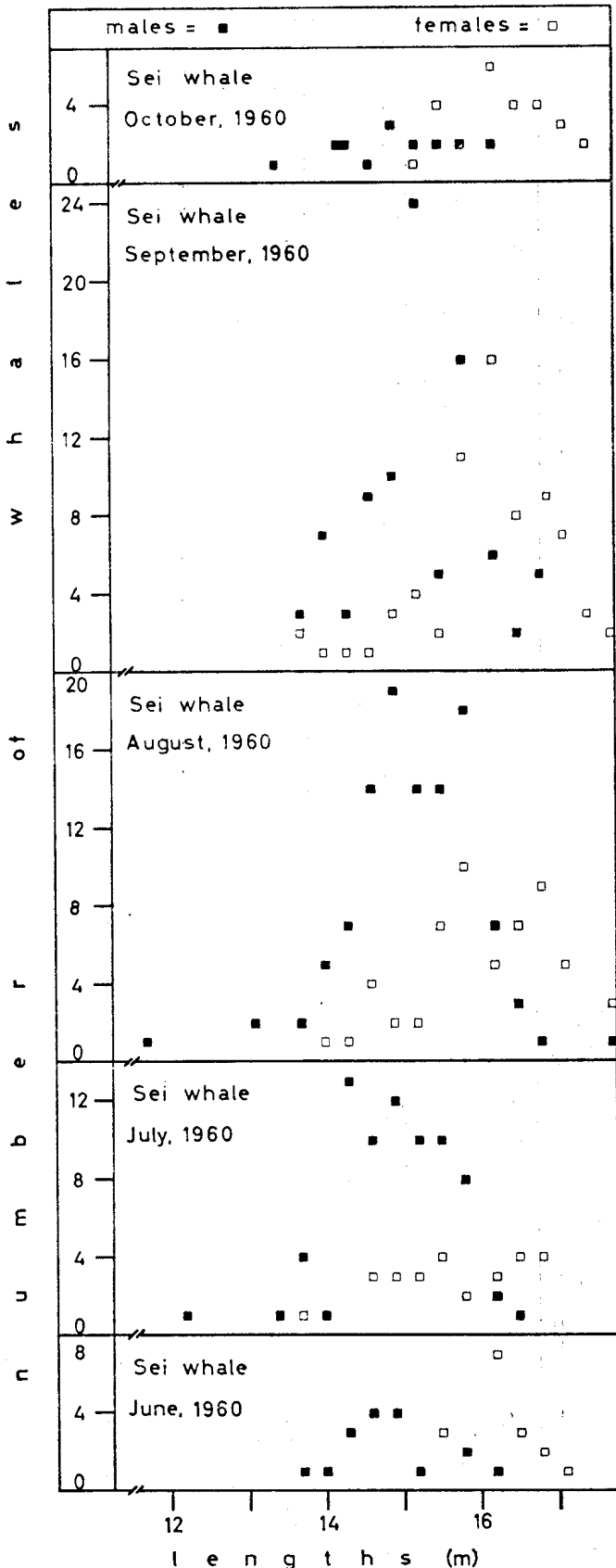


Figure 31 — Length distribution of sei whale caught off Northeastern coast of Brazil, by sexes and months, during the whaling season of 1960.

the killing per voyage increased till August or September, decreasing in the following month(s) of the respective whaling season (table VII).

The available information on the conditions of the sea during the catches of sei whale (seasons 1961 — 1963) are shown in tables XV to XVIII).

Regarding sea surface temperatures, the catches of sei whale were distributed in the following way: between 24.0°C and 27.0°C in 1961, concentrating between 25.0°C and 26.0°C, with the maximum in 25.0°C; between 25.5°C and 28.0°C in 1962, concentrating between 25.5°C and 26.5°C, with the maximum in 26.0°C; between 24.0°C and 27.0°C in 1963, concentrating between 26.0°C and 26.5°C, with the maximum in 26.0°C.

Regarding air temperatures, the catches of sei whale were distributed in the following way: between 25.0°C and 29.0°C in 1961, concentrating between 27.0°C and 29.0°C, with the maximum in 28.0°C; between 25.0°C and 30.0°C in 1962, without regular concentration, with the maximum in 27.0°C; between 25.0°C and 29.0°C in 1963, with a small concentration between 26.5°C and 28.0°C, with the maximum in 27.0°C.

Regarding wind speeds, expressed in Beaufort's scale, the catches of sei whale were distributed in the following way: from number 1 to 6 (0.7 — 13.8 meters per second) in 1961, concentrating between numbers 2 to 5 (2.4 — 11.3 meters per second), with the maximum in number 3 (4.5 — 6.6 meters per second); from number 1 to 8 (0.7 — 19.0 meters per second) in 1962, concentrating between numbers 2 to 4 (2.4 — 8.9 meters per second), with the maximum in number 3 (4.5 — 6.6 meters per second); from number 2 to 4 (2.4 — 8.9 meters per second) in 1963, with the maximum in number 3 (4.5 — 6.6 meters per second).

Regarding wind directions, the catches of sei whale were distributed in the following way: from ESE to W in 1961, with the maximum in SW and SE by order of decreasing importance; from E to SW in 1962, with the maximum in SE; from E to S in 1963, with the maximum in SE.

No differential behavior of sexes was evident, concerning the conditions of the sea considered in this paper.

OBSERVATIONS ON HUMPBACK WHALE

Humpback whale is almost always a runner-up in number of whales caught along the Northeastern coast of Brazil (Paiva, 1961). During the years analysed, except for 1960, this was true (table V).

Catches of this species occurred from July to September, both in 1960 and 1961; from June to September, excluding July, in

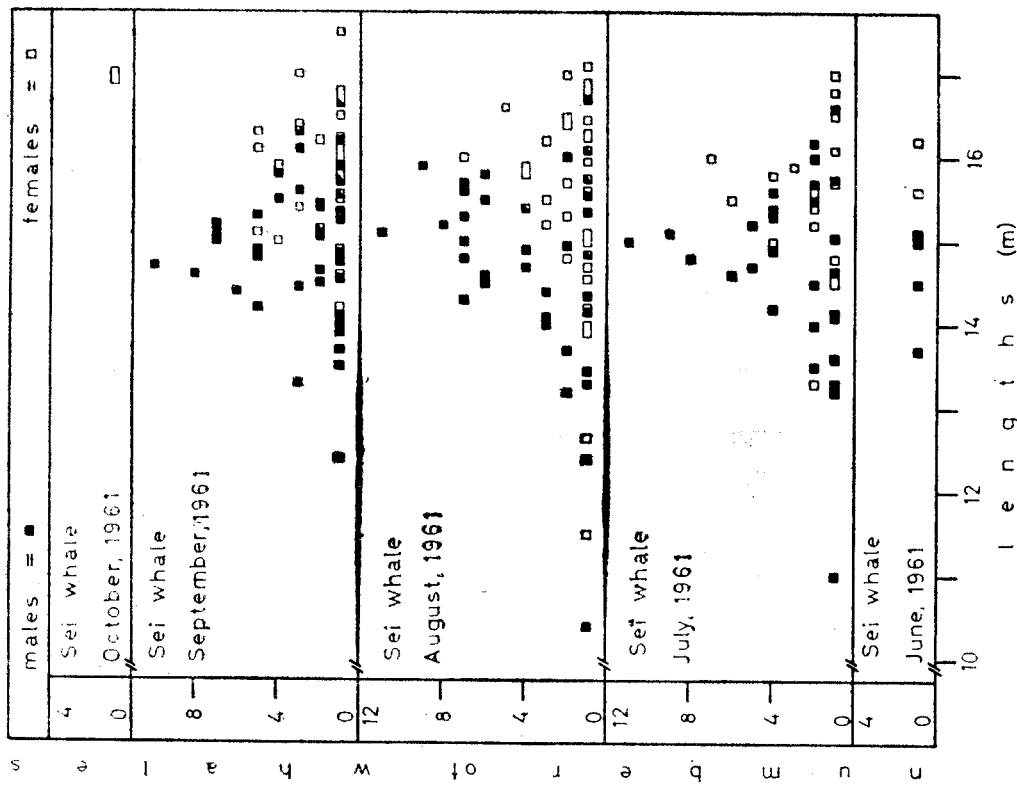


Figure 32 — Length distribution of sei whale Caught off Northeastern coast of Brazil, by sexes and months, during the whale season of 1961.

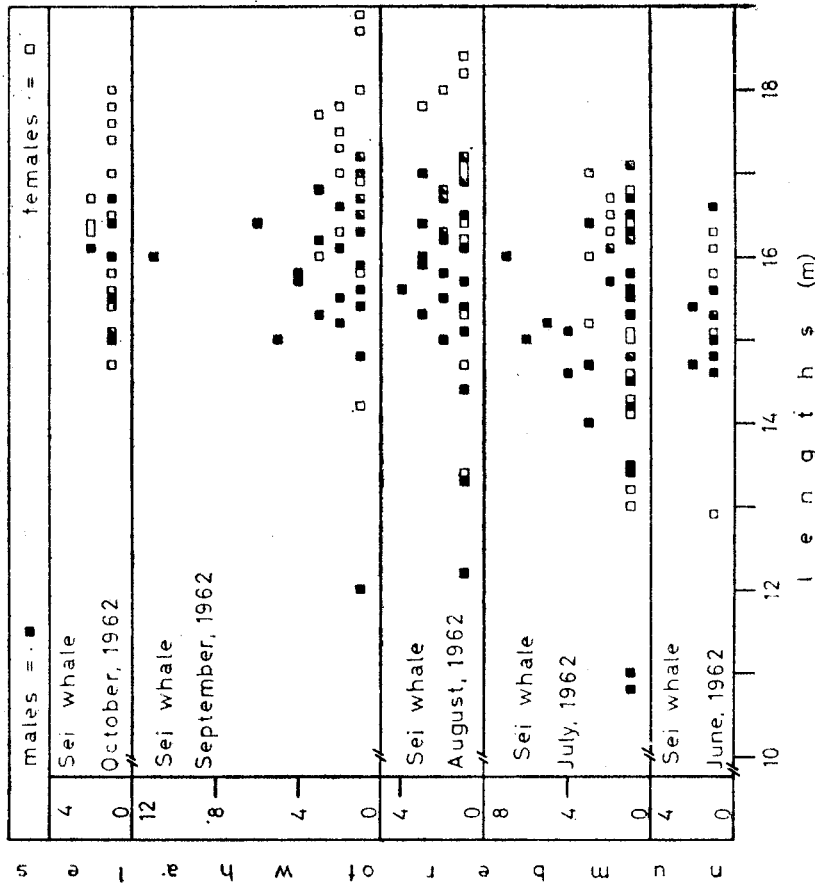


Figure 33 — Length distribution of sei whale caught off Northeastern coast of Brazil, by sexes and months, during the whaling season of 1962.

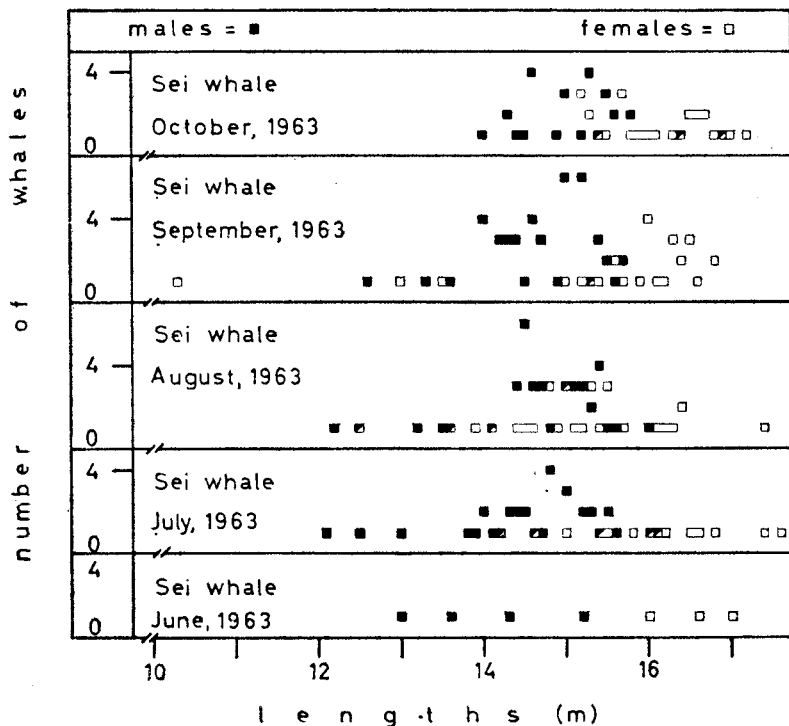


Figure 34 — Length distribution of sei whale caught off Northeastern coast of Brazil, by sexes and months, during the whaling season of 1963.

TABLE XI

Mean lengths, with its respective standard deviations and coefficients of variation, regarding each sex and both grouped, of sei whale caught off Northeastern coast of Brazil during the whaling seasons 1960 — 1963

Years	Sexes	Number of whales (n)	Lengths (m)		
			arithmetic means (\bar{x})	standard deviations (s)	coefficients of variation (C.V.)
1960	males	305	15.08	0.80	5.31
	females	195	16.09	0.84	5.22
	both	500	15.47	0.96	6.21
1961	males	344	14.90	1.09	7.32
	females	164	15.72	0.83	5.28
	both	508	15.16	1.05	6.93
1962	males	173	15.60	0.99	6.35
	females	99	16.40	1.22	7.44
	both	272	15.89	1.15	7.24
1963	males	152	14.72	0.78	5.30
	females	101	15.69	1.04	6.63
	both	253	15.11	1.01	6.68

TABLE XII

Mean lengths, with its respective standard deviations and coefficients of variation, regarding each sex and both grouped, of sei whale caught off Northeastern coast of Brazil during the months of the whaling seasons 1960 — 1963

Years	Months	Number of whales (n)	Sexes	Lengths (m)		
				arithmetic means (\bar{x})	standard deviations (s)	coefficients of variation (C.V.)
1960	June	17	males	14.80	0.66	4.46
		16	females	16.26	0.46	2.83
		33	both	15.50	0.93	6.00
	July	73	males	14.90	0.73	4.90
		27	females	15.67	0.85	5.42
		100	both	15.10	0.84	5.56
	August	108	males	15.13	0.87	5.75
		56	females	16.07	0.88	5.48
		164	both	15.45	0.98	6.34
	September	90	males	15.24	0.76	4.99
		70	females	16.15	0.88	5.45
		160	both	15.64	0.93	5.95
	October	17	males	14.98	0.81	5.41
		26	females	16.35	0.72	4.40
		43	both	15.81	0.97	6.14
1961	June	4	males	14.58	0.64	4.39
		2	females	15.90	0.18	2.64
		6	both	15.02	0.87	5.79
	July	88	males	14.89	0.74	4.97
		42	females	15.55	2.67	17.17
		130	both	15.10	0.80	5.30
	August	135	males	14.99	0.79	5.27
		65	females	15.68	0.96	6.12
		200	both	15.21	0.91	5.98
	September	117	males	14.94	0.67	4.48
		53	females	15.86	0.69	4.35
		170	both	15.23	0.80	5.25
	October	—	males	—	—	—
		2	females	16.95	0.00	0.00
		—	both	—	—	—
1962	June	10	males	15.21	0.60	3.94
		6	females	15.25	1.23	8.07
		16	both	15.23	0.85	5.58
	July	55	males	15.14	1.15	7.60
		29	females	15.74	1.12	7.12
		84	both	15.35	1.17	7.62
	August	43	males	15.85	0.95	6.00
		22	females	16.81	1.19	7.08
		65	both	16.18	1.12	6.92
	September	57	males	15.87	0.76	4.79
		25	females	17.03	1.00	5.87
		82	both	16.22	0.99	6.11
	October	8	males	15.86	0.60	3.78
		17	females	16.45	0.93	5.65
		25	both	16.26	0.87	5.35

1963	June	4	males	14.03	0.95	6.77
		3	females	16.53	0.50	3.02
		7	both	15.10	1.53	10.13
	July	34	males	14.61	0.88	6.03
		14	females	15.91	0.91	5.72
		48	both	14.99	1.06	7.07
	August	40	males	14.67	0.80	5.46
		30	females	15.22	0.93	6.11
		70	both	14.90	0.89	6.97
	September	46	males	14.65	0.66	4.51
		28	females	15.62	1.35	8.64
		74	both	15.02	1.08	7.19
	October	28	males	15.15	0.65	4.29
		26	females	16.08	0.51	3.17
		54	both	15.60	0.79	5.06

TABLE XIII

Mean lengths, with its respective standard deviations and coefficients of variation, regarding each sex and both grouped, of sei whale caught in several extents of longitude during the whaling seasons of 1960 — 1963 off Northeastern coast of Brazil

Years	Western longitudes	Number of whales (n)	Sexes	Lengths (m)		
				arithmetic means (x)	standard deviations (s)	coefficients of variation (C.V.)
1960	34°00' — 34°10'	5	males	14.84	0.72	4.85
		3	females	15.77	1.02	6.47
		8	both	15.19	0.91	5.99
	34°10' — 34°20'	33	males	15.09	0.62	4.11
		11	females	16.09	0.63	3.92
		44	both	15.34	0.61	3.98
	34°20' — 34°30'	171	males	15.18	0.78	5.14
		114	females	16.09	0.86	5.34
		285	both	15.54	0.93	5.98
	34°30' — 34°40'	93	males	14.90	0.88	5.91
		65	females	15.73	1.21	7.69
		158	both	15.23	1.58	10.37
34°40' — 34°50'	3	males	15.40	0.46	2.99	
	2	females	15.85	0.92	5.80	
	5	both	15.58	0.61	3.92	
1961	34°00' — 34°10'	1	males	15.30	—	—
		—	females	—	—	—
		—	both	—	—	—
	34°10' — 34°20'	39	males	15.07	0.69	4.57
		15	females	15.72	0.62	3.94
		54	both	15.24	0.73	4.49
	34°20' — 34°30'	132	males	14.90	0.78	5.23
		77	females	15.64	0.84	5.37
		209	both	15.17	0.93	6.13
	34°30' — 34°40'	153	males	14.82	1.40	9.45
		67	females	15.84	0.86	5.43
		220	both	15.13	1.34	8.86
34°40' — 34°50'	19	males	15.06	0.72	4.78	
	5	females	15.80	0.50	3.16	
	24	both	15.21	0.73	4.80	

1962	34°00' — 34°10'	1	males	15.00	—	—
		1	females	16.50	—	—
		2	both	15.75	1.06	6.73
	34°10' — 34°20'	30	males	15.36	0.66	4.30
		16	females	15.77	1.45	9.19
		46	both	15.50	1.09	7.03
	34°20' — 34°30'	116	males	15.58	1.05	6.74
		62	females	16.53	1.20	7.26
		178	both	15.90	1.24	7.80
	34°30' — 34°40'	26	males	15.97	0.51	3.19
		18	females	16.50	0.85	5.15
		44	both	16.19	0.58	3.58
34°40' — 34°50'	—	males	—	—	—	
	2	females	15.25	1.49	9.77	
	—	both	—	—	—	
1963	34°00' — 34°10'	1	males	14.70	—	—
		1	females	17.00	—	—
		2	both	15.85	0.35	2.21
	34°10' — 34°20'	36	males	14.66	0.63	4.30
		19	females	15.88	0.82	5.16
		55	both	15.08	0.91	6.03
	34°20' — 34°30'	20	males	14.93	0.92	6.16
		17	females	15.68	0.81	5.17
		37	both	15.27	0.94	6.16
	34°30' — 34°40'	94	males	14.78	0.72	4.87
		63	females	15.63	1.21	7.74
		157	both	15.12	1.03	6.81
34°40' — 34°50'	1	males	14.00	—	—	
	1	females	16.00	—	—	
	2	both	15.00	1.41	9.40	

TABLE XIV

Data concerning pregnant sei whales caught off Northeastern coast of Brazil during the whaling seasons 1960 — 1963

Years	Catches		Lengths (m)		Sexes of the foetuses
	days	positions	mothers	foetuses	
1960	June, 24th	6°46'S — 34°23'W	16.20	3.50	female
1961	July, 7th	6°43'S — 34°16'W	15.20	2.60	male
1961	July, 8th	6°51'S — 34°14'W	16.80	2.60	male
1961	August, 15th	6°49'S — 34°32'W	15.70	4.60	female
1962	August, 20th	6°34'S — 34°29'W	17.10	0.06	unknown
1963	August, 2nd	7°02'S — 34°23'W	14.50	1.90	female
1963	September, 11th	6°40'S — 34°29'W	16.40	0.14	male

1962; from July to October in 1963 (table VI).

Available data (table VI) do not permit to draw the sex-ratio in the stock of this species, because the killings were selected due to the prohibition of hunting females accompanied by their calves. The relation between males and females killed (2.3: 1.0 in 1960; 0.6: 1.0 in 1961; 0.3: 1.0 in 1962; 1.2: 1.0 in 1963) in each whaling season, does not show a definite predominance of one

sex on the other. It is possible that in certain years males predominate on the stock of the area, while in others females predominate.

Figures 37 to 40 show the distribution of males and females of humpback whale killed during the whaling seasons studied. In different seasons the killing area varied largely, restricting or extending without showing a tendency for concentration of killings.

Killings distribution by months and sexes, in each whaling season (table VI), is not consistent and therefore does not permit a proper analysis.

Arithmetic means of humpback whale lengths caught in the whaling seasons 1960 — 1963 were calculated, with their respective standard deviations and coefficients of variation (table XIX). Only in 1960 the mean length of males was larger than that of females, since the opposite was found in other years.

All humpback whales caught during the whaling seasons 1960 — 1963 had empty stomachs. This confirms that the migration to tropical waters is made for purposes of reproduction.

Only in 1963 a pregnant humpback whale was recorded. In August 30 of that year, at latitude 7° 03' S and longitude 35° 34' W, a female of 15.00 meters of length was killed, and in its belly a female foetus, which measured 4.60 meters of length, was found.

T A B L E X V

Distribution according the different sea surface temperatures, of sei whale caught during the months of the whaling seasons 1961 — 1963, off Northeastern coast of Brazil

Years	Months	Sexes	Sea surface temperatures (°C)									Total
			24.0	24.5	25.0	25.5	26.0	26.5	27.0	27.5	28.0	
1961	June	males	—	—	—	—	2	—	2	—	—	4
		females	—	—	—	—	1	—	1	—	—	2
		both	—	—	—	—	3	—	3	—	—	6
	July	males	2	—	29	—	52	—	5	—	—	88
		females	2	—	11	—	29	—	—	—	—	42
		both	4	—	40	—	81	—	5	—	—	130
	August	males	2	—	85	—	48	—	—	—	—	135
		females	2	—	34	—	29	—	—	—	—	65
		both	4	—	119	—	77	—	—	—	—	200
	September	males	—	—	96	—	21	—	—	—	—	117
		females	—	—	35	—	18	—	—	—	—	53
		both	—	—	131	—	39	—	—	—	—	170
October	males	—	—	—	—	—	—	—	—	—	—	
	females	—	—	2	—	—	—	—	—	—	2	
	both	—	—	2	—	—	—	—	—	—	2	
Total	males	4	—	210	—	123	—	7	—	—	344	
	females	4	—	82	—	77	—	1	—	—	164	
	both	8	—	292	—	200	—	8	—	—	508	
1962	June	males	—	—	—	—	—	9	—	—	9*	
		females	—	—	—	—	—	3	—	—	3**	
		both	—	—	—	—	—	12	—	—	12	
	July	males	—	—	—	7	35	13	—	—	—	55
		females	—	—	—	2	16	11	—	—	—	29
		both	—	—	—	9	51	24	—	—	—	84
	August	males	—	—	—	7	31	1	—	—	4	43
		females	—	—	—	1	16	4	—	—	1	22
		both	—	—	—	8	47	5	—	—	5	65
	September	males	—	—	—	12	41	4	—	—	—	57
		females	—	—	—	5	19	1	—	—	—	25
		both	—	—	—	17	60	5	—	—	—	82
October	males	—	—	—	—	4	4	—	—	—	8	
	females	—	—	—	—	3	14	—	—	—	17	
	both	—	—	—	—	7	18	—	—	—	25	
Total	males	—	—	—	26	111	31	—	—	4	172*	
	females	—	—	—	8	54	33	—	—	1	96**	
	both	—	—	—	34	165	64	—	—	5	268	

1963	June	males	—	2	2	—	—	—	—	—	—	4
		females	—	—	3	—	—	—	—	—	—	3
		both	—	2	5	—	—	—	—	—	—	7
	July	males	1	2	2	—	6	22	1	—	—	34
		females	—	—	1	1	6	6	—	—	—	14
		both	1	2	3	1	12	28	1	—	—	48
	August	males	—	—	1	1	34	4	—	—	—	40
		females	—	—	1	4	19	6	—	—	—	30
		both	—	—	2	5	53	10	—	—	—	70
	September	males	—	—	—	—	42	4	—	—	—	46
		females	—	—	—	—	24	4	—	—	—	28
		both	—	—	—	—	66	8	—	—	—	74
	October	males	—	—	—	—	8	20	—	—	—	28
		females	—	—	—	—	10	16	—	—	—	26
		both	—	—	—	—	18	36	—	—	—	54
	Total	males	1	4	5	1	90	50	1	—	—	152
		females	—	—	5	5	59	32	—	—	—	101
		both	1	4	10	6	149	82	1	—	—	253

*) The temperature regarding one male was not recorded.

**) The temperatures regarding three females were not recorded.

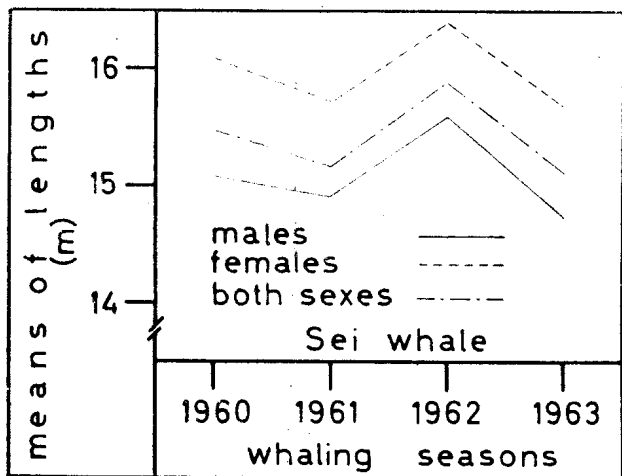


Figure 35 — Distribution of mean lengths of sei whale caught off Northeastern coast of Brazil, by sexes and both grouped, during the whaling seasons 1960 — 1963.

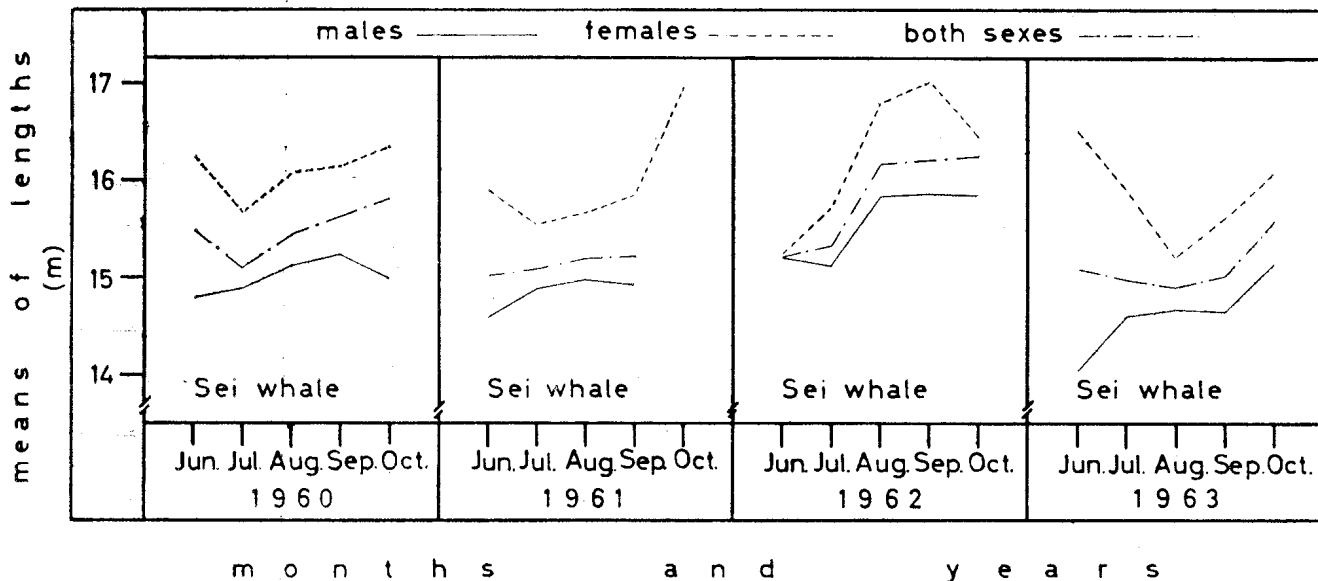


Figure 36 — Distribution of mean lengths of sei whale caught off Northeastern coast of Brazil, by sexes and both grouped, during the several months of the whaling seasons 1960 — 1963.

Humpback whale killing per voyage were the following in the years analysed: 0.04 in 1960, 0.03 in 1961, 0.07 in 1962, and 0.09 in 1963 (table V). Humpback whale was more abundant in the last two years in the area studied. Data regarding the killing per voyage were not consistent during the months of each whaling season (table VII), and do not permit a proper analysis.

The available information on the conditions of the sea during the catches of hump-

back whale (seasons 1961 — 1963) are shown in tables XX to XXIII.

Regarding sea surface temperatures, the catches of humpback whale were distributed in the following way: between 25.0°C and 27.0°C in 1961; between 25.5°C and 26.0°C in 1962; between 25.5°C and 27.0°C in 1963. Generally the concentration was around 26.0°C.

Regarding air temperatures, the catches of humpback whale were distributed in the

T A B L E X V I

Distribution, by the different air temperatures, of sei whale caught during the months of the whaling seasons 1961 — 1963, off Northeastern coast of Brazil

Years	Months	Sexes	Air temperatures (°C)												Total
			25.0	25.5	26.0	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0		
1961	June	males	2	—	2	—	—	—	—	—	—	—	—	—	4
		females	1	—	1	—	—	—	—	—	—	—	—	—	2
		both	3	—	3	—	—	—	—	—	—	—	—	—	6
	July	males	—	—	—	—	24	—	48	—	16	—	—	—	88
		females	—	—	—	—	8	—	31	—	3	—	—	—	42
		both	—	—	—	—	32	—	79	—	19	—	—	—	130
	August	males	—	—	19	—	26	—	50	—	40	—	—	—	135
		females	—	—	8	—	13	—	22	—	22	—	—	—	65
		both	—	—	27	—	39	—	72	—	62	—	—	—	200
	September	males	—	—	10	—	30	—	48	—	29	—	—	—	117
		females	—	—	6	—	18	—	16	—	13	—	—	—	53
		both	—	—	16	—	48	—	64	—	42	—	—	—	170
October	males	—	—	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	2	—	—	—	—	—	2	
	both	—	—	—	—	—	—	2	—	—	—	—	—	2	
Total	males	2	—	31	—	80	—	146	—	85	—	—	—	344	
	females	1	—	15	—	39	—	71	—	38	—	—	—	164	
	both	3	—	46	—	119	—	217	—	123	—	—	—	508	
1962	June	males	—	—	—	—	5	2	2	—	—	—	—	9*	
		females	—	—	—	—	3	—	—	—	—	—	—	3**	
	both	—	—	—	—	8	2	2	—	—	—	—	—	12	
		males	—	5	6	6	33	—	2	—	—	—	3	55	
	July	females	—	1	1	3	17	—	3	—	—	—	4	29	
		both	—	6	7	9	50	—	5	—	—	—	7	84	
	August	males	3	—	—	7	21	2	10	—	—	—	—	43	
		females	—	—	—	1	15	1	4	—	1	—	—	22	
		both	3	—	—	8	36	3	14	—	1	—	—	65	
	September	males	—	—	—	2	10	3	14	3	6	5	14	57	
		females	—	—	—	—	4	3	3	2	3	5	5	25	
		both	—	—	—	2	14	6	17	5	9	10	19	82	
October	males	—	—	—	—	1	—	—	—	2	2	3	8		
	females	—	—	—	—	1	1	2	—	9	3	1	17		
	both	—	—	—	—	2	1	2	—	11	5	4	25		
Total	males	3	5	6	15	70	7	28	3	8	7	20	172*		
	females	—	1	1	4	40	5	12	2	13	8	10	96**		
	both	3	6	7	19	110	12	40	5	21	15	30	268		

1963	Month	Males			Females			Both			Total
		1	2	3	1	2	3	1	2	3	
June	males	—	—	1	—	3	—	—	—	—	4
	females	—	—	—	—	2	1	—	—	—	3
	both	—	—	1	—	5	1	—	—	—	7
July	males	4	—	2	5	15	1	3	2	2	34
	females	—	—	2	6	4	—	—	2	—	14
	both	4	—	4	11	19	1	3	4	2	48
August	males	2	—	2	8	27	—	1	—	—	40
	females	4	—	2	6	15	—	3	—	—	30
	both	6	—	4	14	42	—	4	—	—	70
September	males	—	—	3	1	34	8	—	—	—	46
	females	—	—	2	1	21	4	—	—	—	28
	both	—	—	5	2	55	12	—	—	—	74
October	males	—	—	—	—	4	7	11	—	6	28
	females	—	—	—	—	2	11	10	—	3	26
	both	—	—	—	—	6	18	21	—	9	54
Total	males	6	—	8	14	83	16	15	2	8	152
	females	4	—	6	13	44	16	13	2	3	101
	both	10	—	14	27	127	32	28	4	11	253

*) — The temperature regarding one male was not recorded.

**) — The temperatures regarding three females were not recorded.

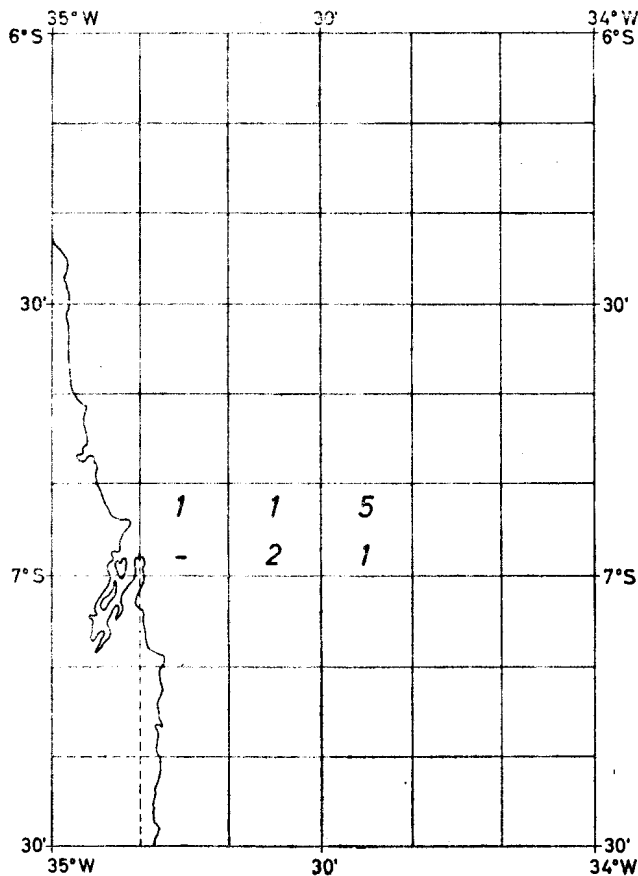


Figure 37 — Distribution of males (above) and females (below) of humpback whale caught off Northeastern coast of Brazil during the whaling season of 1960.

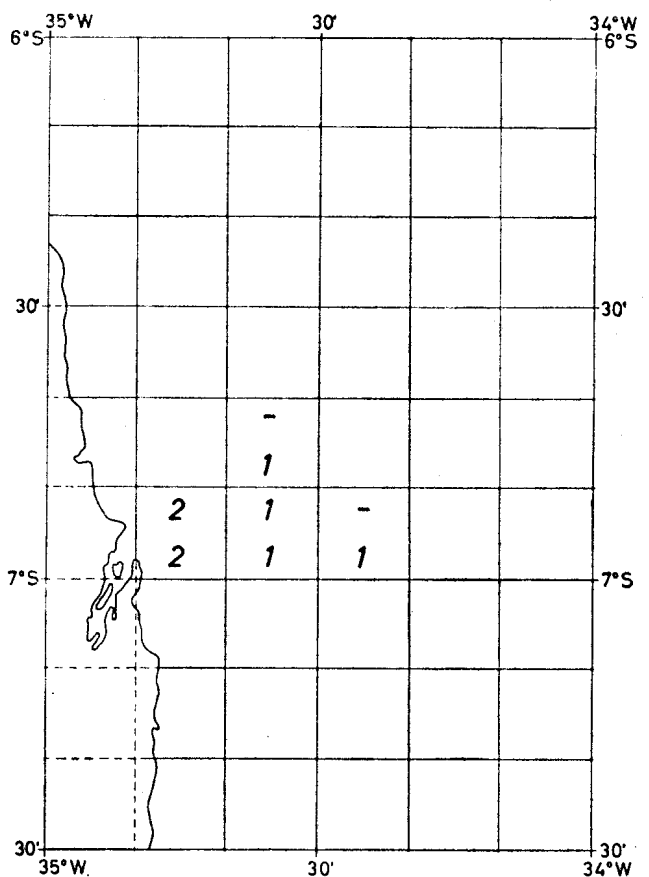


Figure 38 — Distribution of males (above) and females (below) of humpback whale caught off Northeastern coast of Brazil during the whaling season of 1961.

1963	Sexes	Humpback whale			Minke whale *			Sperm whale					
		number of whales (n)	arith- metic means (\bar{x})	lengths (m) standard deviations (s)	coefficients of variation (C.V.)	number of whales (n)	arith- metic means (\bar{x})	lengths (m) standard deviations (s)	coefficients of variation (C.V.)				
June	males	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	—	—	—	—	—	
	both	—	—	—	—	—	—	—	—	—	—	—	
July	males	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	—	—	—	—	—	
	both	—	—	—	—	—	—	—	—	—	—	—	
August	males	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	—	—	—	—	—	
	both	—	—	—	—	—	—	—	—	—	—	—	
September	males	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	—	—	—	—	—	
	both	—	—	—	—	—	—	—	—	—	—	—	
October	males	—	—	—	—	—	—	—	—	—	—	—	
	females	—	—	—	—	—	—	—	—	—	—	—	
	both	—	—	—	—	—	—	—	—	—	—	—	
Total	males	5	2	11	9	5	8	13	112	97	23	—	—
	females	3	1	17	5	38	5	3	46	38	14	—	—
	both	8	3	28	14	—	8	16	58	—	1	—	—
Total	males	8	3	28	14	—	8	13	112	97	23	—	—
	females	3	1	17	5	38	5	3	46	38	14	—	—
	both	11	4	45	19	75	13	16	158	135	37	—	—

T A B L E X I X

Annual mean lengths, with its respective standard deviations and coefficients of variation, regarding each sex of the species humpback whale, minke whale and sperm whale caught during the whaling seasons 1960—1963, off Northeastern coast of Brazil

Years	Sexes	Humpback whale			Minke whale *			Sperm whale					
		number of whales (n)	arith- metic means (\bar{x})	lengths (m) standard deviations (s)	coefficients of variation (C.V.)	number of whales (n)	arith- metic means (\bar{x})	lengths (m) standard deviations (s)	coefficients of variation (C.V.)				
1960	males	7	13.36	2.45	18.35	2	8.50	0.85	10.00	1	17.50	—	—
	females	3	12.47	1.50	12.03	9	8.80	0.41	4.66	—	—	—	—
1961	males	3	11.70	0.96	8.20	—	—	—	—	3	12.55	2.19	17.45
	females	5	12.94	1.96	15.14	—	—	—	—	3	9.83	2.75	27.97
1962	males	2	13.90	0.99	7.12	—	—	—	—	3	15.73	1.24	7.88
	females	6	14.40	1.15	7.98	1	9.30	—	—	1	13.00	—	—
1963	males	6	12.22	1.10	9.00	—	—	—	—	4	12.63	0.40	3.17
	females	5	14.48	0.63	4.35	1	9.50	—	—	3	11.70	0.26	2.22

*) — The minke whales caught in 1960 were not officially registered.

T A B L E X X I I I

Distribution, by the different wind directions, of humpback whale, minke whale and sperm whale caught during the whaling seasons 1961 -- 1963 off Northeastern coast of Brazil

Years	Species	Wind directions																Total
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
1961	humpback whale	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	8
	minke whale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	sperm whale	-	-	-	-	-	-	3	-	-	-	5	-	-	-	-	-	5
1962	humpback whale	-	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-	8
	minke whale	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
	sperm whale	-	-	-	-	2	-	2	-	-	-	2	-	-	-	-	-	4
1963	humpback whale	-	-	-	-	-	-	5	4	2	-	-	-	-	-	-	-	11
	minke whale	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
	sperm whale	-	-	-	-	3	-	3	1	-	-	-	-	-	-	-	-	7

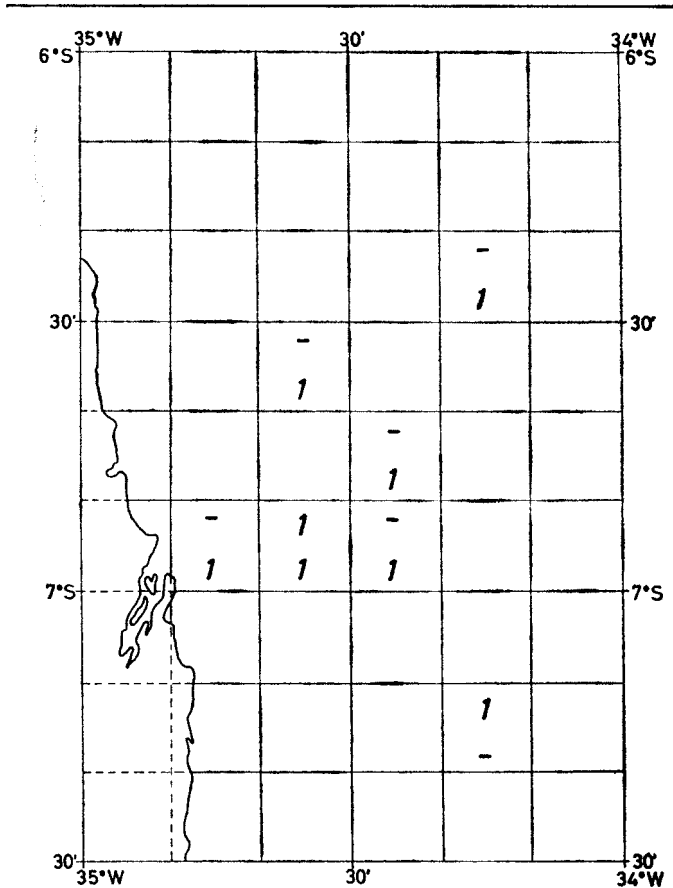


Figure 39 — Distribution of males (above) and females (below) of humpback whale caught off Northeastern coast of Brazil during the whaling season of 1962.

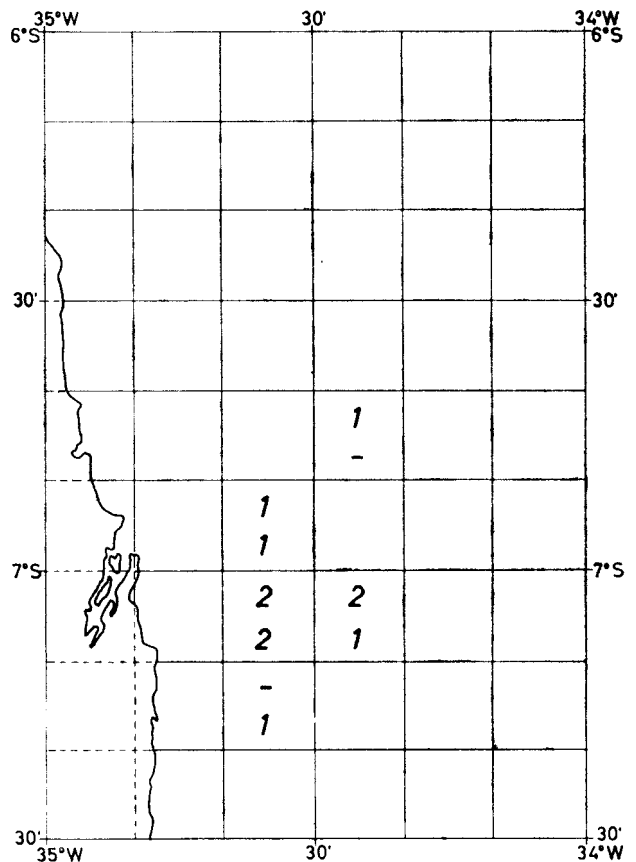


Figure 40 — Distribution of males (above) and females (below) of humpback whale caught off Northeastern coast of Brazil during the whaling season of 1963.

following way: between 26.0°C and 29.0°C in 1961; between 26.0°C and 30.0°C in 1962; between 25.0°C and 29.0°C in 1963.

Regarding wind speeds, expressed in Beaufort's scale, the catches of humpback whale were distributed in the following way: from number 2 to 6 (2.4 — 13.8 meters per second) in 1961; from number 2 to 4 (2.4 — 8.9 meters per second) in 1962 and 1963.

Regarding wind directions, the catches of humpback whale were distributed in the following way: from SE to SW in 1961, with the maximum in SW; from ESE to SSE in 1962, with the maximum in SE; from SE to S in 1963, concentrating between SE and SSE.

OBSERVATIONS ON MINKE WHALE

Minke whale is seldom caught along the coast of Northeastern Brazil (Paiva, 1961). In number of individuals caught, minke whale ranked second in 1960; in 1961 it was not caught; in 1962 and 1963 it occupied the last place (table V).

In the years in which this species was caught, this occurred only in October (table VI).

Available data (table VI) do not permit to draw the sex-ratio in the stock of this species, because the killings were selected due to the prohibition of hunting females accompanied by their calves. In 1960 the relation between males and females killed was 0.2: 1.0. In 1962, as well as in 1963, only one female was caught. This shows that females predominate in the area studied.

The minke whales caught in 1960 were not officially registered. The female caught in 1962 was killed at latitude 6° 59' S and longitude 34° 40' W; the one of 1963, at latitude 6° 55' S and longitude 34° 32' W.

Aritmetic means of minke whale lengths caught in 1960 were calculated separately by sexes, with their respective standard deviations and coefficients of variation (table XIX). It can be seen that females were larger than males.

The females caught in 1962 and 1963 had empty stomachs, and were not pregnant.

Minke whale killing per voyage were the following in the years analysed: 0.04 in 1960, none in 1961, and 0.01 in 1962 and 1963 (table V). In October the killing per voyage were 0.28 in 1960, none in 1961, 0.05 in 1962, and 0.03 in 1963 (table VII). From 1961 on the number of individuals in the area studied was less abundant.

The females of 1962 and 1963 were caught in waters where the surface temperature was of 26.5°C (table XX), with the air temperature equal to 29.5°C and 28.0°C respectively (table XXI). At the time of

their catches the wind speeds, expressed in Beaufort's scale, were number 3 (4.5 — 6.6 meters per second) and number 2 (2.4 — 4.4 meters per second), respectively in 1962 and 1963 (table XXII), with the direction ESE (table XXIII).

OBSERVATIONS ON SPERM WHALE

Sperm whale almost always occupies the third rank in number of individuals caught along the Northeastern coast of Brazil (Paiva, 1961). During the years analysed, except for 1960, this has been true (table V).

In 1960 this species was caught only in September; in 1961, from June to August; in 1962 and 1963, from August to October (table VI).

Available data (table VI) do not permit to draw the sex-ratio in the stock of this species, because the killings were selected due to the prohibition of hunting females accompanied by their calves. In 1960 only one male was caught. In the following years the relation between males and females killed (0.3: 1.0 in 1961; 3.0: 1.0 in 1962; 1.3: 1.0 in 1963) except for 1961, was favorable for females. It is possible that in certain years males predominate on the stock of the area, while in others females predominate.

Figures 41 to 44 show the distribution of males and females of sperm whale killed during the whaling seasons studied. In different seasons the killing area varied largely, restricting or extending without showing a tendency for concentration of killings.

Killings distribution by months and sexes, in each whaling season (table VI), is not consistent and therefore does not permit a proper analysis.

Arithmetic means of sperm whale lengths caught in the whaling seasons 1961 — 1963 were calculated, with their respective standard deviations and coefficients of variation (table XIX). The mean lengths of males were larger than those of females.

All sperm whales caught during the whaling seasons 1960 — 1963 had empty stomachs. Among females none was pregnant.

Sperm whale killing per voyage were the following in the years analysed: 0.00 in 1960, 0.02 in 1961, 0.04 in 1962, and 0.06 in 1963 (table V). This shows an increase of abundance of the species in the area studied. Data regarding the killing per voyage during the months of each whaling season (table VII) permit to suppose a decrease of abundance of the species, from the month on which the catch was started.

The available information on the conditions of the sea during the catches of sperm whale (seasons 1961 — 1963) are shown in tables XX to XXIII.

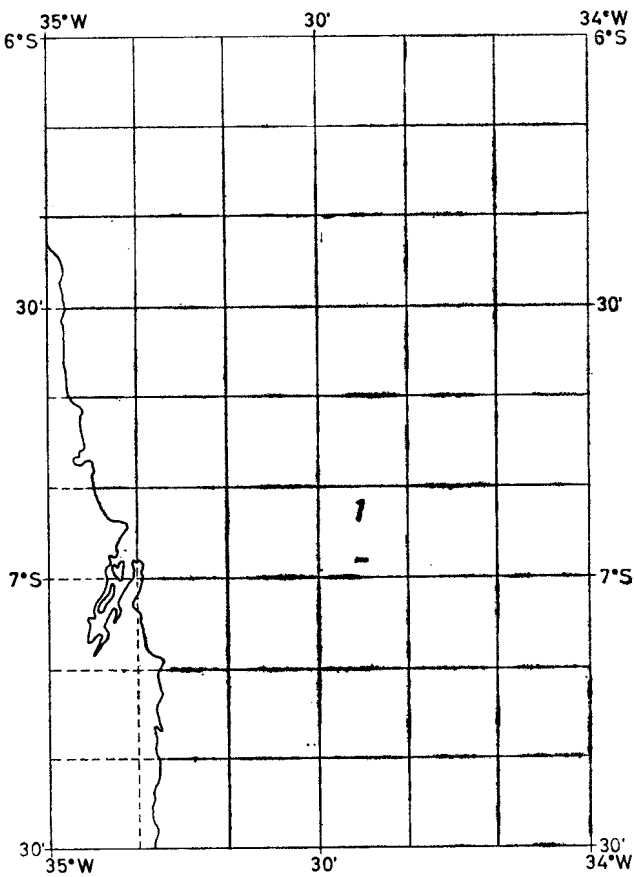


Figure 41 — Distribution of males (above) and females (below) of sperm whale caught off Northeastern coast of Brazil during the whaling season of 1960.

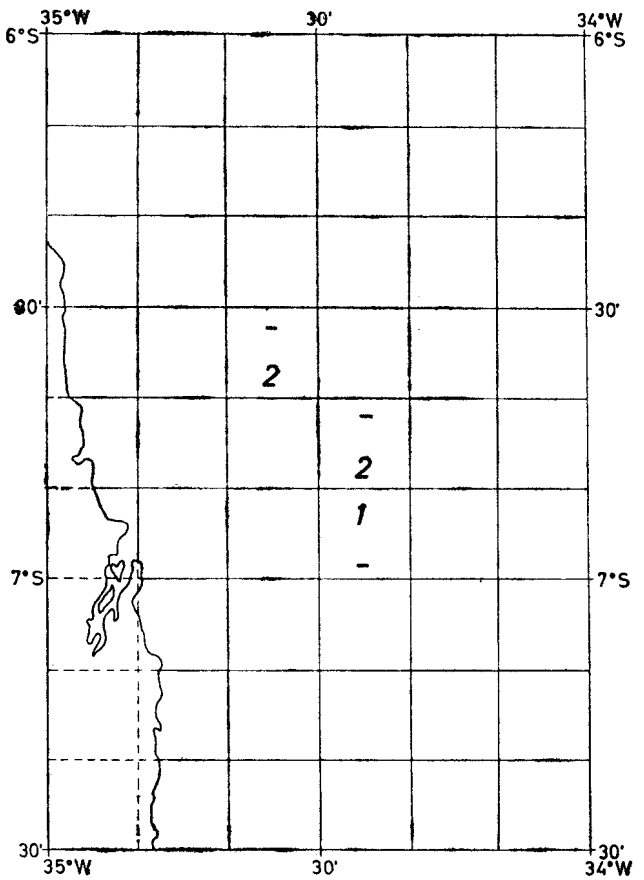


Figure 42 — Distribution of males (above) and females (below) of sperm whale caught off Northeastern coast of Brazil during the whaling season of 1961.

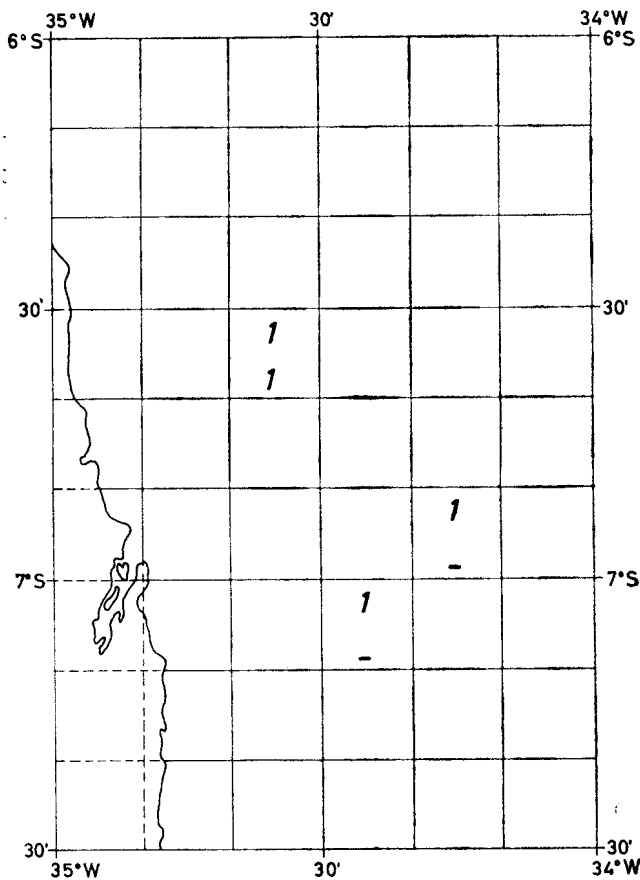


Figure 43 — Distribution of males (above) and females (below) of sperm whale caught off Northeastern coast of Brazil during the whaling season of 1962.

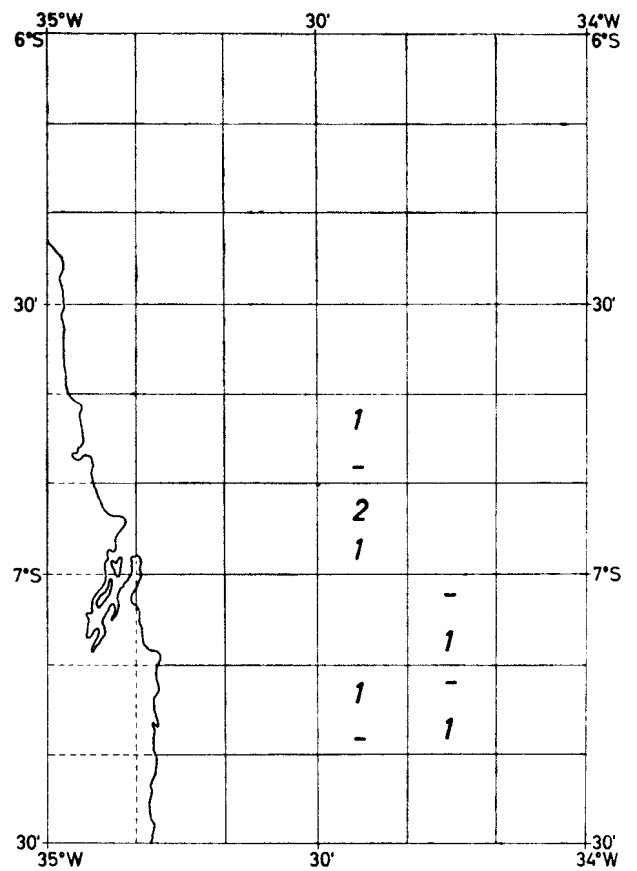


Figure 44 — Distribution of males (above) and females (below) of sperm whale caught off Northeastern coast of Brazil during the whaling season of 1963.

Regarding sea surface temperatures, the catches of sperm whale were distributed in the following way: between 25.0°C and 26.0°C in 1961; between 26.0°C and 26.5°C in 1962; only 26.0°C in 1963.

Regarding air temperatures, the catches of sperm whale were distributed in the following way: between 25.0°C and 28.0°C in 1961; between 28.0°C and 29.0°C in 1962; between 26.5°C and 28.0°C in 1963.

Regarding wind speeds, expressed in Beaufort's scale, the catches of sperm whale were distributed in the following way: from number 2 to 4 (2.4 — 8.9 meters per second) in 1961; from number 2 to 3 (2.4 — 6.6 meters per second) in 1962; from number 3 to 4 (4.5 — 8.9 meters per second) in 1963.

Regarding wind directions, the catches of sperm whale were distributed in the following way: SE and SW in 1961; E and SE in 1962; from E to SSE in 1963.

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