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THE 1980 NORTHERN SHELIKOF STRAIT BOTTOMFISH OTTER TRAWL SURVEY

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July 1981

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ABSTRACT

During the summer of 1980 an otter trawl survey was conducted in northern Shelikof Strait. The primary objectives were to evaluate the use of trawls in assessing red king crabs *(Paralithodes camtschatica)* and Tanner crab *(Chionoecetes bairdi)* populations and to determine distribution and abundance of bottomfish stocks. Only the latter objective is addressed in this paper. For each of the 44 trawls completed in a systematic grid, average depth, cod end weight, species composition, and measurements for select species were determined.

The most abundant species caught were flathead sole at 215 kg/hr, walleye pollock at 152 kg/hr, Pacific cod at 118 kg/hr, arrowtooth flounder at 98 kg/hr, Pacific halibut at 55 kg/hr, and sablefish at 48 kg/hr. Biomass estimates were also calculated for the most abundant species from the following major groups: flatfish, roundfish, invertebrates, elasmobranchs, and rockfish.

The total catch rate tended to decrease with increasing depth. There was also apparent distributional and depth patterns for individual taxa and figures illustrating distributions are presented. Species abundance correlations were determined by depth.

INTRODUCTION

During the summer of 1980 (19 June - 2 July) an otter trawl survey was conducted by the Alaska Department of Fish and Game in northern Shelikof Strait. The primary objectives were to evaluate the use of trawls in assessing king *(Paralithodes camtschatica)* and Tanner crab *(Chionoecetes bairdi)* populations (for more specific information on objectives, results, and discussion of the Tanner crab survey see the Westward Region crab report to the Alaska Board of Fisheries, December 1980) and to determine the distribution and abundance of bottomfish stocks in Shelikof Strait. Biological information on bottomfish such as age and size was also collected. This survey had significantly more trawl stations per unit area than previous surveys.

Previously, only two major bottomfish surveys have occurred in the Gulf of Alaska. One survey was conducted by the International Pacific Halibut Commission (IPHC) and the old Federal Bureau of Commercial Fisheries (BCF) from 1961 to 1963 and another by the National Marine Fisheries Service (NMFS) from 1973 to 1976. These surveys were designed to define distributions and relative abundance of demersal fish and shellfish resources, provide estimates of standing stocks and size composition of commercially important species, define the nature of species associations by area and depth, and provide biological information such as the age composition and growth rates of selected species (Ronholt et al. 1978).

Results from these surveys indicated statistically significant changes in catch per unit effort from the 1960's and 1970's. A significant increase had occurred in walleye pollock *(Theragra chalcograma)*, Dover sole *(Microstomus pacificus)*, and a decrease in Pacific ocean perch *(Sebastes alutes)* throughout the entire Gulf of Alaska. In northern Shelikof Strait between 57° and 58°50' N latitude, the surveys showed significant increases in walleye pollock and Pacific halibut *(Hippoglossus stenolepis)*, and decreases in Pacific cod *(Gadus macrocephalus)* and arrowtooth flounder *(Atheresthes stomias)* (Pereyra and Ronholt 1976).

METHODS

The F/V COMMANDER [25 m (82 ft) keel] towed a 400 mesh Eastern otter trawl net similar to that used previously by the IPHC and BCF in 1961-63 and NMFS in 1973-76 survey in the Gulf of Alaska. The net had a 28 m (92 ft) headrope with 18 floats 20 cm (8 in) in diameter. The footrope was 22 m (72 ft) long without roller gear or ticklers. The two dandylines were 46 m (18 fm) long with a 18 m (10 fm) section of 16 mm (5/8 in) cable between each door and flounder plate and two 27 m (15 fm) sections of 13 mm (1/2 in) cable between each plate and net wing. The doors measured 1.5 m x 2.1 m (4.9 ft x 6.9 ft) and the triangular flounder plates were made of 16 mm (5/8 in) gauge steel and had a base of 28 cm (11 in) and width of 23 cm (9 in). The net was constructed with 102 mm (4 in) mesh at the mouth, 89 mm (3-1/2 in) mesh in the body, and the cod end had a 32 mm (1-1/4 in) mesh cod end liner. The net was designed to sweep a 12 m (40 ft) path.

The sample area was divided into 65 stations to be trawled as close to the midpoint as possible. All sampling was conducted in Shelikof Strait between 58°07' and 58°53' N latitude. Trawl density was to be 1 trawl per 25 square nmi of ocean or 6 square nmi of bay (Figure 1). Where possible, each tow was 30 minutes long and at 3 knots.

After the tow was brought on board, the cod end was weighed in pounds and converted to kilograms. The contents of the cod end were released on deck and all halibut and crabs were separated from the catch. The halibut were immediately measured and thrown overboard. The crabs were identified, sexed, counted, and weighed in to the nearest 0.1 kg. Next, extremely large species or those occurring non-randomly were sorted from the entire catch. Then a three basket random sample was taken of the remaining fish and other marine organisms. All organisms were identified to species (where possible) and weighed to the nearest 0.1 kg. Fish species were measured such as arrowtooth flounder, sablefish *(Anoplopoma fimbria)*, Pacific cod, Pacific halibut, flathead sole *(Hippoglossoides elassodon)*, walleye pollock, and Alaska plaice *(Plueronectes quadrituberculatus)* to the nearest centimeter. Scales of sablefish were taken for aging purposes.

To determine biomass estimates, the ratio of the size of the study area to the average area swept in 1 hour of trawling is multiplied by mean catch per hour. The following formula describes this relationship:

$$\hat{p} = \frac{1}{\text{Sweep of Net}} \text{ (ft in nmi x Aj) x Xj}$$

Where:

$\hat{p}$ = *Total Biomass*

Sweep of net = 40 ft

Ft in nmi = 6076

Aj = number of square miles in the sample area (1062.9 sq nmi)

Xj = average catch weight per hour in the survey

The formula assumes a velocity of 3 knots and yields the constant 53,818 hours times the catch in kg per hour.

A total of 44 trawls were successfully completed out of the 47 attempted (Figure 1). Dragging occurred at the midpoint of each square unless bad bottom, tidal surge, weather conditions, depth profile, proximity to land, or gear hangups forced the tow to other positions. Some stations were forfeited as a result of the lack of time. Of the successful tows, 43 were at ocean stations representing 1968.5 sq km (1,062.9 sq nmi) in area [an average of 45.7 sq km/trawl (24.7 sq nmi) trawl]. Only one bay station was completed and that was in Kukak Bay on the Alaska Peninsula.

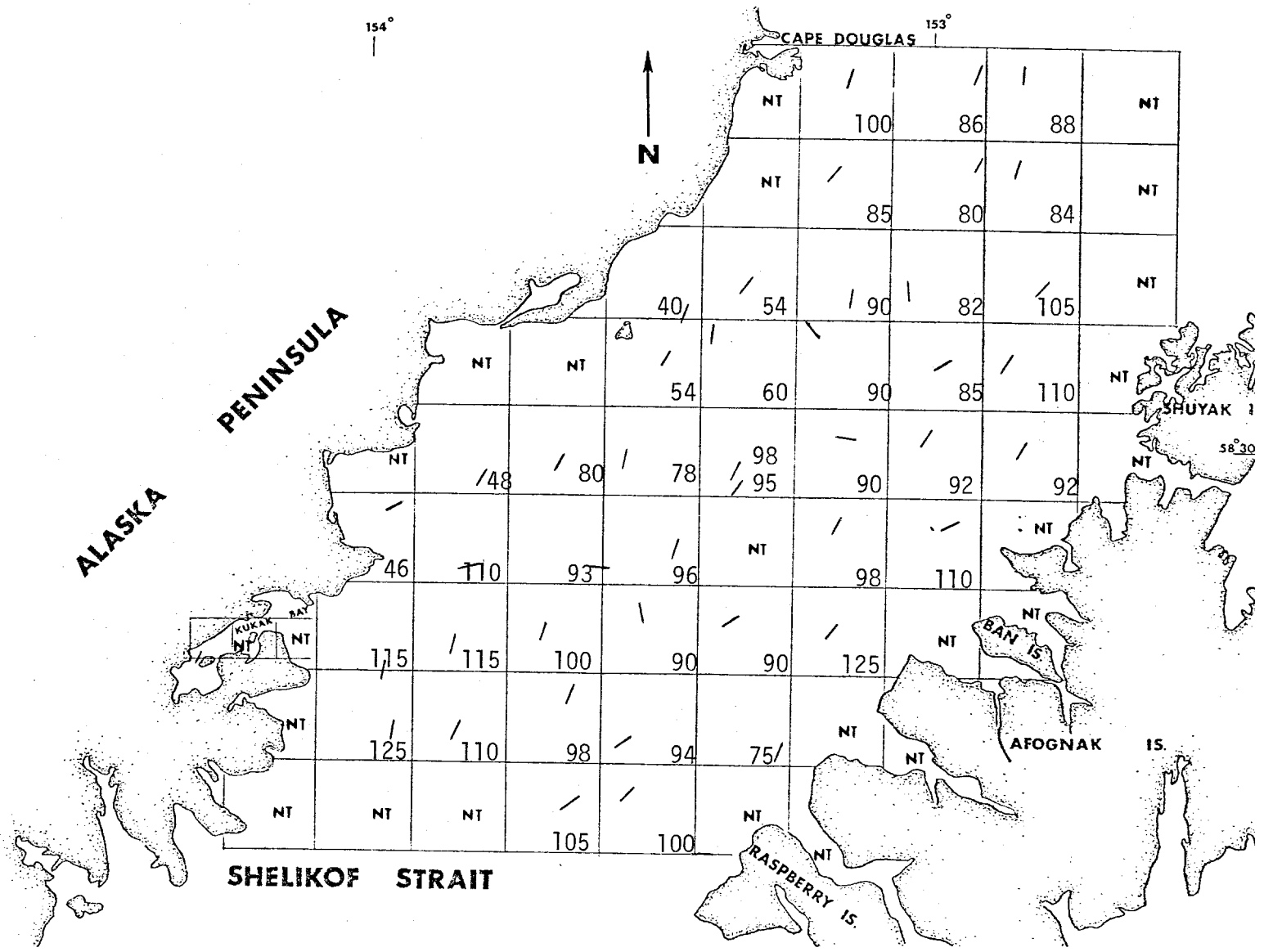

Figure 1. Trawl position, length, and direction per twenty-five square mile area in Shelikof Strait summer 1980. Number indicates depth of trawl in fathoms per tow.

Species abundance correlations were calculated using the mean catch by 18 m (10 fm) depth zones. For every taxonomic group that occurred in four or more depth zones coefficients of correlation (r) between the taxon and each other taxon were calculated. These correlation coefficients were then summarized in the form of a dendrogram by repeatedly combining taxa with the highest correlation coefficient. Each time two taxa were combined new values relating the resulting combined group with other taxa were calculated as simple averages of all the original correlation coefficients relating members of one group to members of the other.

RESULTS AND DISCUSSION

Weight of the catch was 42% flatfish, 39% roundfish, 15% invertebrates, 3% elasmobranchs, and 1% rockfish. The most abundant species caught were flathead sole at 215 kg/hr (474 lb/hr), walleye pollock at 152 kg/hr (335 lb/hr), Pacific cod at 118 kg/hr (260 lb/hr), arrowtooth flounder at 98 kg/hr (216 lb/hr), Pacific halibut at 55 kg/hr (121 lb/hr), and sablefish at 48 kg/hr (106 lb/hr). The above species and all others sampled were ranked in order of abundance (Table 1).

As shown in Figure 1 trawls were completed at depths ranging from 73 m to 229 m (40 fm to 125 fm). The number of tows in each 18 m (10 fm) depth interval varied from 2 to 12 (Table 2). Total catches ranged from 332 to 1950 kg/hr (732 to 4300 lb/hr) with an average of 919 kg/hr (2026 lb/hr). Distribution patterns of the total catches were not apparent (Figure 2), but there was a trend toward decreasing total catch rates with increasing depth (Table 2). Both distributional patterns and depth patterns are apparent for individual taxa (Table 2; Appendix Figures 1 through 44)[1].

Flatfish

In Shelikof Strait, flatfish were caught at higher rates than roundfish during the 1960's survey, but at lower rates than roundfish during the 1970's survey (Pereyra and Ronholt 1976). During the summer of 1980, flatfish were found to be the most abundant group. This was due to the large catches of flathead sole. Flathead were caught at higher rates than arrowtooth flounder which had been established as the dominant flounder in the Gulf of Alaska by previous surveys (Pereyra and Ronholt 1976). Nine of the twelve species of flounder common to the Kodiak area were caught with an aggregate average of 385 kg/hr (849 lb/hr). Only the four most important are considered here.

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[1] Taxa distributional figures are arranged in order of abundance as listed on Table 2.

Table 1. Otter trawl catch rate in kg/hr by 10 fathom depth interval and taxon in northern Shelikof Strait during summer of 1980.

TAXON	Depth as the Center of (Ten Fathom) Intervals								
Meters	64	82	101	137	155	174	192	210	229
Fathoms	35	45	55	75	85	95	105	115	125
Flathead sole	963	625	129	44	127	234	199	97	226
Walleye pollock	108	299	265	274	110	206	38	13	5
Pacific cod	2	39	63	204	160	107	125	71	81
Arrowtooth flounder	54	50	80	104	113	102	133	37	47
Pacific halibut	201	99	49	39	36	38	110	17	12
Tanner (male)	147	108	137	82	40	15	44	8	9
Sablefish	11	1	0	10	18	49	56	18	26
Eelpouts	44	18	61	50	52	39	15	39	8
Sponge	0	0	1	74	70	0	T	0	0
Big skate	49	97	19	17	10	19	0	39	0
Great sculpin	41	59	91	18	5	9	0	0	0
Tanner (female)	19	30	32	27	12	9	8	3	5
Basket starfish	0	0	3	18	4	12	19	19	18
Shrimp	48	36	5	9	6	10	7	5	8
Skates (unident.)	0	0	0	0	15	3	29	11	19
Rougheye rockfish	0	0	0	2	15	4	16	3	7
Alaska plaice	36	16	44	3	2	5	0	0	0
Starfish (unident.)	11	1	T	3	5	6	17	8	18
Snails	0	0	2	4	8	5	8	3	2
Dover sole	0	0	0	19	3	9	2	0	0
Sea urchins	0	0	0	T	13	5	1	0	0
Red king crab (male)	0	72	5	4	0	0	0	0	0
Spinyhead sculpin	2	6	3	2	2	6	4	6	4
Eulachon	T	0	1	T	2	9	2	3	1
Giant wrymouth	0	0	0	0	8	0	5	0	0
Red king crab (female)	0	7	22	0	0	0	0	0	0
Hermit crab	0	0	T	2	4	2	2	1	1
Sea anemone	0	3	0	3	3	1	1	6	2
Rock sole	0	5	7	0	2	1	1	0	0
Rex sole	0	0	1	15	1	T	1	0	0
Longnose skate	0	0	0	0	1	1	2	5	0
Yellowfin sole	19	0	0	0	0	2	0	0	0
Longsnout prickleback	2	0	0	0	1	1	2	1	2
Barnacles	0	0	0	0	4	T	0	0	0
Dusky rockfish	0	0	0	0	0	4	0	0	0
Golden king crab (male)	0	0	0	0	0	1	4	0	0
Yellow Irish lord	0	0	1	1	1	1	1	0	0
Sea pen	8	1	0	0	T	1	T	0	0
Octopus	0	0	0	0	0	0	5	0	0
Sturgeon poacher	0	0	0	0	1	2	T	0	0
Sea slug	0	0	0	0	0	2	0	0	0
Pacific Ocean perch	0	0	0	0	1	1	0	0	0
Bigmouth sculpin	0	2	0	0	0	0	3	0	0
Scallops	0	10	0	0	T	T	T	0	0
Squid	0	0	0	0	0	0	T	4	4

-Continued-

Table 1. Otter trawl catch rate in kg/hr by 10 fathom depth interval and taxon in northern Shelikof Strait during summer of 1980 (continued).

TAXON	Depth as the Center of (Ten Fathom) Intervals								
Meters	64	82	101	137	155	174	192	210	229
Fathoms	35	45	55	75	85	95	105	115	125
Golden king crab (female)	0	0	0	0	0	0	3	0	3
Atka mackeral	0	0	0	0	0	1	1	1	0
Sea cucumber	0	0	0	T	1	0	T	0	0
Dungeness	1	T	0	0	0	0	0	0	0
Starry flounder	0	0	0	0	0	1	0	0	0
Skate egg case	0	0	0	0	T	T	0	0	0
Rockfish (unident.)	0	0	0	0	T	0	0	0	0
Harlequin	0	0	0	1	0	0	0	0	0
Snailfish	0	0	0	T	0	T	0	0	0
Dwarf wrymouth	2	0	0	0	0	0	0	0	0
Poachers (unident.)	0	0	0	0	T	T	0	0	0
Searcher	0	0	0	T	0	0	0	0	0
Lyre crab	0	0	0	0	0	0	0	T	0
Tows	2	2	3	4	11	12	6	2	2
TOTAL kg./hr.	1763	1579	1019	1027	855	923	862	416	505

Table 2 . Common and scientific name, rank, and catch per unit effort of taxa caught by otter trawl during the summer of 1980 in northern Shelikof Strait.

COMMON NAME	SCIENTIFIC NAME	RANK	CPUE kg/hr
Flathead sole	Hippoglossoides elassodon	1	215
Walleye pollock	Theragra chalcogramma	2	152
Pacific cod	Gadus macrocephalus	3	118
Arrowtooth flounder	Atheresthes stomias	4	98
Pacific halibut	Hippoglossus stenolepis	5	55
Tanner (male)	Chionoecetes bairdi	6	48
Sablefish	Anoplopoma fimbria	7	30
Eelpouts (unident.)	Family Zoarcidae[1]	8	26
Sponge (unident.)	Phylum Porifera	9	23
Big skate	Raja binoculata	10	19
Great sculpin	Myoxocephalus polyacanthocephalus spp.	11	16
Tanner (female)	Chionoecetes bairdi	12	13
Basket starfish	Genus Gorgonocephalus spp.	13	11
Shrimp	Families Crangonidae Hippolytidae and Pandalidae[2]	14	10
Skate (unident.)	Rajidae	15	10
Rougheye rockfish	Sebastes aleutianus	16	8
Alaska plaice	Pleuronectes quadrituberculatus	17	7
Starfish (unident.)	Classes Asteroidea and Ophiuroidea[3]	18	7
Snails (unident.)	Class Gastropoda	19	5
Dover sole	Microstomus pacificus	20	5
Sea Urchins	Class Echinoidea	21	5
Red king crab (male)	Paralithodes camtschatica	22	4
Spinyhead sculpin	Dasycottus setiger	23	4
Eulachon	Thaleichthys pacificus	24	4
Giant wrymouth	Delolepis gigantea	25	3
Red king crab (female)	Paralithodes camtschatica	26	2
Hermit crab (unident.)	Family Paguridae	27	2
Sea anemone (unident.)	Order Actiniaria	28	2
Rock sole	Lepidopsetta bilineata	29	2
Rex sole	Glyptocephalus zachirus	30	2
Longnose skate	Raja rhina	31	1
Yellowfin sole	Limanda aspera	32	1
Longsnout prickleback	Lumpenella longirostris	33	1
Barnacles (unident.)	Subclass Cirripedia	34	1
Dusky rockfish	Sebastes ciliatus	35	1
Golden king crab (male)	Lithodes aequispina	36	.8
Yellow irish lord	Hemilepidotus jordani	37	.7
Sea pen	Order Pennatulacea	38	.6
Octopus	Octopus dofleini	39	.6
Sturgeon poacher	Agonus acipenserinus	40	.6
Sea slug	Order Nudibranchia	41	.6
Pacific ocean perch	Sebastes alutes	42	.5
Big mouth sculpin	Hemitripterus bolini	43	.5
Scallops	Pecten spp.	44	.5
Golden king crab (female)	Lithodes aequispina	45	.5
Squid (unident.)	Order Decapoda	46	.4
Atka mackeral	Pluerogrammus monopterygius	47	.4

-Continued-

Table 2. Common and scientific name, rank, and catch per unit effort of taxa caught by otter trawl during the summer of 1980 in northern Shelikof Strait (continued).

COMMON NAME	SCIENTIFIC NAME	RANK	CPUE kg/hr
Sea cucumber (unident.)	Class Holothuroidea	48	.4
Dungeness	Cancer magister	49	.4
Starry flounder	Platichthys stellatus	50	.3
Skate egg case (unident.)	Family Rajidae	51	T
Rockfish (unident.)	Sebastes spp.[4]	52	T
Harlequin rockfish	Sebastes variegatus	53	T
Snailfish (unident.)	Family Cyclopteridae	54	T
Dwarf wrymouth	Lyconectes aleutensis	55	T
Poacher (unident.)	Family Agonidae	56	T
Searcher	Bathymaster signatus	57	T
Lyre crab	Hyas lyratus	58	T

[1] Two species were caught, Lycodes brevipes and L. palearis. Over 90% of the catch of eelpouts were L. brevipes.

[2] Two species were most common, Pandalus borealis and Pandalopsis dispar.

[3] Over 90% of the starfish (unident.) were Ctenodiscus crispatus from the family Porcellanasteridae.

[4] Rockfish with 14 dorsal spines, 1 spine under eye, black peritoneum, 8 strong head spines and coloration of rougheye rockfish.

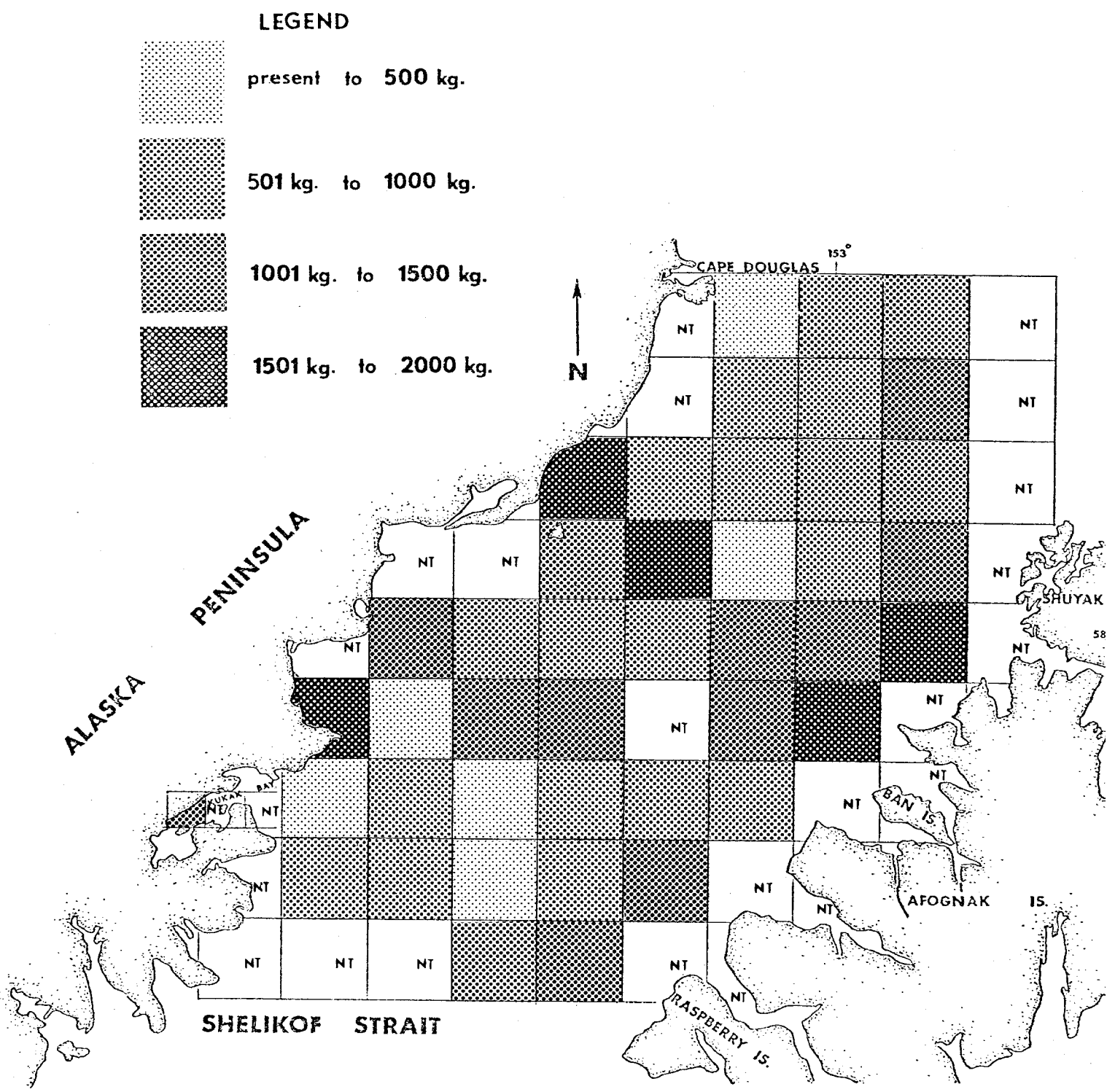

Figure 2. Distribution of total catch per unit effort, in kg/hr, taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.

Flathead Sole:

Flathead sole was the most abundant species, averaging 215 kg/hr (474 lb/hr); constituting 23% of the total catch and 56% of the flatfish catch. For the 1980 survey period and area, the standing stock of flathead sole was estimated to be 11,571 mt (25.5 mil lb).

Flathead were found at all stations. Greatest concentrations were in shallow water from 84 to 88 m (46 to 48 fm) near Hallo Bay on the Alaska Peninsula side and along Shuyak and Afognak Island between 155 and 229 m (85 to 125 fm). Lowest concentrations were found deeper than 92 m (50 fm) at the northern end of the study area and along the Alaskan Peninsula (Appendix Figure 1). Figure 3 shows that flathead sole ranged from 15 to 41 cm (6 to 16 in) with a mean of 32 cm (13 in).

Arrowtooth Flounder:

Arrowtooth was the fourth most abundant species and second most prevalent flatfish caught, averaging 98 kg/hr (216 lb/hr); comprising 11% of the total catch and 25% of the flatfish catch. For the 1980 survey period and area, the standing stock of arrowtooth flounders was estimated to be 5274 mt (11.6 mil lb).

The highest catches were along the Afognak side of the strait with the greatest success occurring from 130 to 201 m (71 to 110 fm). Smallest catches were along the Alaskan Peninsula side (Appendix Figure 4).

Halibut:

Halibut was the fifth most abundant species and third most prevalent flatfish caught, averaging 55 kg/hr (121 lb/hr), comprising 6% of the total catch and 14% of the flatfish catch. For the 1980 survey period and area, the standing stock of halibut was estimated to be 2960 mt (6.5 mil lb).

There was a general trend of decreasing CPUE with increasing depth. Largest tows were in Kukak and Hallo Bay and at 201 m (110 fm) near Shuyak Island (Appendix Figure 5). As can be seen in Figure 4 halibut size ranged from 35 to 161 cm (14 to 63 in) with a mean of 69 cm (27 in).

Alaska Plaice:

Alaska plaice was the seventeenth most abundant species and the fourth most prevalent flatfish caught, averaging 7 kg/hr (15 lb/hr), comprising less than 1% of the total catch and 2% of the flatfish catch. For the 1980 survey period and area the standing stock of Alaska plaice was estimated to be 377 mt (831,285 lb).

Plaice were concentrated mainly along the Alaska Peninsula between Hallo Bay and Douglas Reef (Appendix Figure 17). They were most abundant at depths less than 92 m (50 fm) and absent from stations deeper than 183 m (100 fm). Plaice size ranged from 26 to 54 cm (10 to 21 in) with a mean of 40 cm (16 in) (Figure 3).

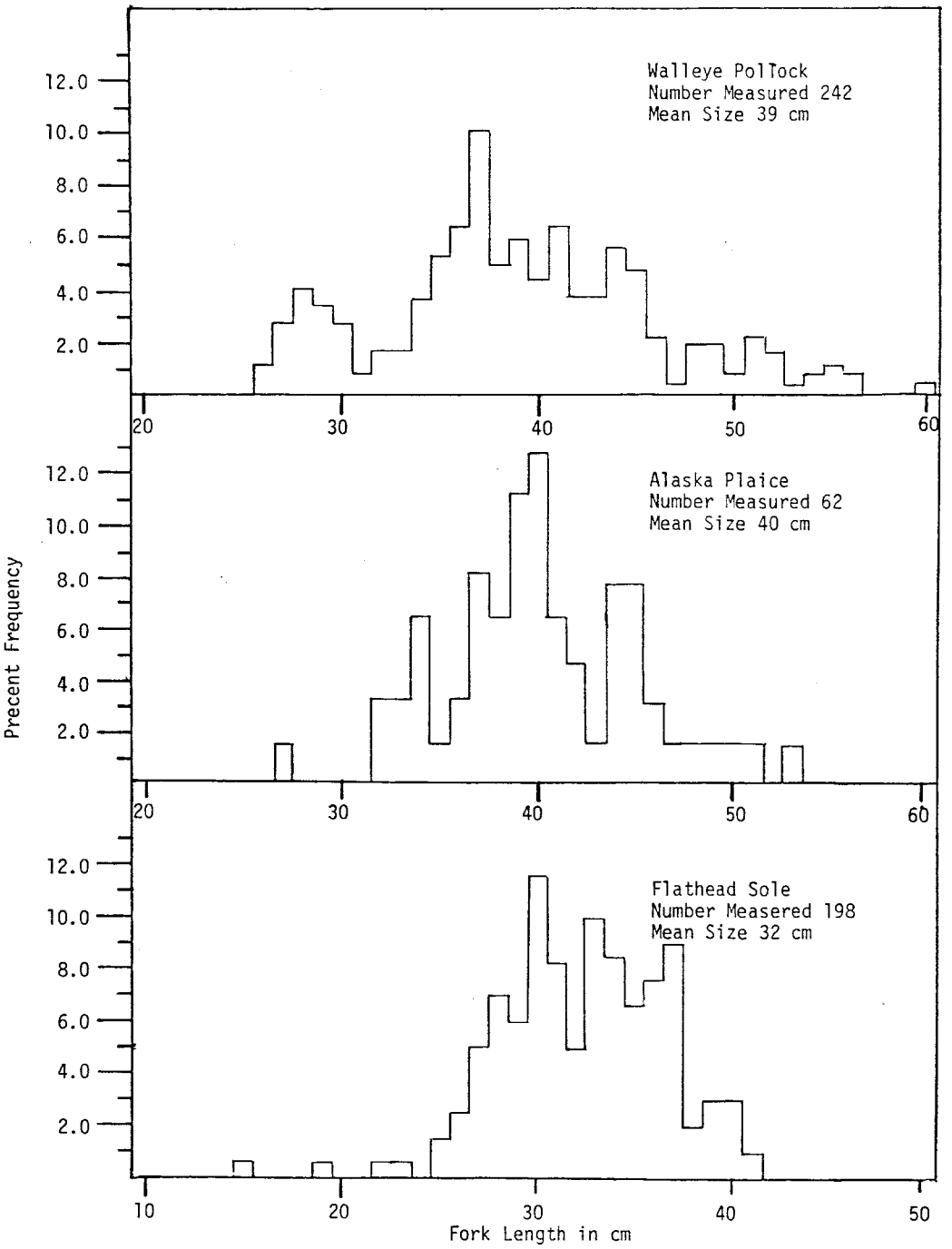

Figure 3. Length frequencies of walleye pollock, Alaska plaice, and flathead sole taken as random samples from trawl catches in Shelikof Strait during summer of 1980.

Roundfish

The roundfish group was caught a lower catch rates than flatfish, however, in winter months a large pollock school spawns in Shelikof Strait. A winter survey could yield a much higher roundfish catch.

At least 15 species of roundfish were caught with walleye pollock, Pacific cod, and sablefish being the most important. The total catch rate for all roundfish species was 356 kg/hr (785 lb/hr).

Walleye Pollock:

Walleye pollock was the second most abundant species, averaging 152 kg/hr (335 lb/hr), comprising 17% of the total catch and 43% of the roundfish catch. For the 1980 survey period and area, the standing stock of pollock was estimated to be 8180 mt (18.0 mil lb).

Extreme variability existed between tows (Appendix Figure 2) but the most successful were at depths less than 183 m (100 fm). Figure 3 shows that pollock size ranged from 26 to 60 cm (10 to 24 in) with an average of 39 cm (15 in).

Pacific Cod:

Pacific cod was the third most abundant species and second most prevalent roundfish caught, averaging 118 kg/hr (260 lb/hr), comprising 13% of the total catch and 33% of the roundfish catch. For the 1980 survey period and area, the standing stock of Pacific cod was estimated to be 6351 mt (14.0 mil lb).

Pacific cod were distributed throughout the study area (Appendix Figure 3) with the greatest success occurring from 129 to 207 m (71 to 110 fm). Pacific cod size ranged in Figure 4 from 25 to 92 cm (10 to 36 in) with a mean of 51 cm (20 in).

Sablefish:

Sablefish was the seventh most abundant species and third most prevalent roundfish, averaging 30 kg/hr (66 lb/hr), making up 3% of the total catch. For the 1980 survey period and area, the standing stock of sablefish was estimated to be 1615 mt (3.6 mil lb).

Sablefish were most abundant in the southern part of the study area especially off Raspberry Island (Appendix Figure 7). The best tows were made between 167 to 201 m (91 to 110 fm) throughout the study area. Sablefish had two distinct size modes, the smallest mode was measured from Kukak and the largest at sea stations. The mean size for sablefish shown in Figure 4 was 50 cm (20 in).

Invertebrates

Invertebrates were the third most abundant group and were represented in the

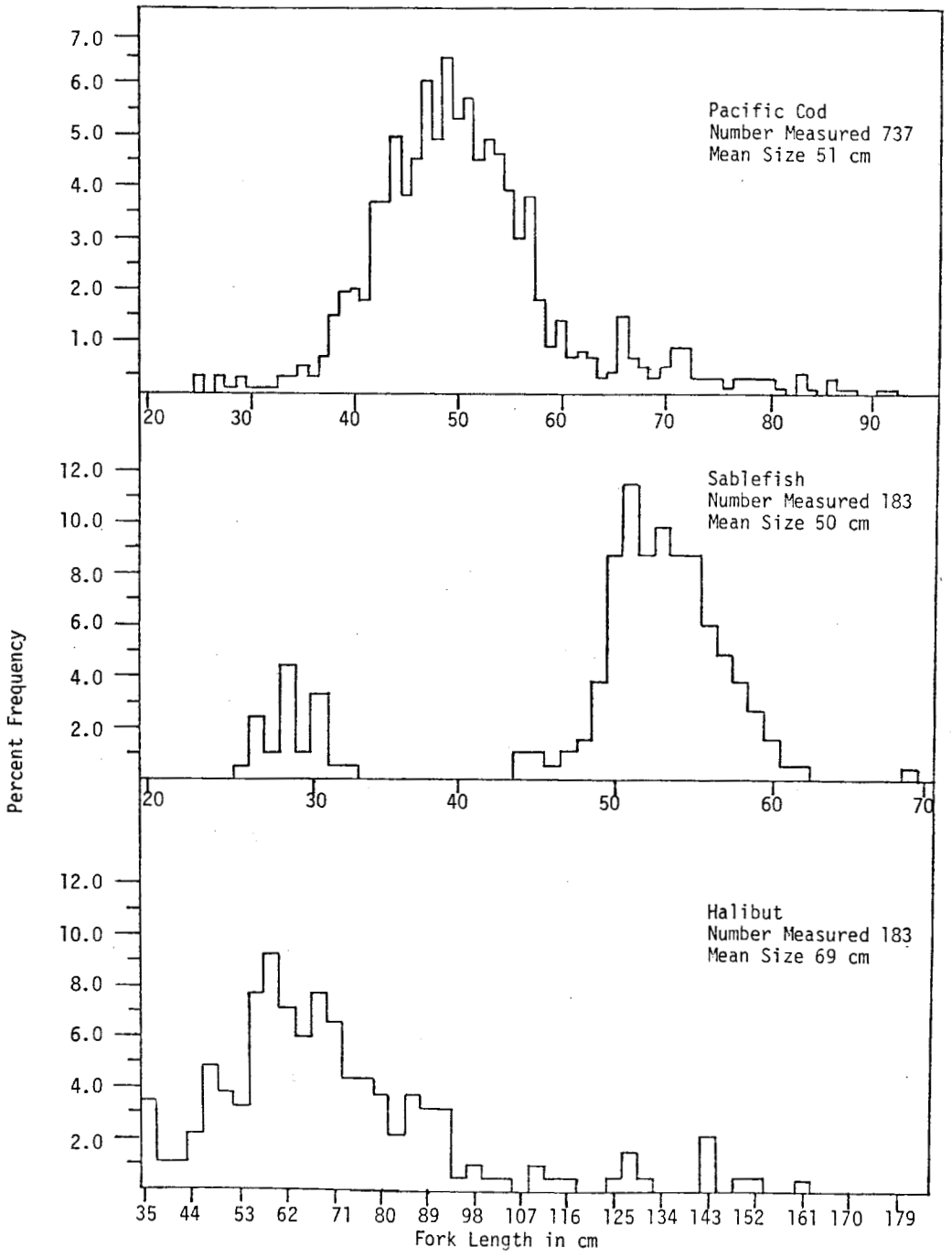

Figure 4. Length frequencies of Pacific cod, sablefish, and halibut taken as random samples from trawl catches in Shelikof Strait during summer of 1980.

the catch by the following phyla: arthropoda constituted 59%, echinodermata 17%, porifera 17%, mollusca 5%, and cnidaria 2%. The entire invertebrate group was caught at 138 kg/hr (304 lb/hr).

In the arthropod group, crab were the dominant species. Five species of crab were caught at a total rate of 69 kg/hr (152 lb/hr). The most important was Tanner crab.

Tanner Crab:

Tanner crab were caught at 61 kg/hr (135 lb/hr) and constituted 88% of the crab catch. For the survey period and area, the standing stock of Tanner crab, including male, female, and under legal size, was estimated to be 3283 mt (7.2 mil lb).

Highest concentrations of both male and female Tanner crab were along the Alaska Peninsula from Hallo Bay north (Appendix Figure 6 and 12). A general trend of decreasing CPUE occurred with each 18 m (10 fm) increase in depth[1].

Elasmobranchs

The only elasmobranchs caught were skates and at a total catch rate of 30 kg/hr (66 lb/hr). The only skates identified to species were longnose and big skate with the latter being the most important.

Big Skate:

Big skate was the most abundant skate caught, averaging 19 kg/hr (42 lb/hr), forming 2% of the total catch and 63% of the skate catch. For the survey period and area, the standing stock of big skates was estimated to be 1023 (2.3 mil lb).

Almost the entire catch was along the Alaska Peninsula from Hallo Bay north to south of Douglas reef (Figure 4). The largest tows were in less than 92 m (50 fm). Big skate had an average weight of 11.2 kg (25 lb).

Rockfish

Rockfish were caught at a total catch rate of 10 kg/hr (22 lb/hr). The following four species were identified during the survey: rougheye rockfish, Pacific ocean perch, dusky rockfish, and harlequin rockfish. Rougheye was the most important of these species.

Rougheye Rockfish:

Rougheye averaged 8 kg/hr (18 lb/hr), comprised less than 1% of the total

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[1] For further information about Tanner crab see the Westward Region Report to the Alaska Board of Fisheries, December 1980.

catch and 80% of the rockfish catch. For the survey period and area, the standing stock of rougheye rockfish was estimated to be 430 mt (948,150 lb).

Appendix Figure 16 shows that rougheye were most abundant along Afognak Island at depths greater than 128 m (70 fm). Rougheye averaged 40 cm (16 in) in length.

Species Abundance Correlations

The dendrogram presenting the results of the species abundance correlations (Figure 5) contains a lot of detail and requires some interpretation. Examining the last two groups to be combined (a group of 12 taxa with a group of 19 taxa) and comparing the dendrogram with Table 2, the smaller group contains all the taxa which were most abundant at 55 to 108 m (30 to 59 fm) while the larger group contains those taxa which were most abundant at depths greater than 128 m (70 fm).

Some groups are highly correlated. Flathead sole, shrimp, sea pen, and halibut were combined at greater than the 99% level of significance. Halibut and shrimp (pink and sidestripe, which were the predominant shrimp) like hard bottom and sea pens grow in sandy bottom. The bottom type preferred by flathead sole is not known but these results suggest it is hard. There are other groups that are highly correlated.

Before much credibility can be placed on these features, some idea of their repeatability or validity must be established. This dendrogram is a function of the time and area surveyed, the way of handling the data, and sampling variability, among other things.

It was presented to preserve the information, to be able to compare it with similar analyses from future surveys, and to exploit its tendency to stimulate new ideas about the interrelation of marine species.

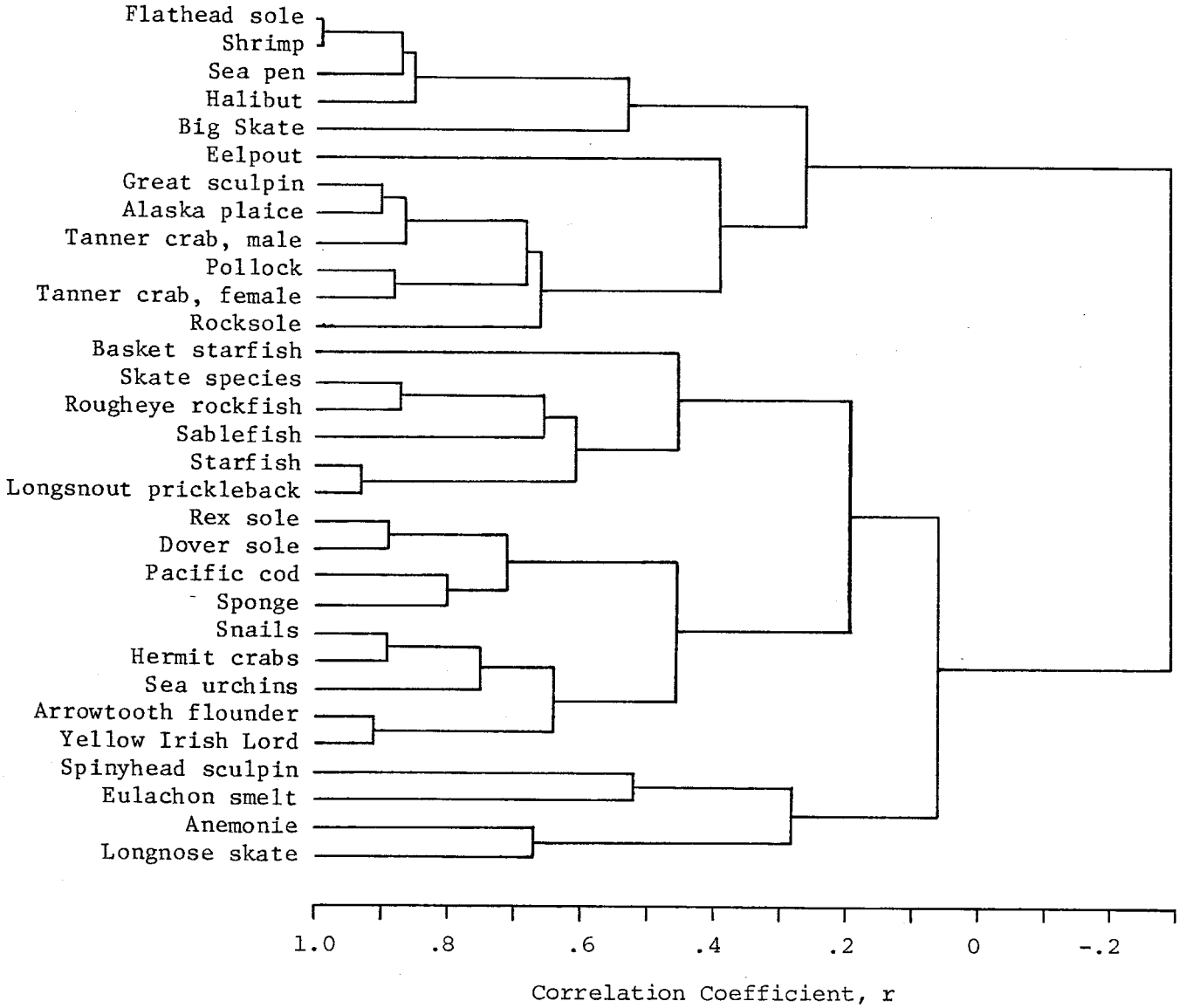


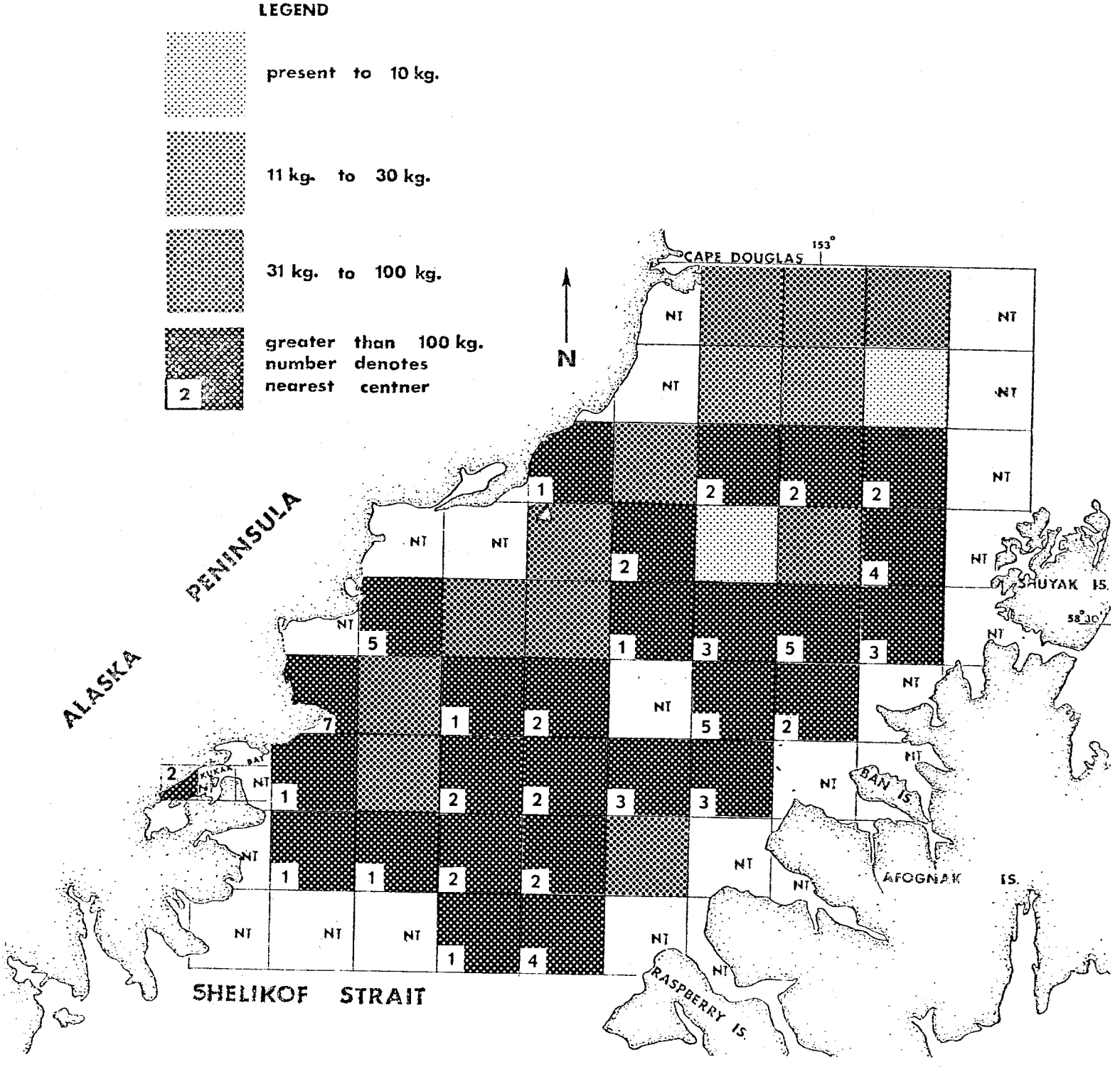
Figure 5. Dendrogram from correlation coefficients (r) among catch rate by depth for taxa taken in four or more depth zones. The 95% and 99% levels of significance for an individual r, are 0.666 and 0.798.

REFERENCES

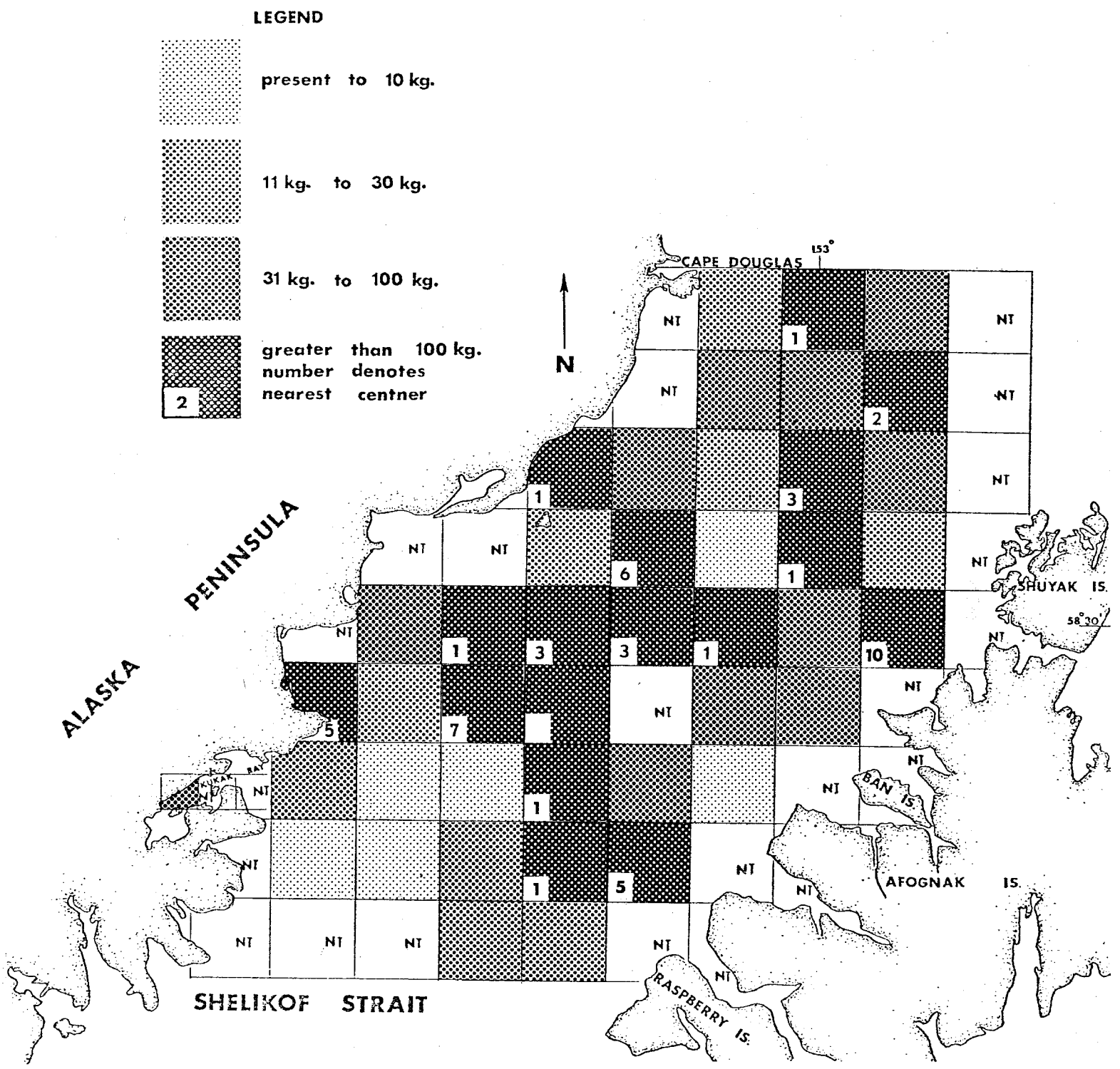
Pereyra, W.T. and L.L. Ronholt. 1976. Baseline studies of demersal resources of the northern Gulf of Alaska shelf and slope. Dept. of Commerce, NOAA, NMFS, Northwest Fisheries Center. OCSEAP Res. Unit. 174. Oct. 15, 1976. 281 pp.

Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1978. Demersal fish and shellfish resources of the Gulf of Alaska from Cape Spencer to Unimak Pass 1948-1976, a historical review. Final Report, NOAA, OCSEAP, Research Unit 174. National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Washington.

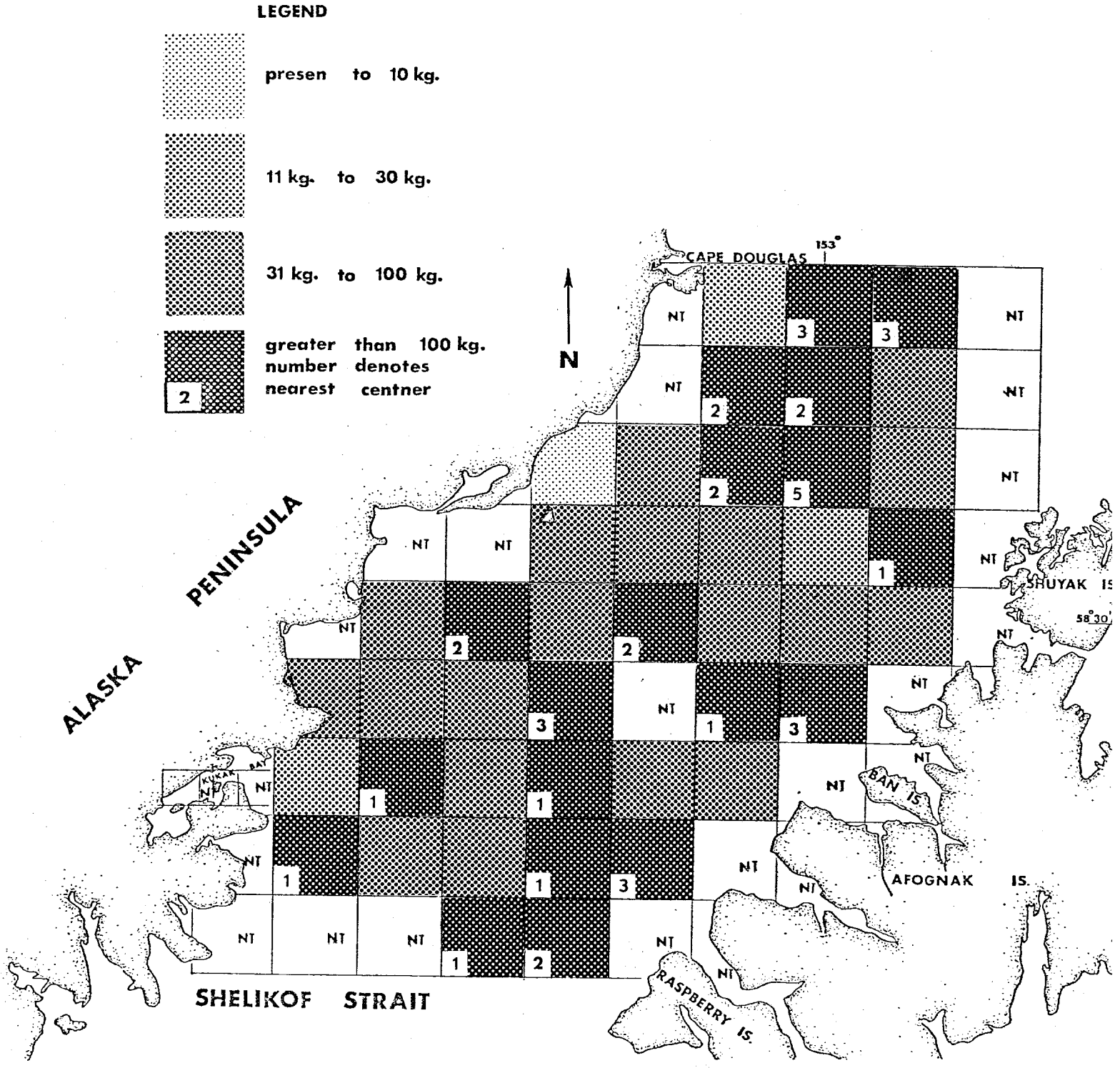
APPENDICES



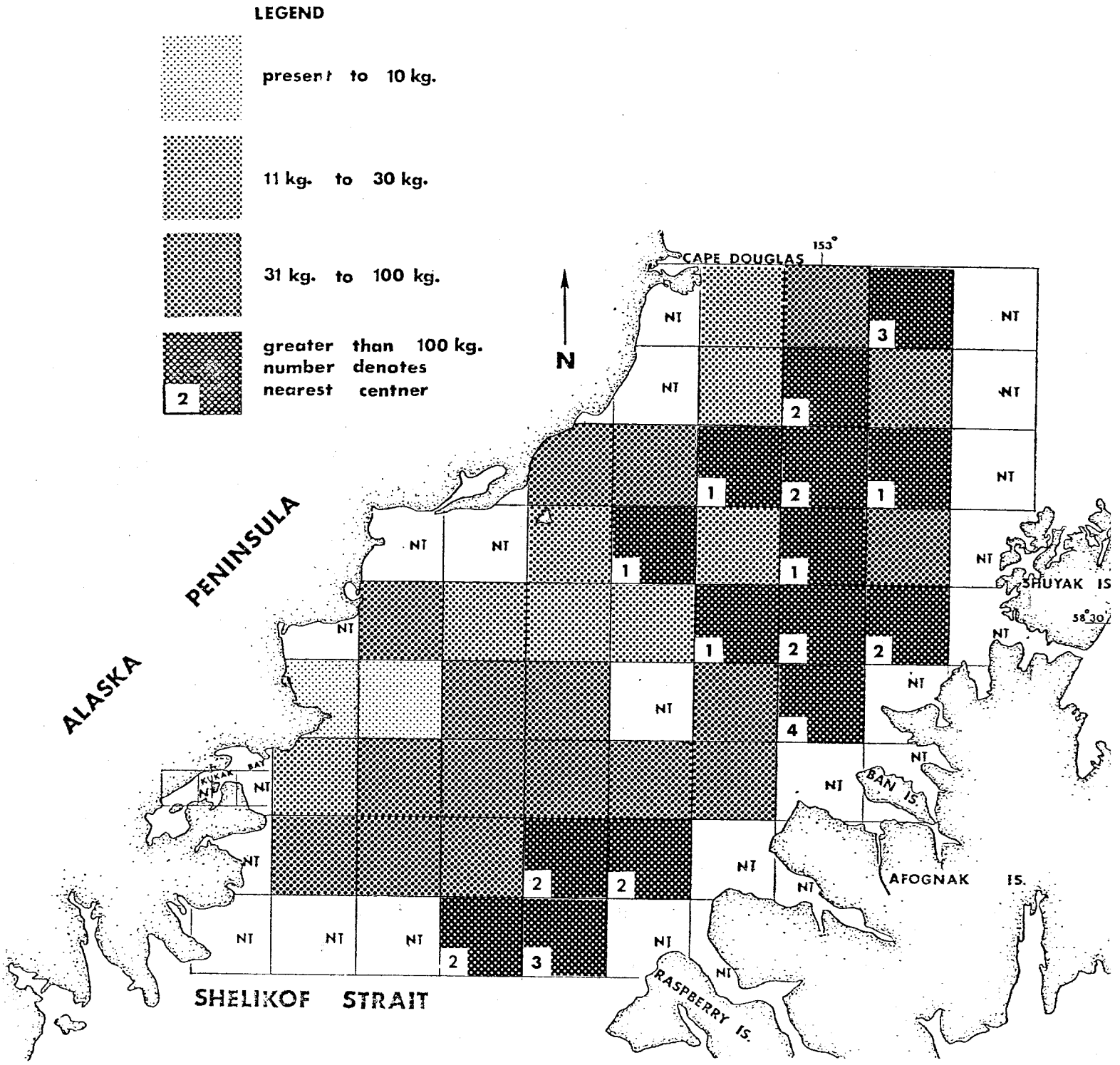
Appendix Figure 1. Distribution of flathead sole in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



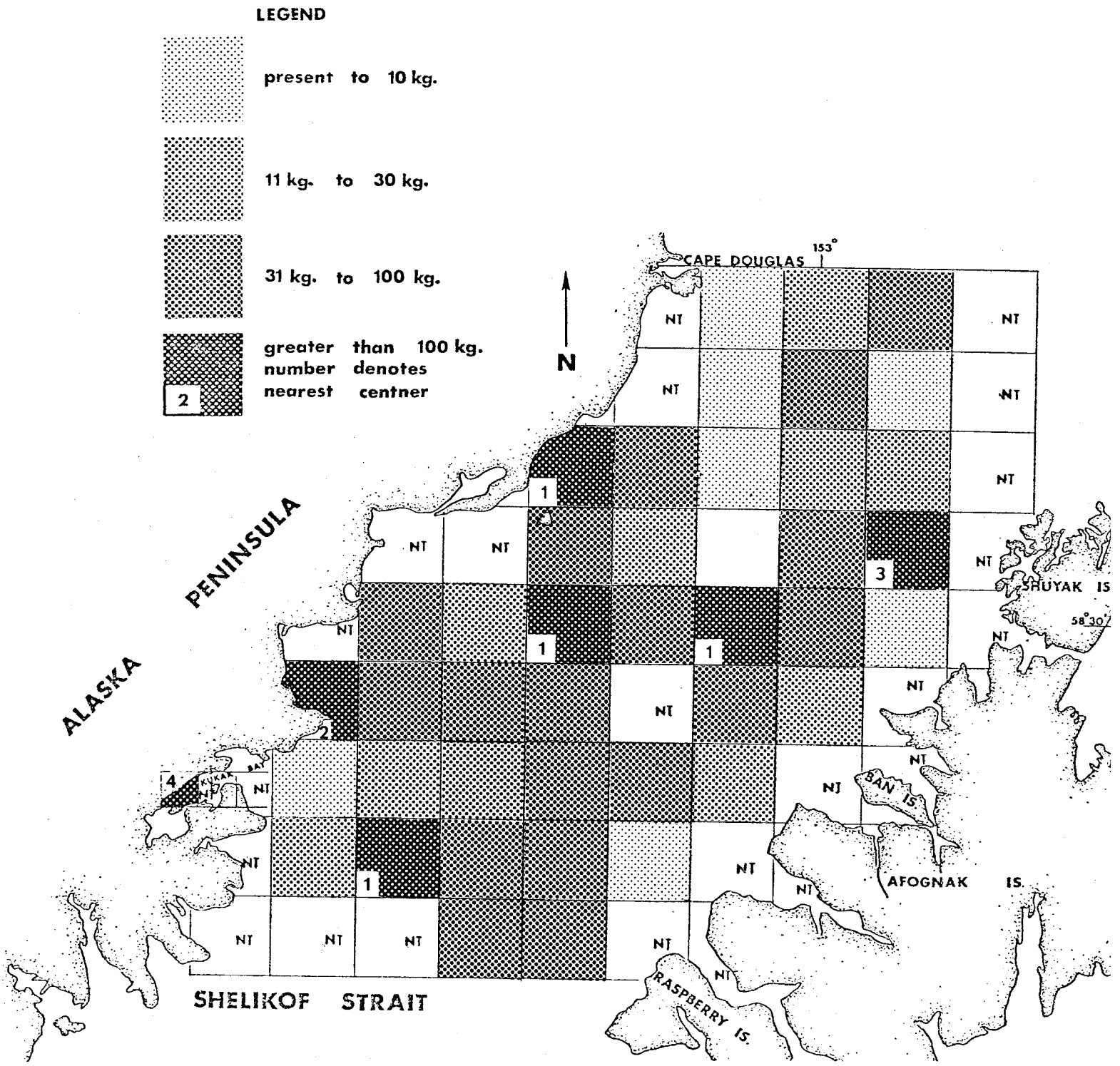
Appendix Figure 2. Distribution of walleye pollock in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



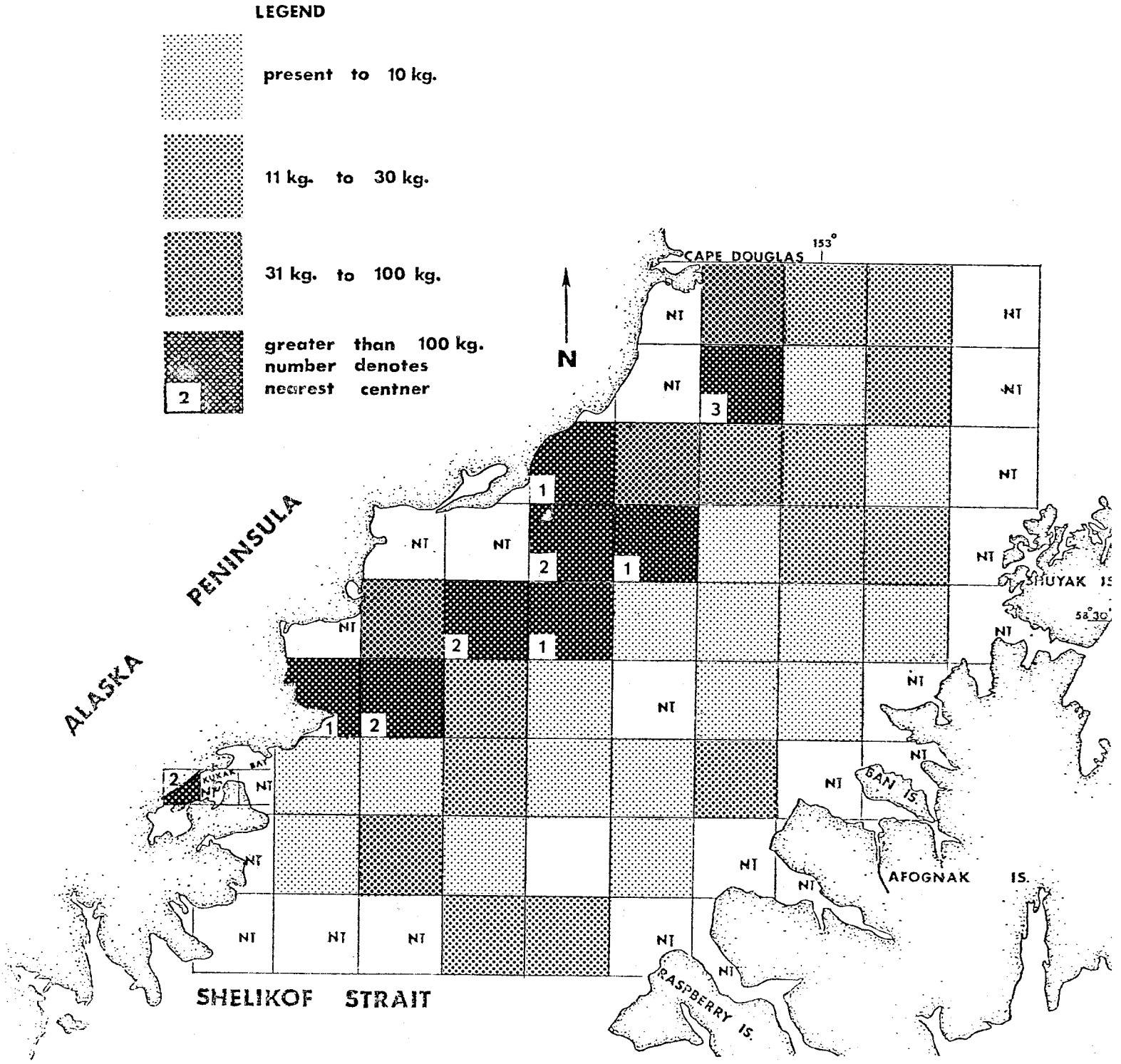
Appendix Figure 3. Distribution of Pacific cod in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



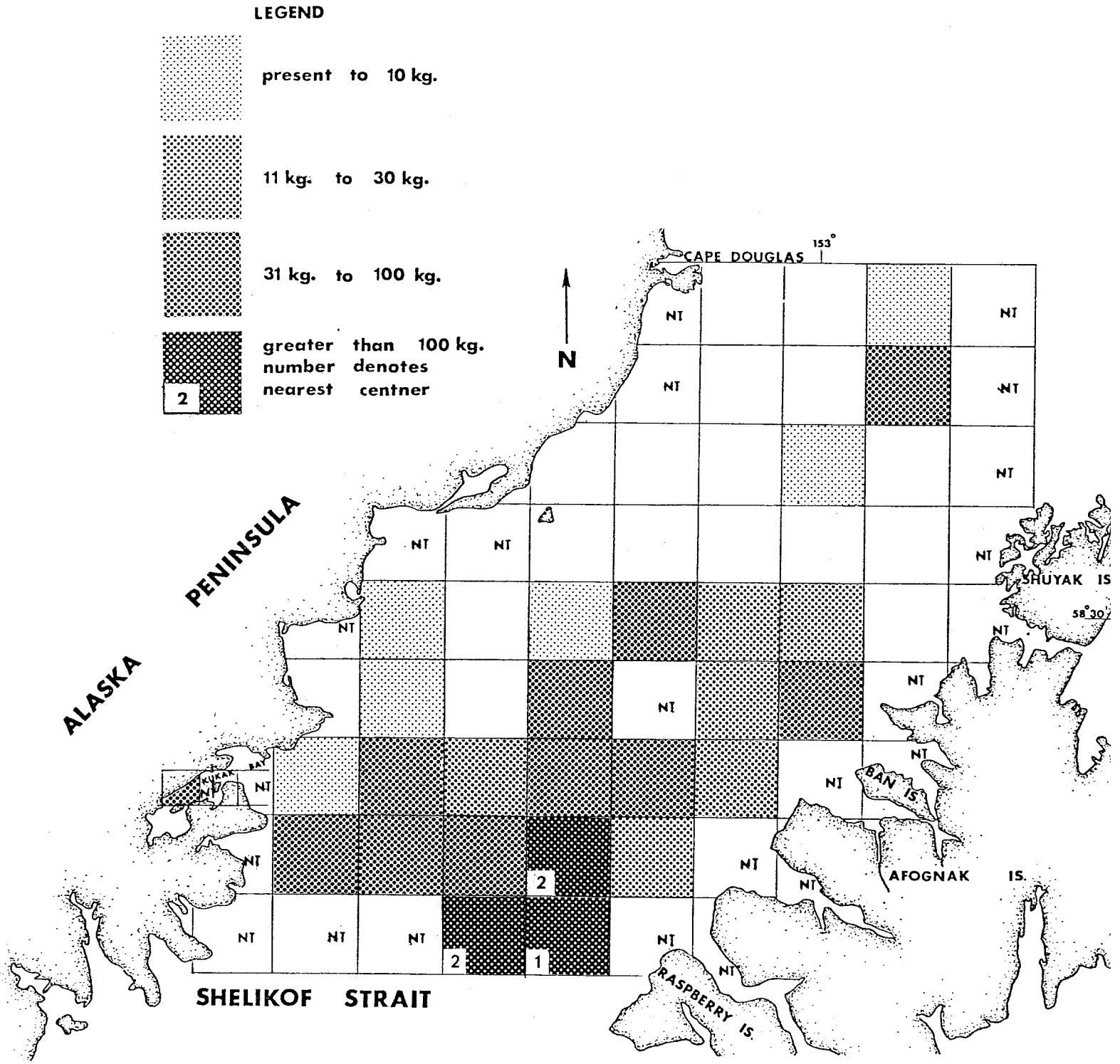
Appendix Figure 4. Distribution of arrowtooth flounder in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



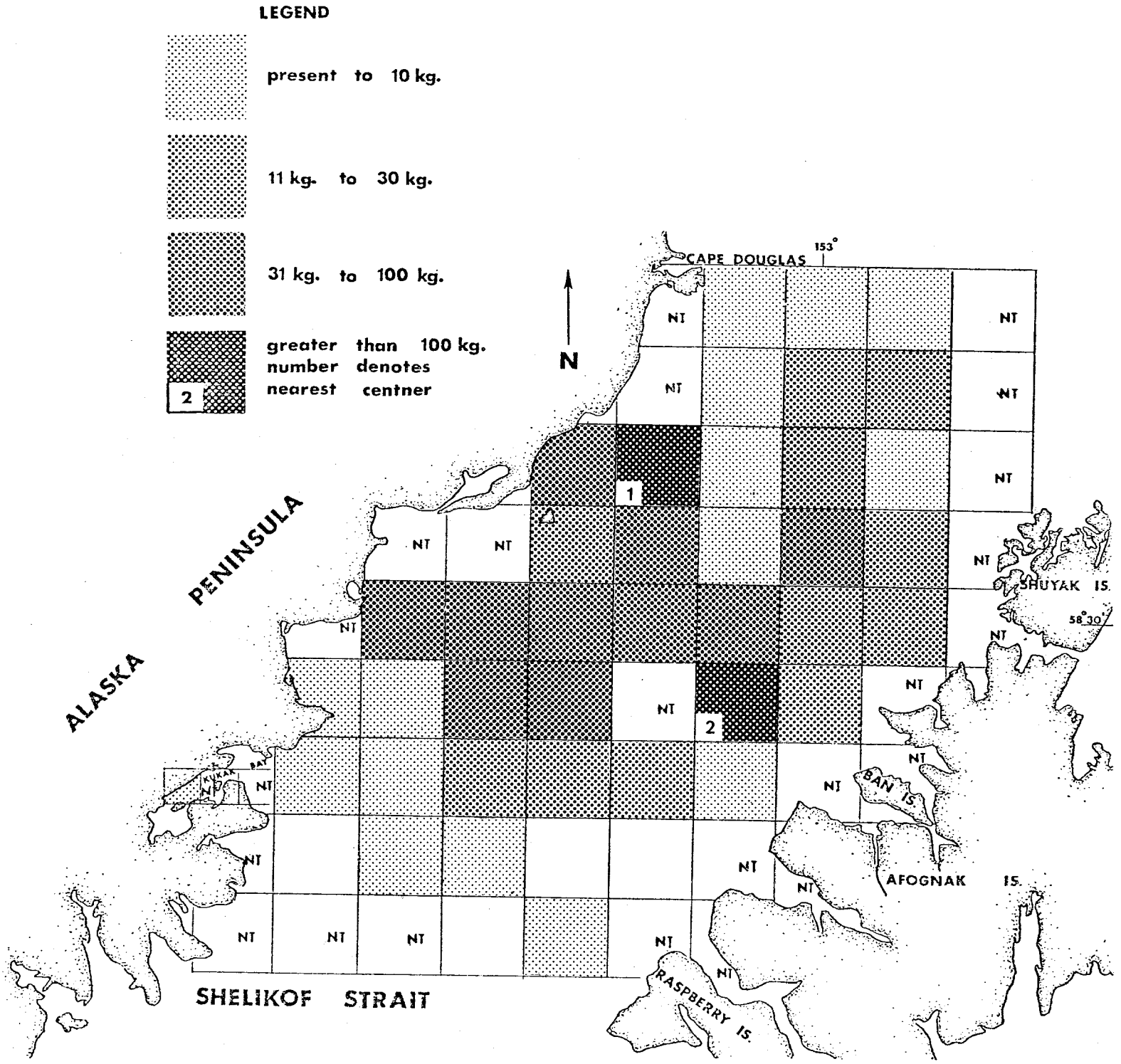
Appeneix Figure 5. Distribution of halibut in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



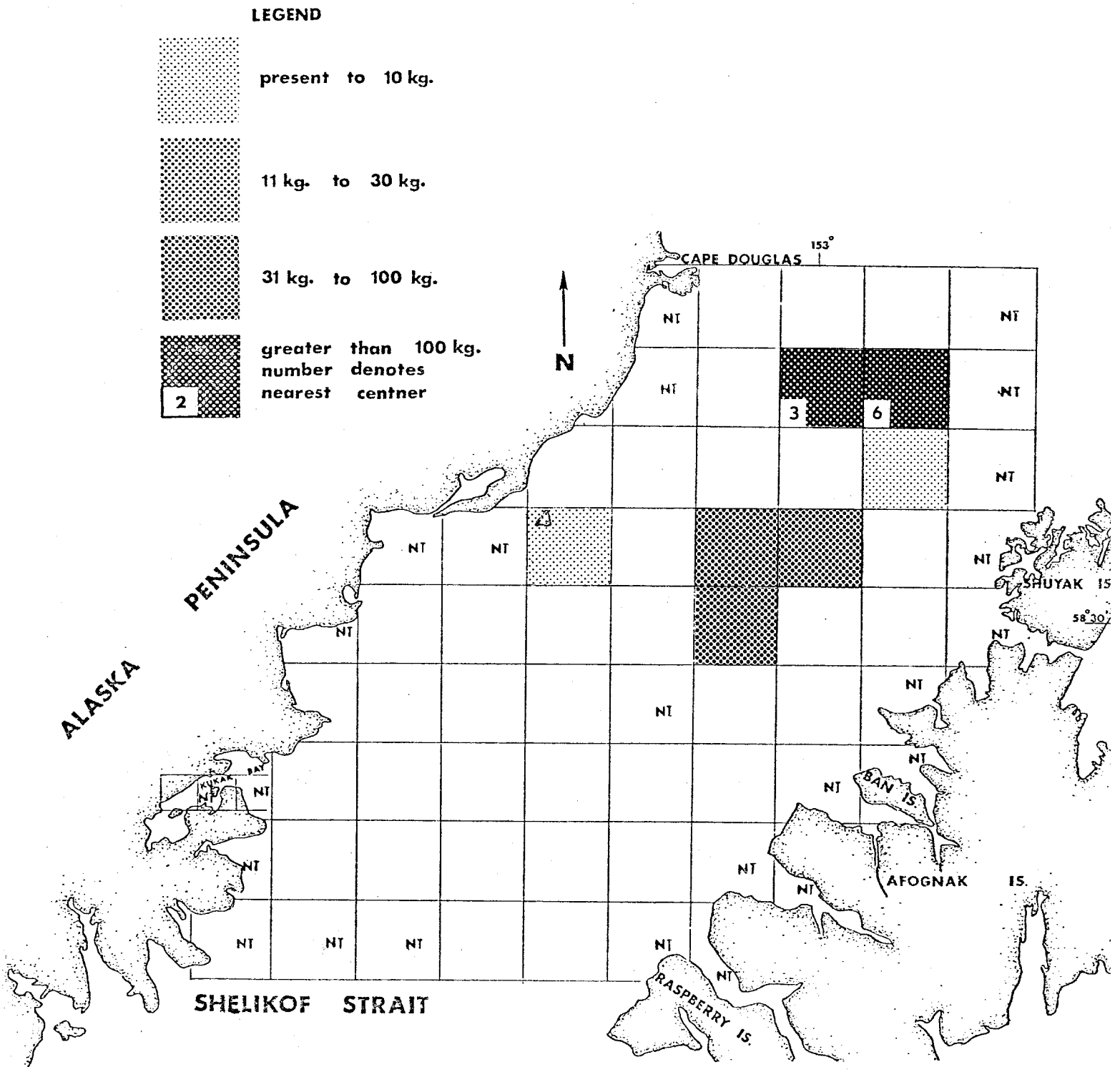
Appendix Figure 6. Distribution of male Tanner crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



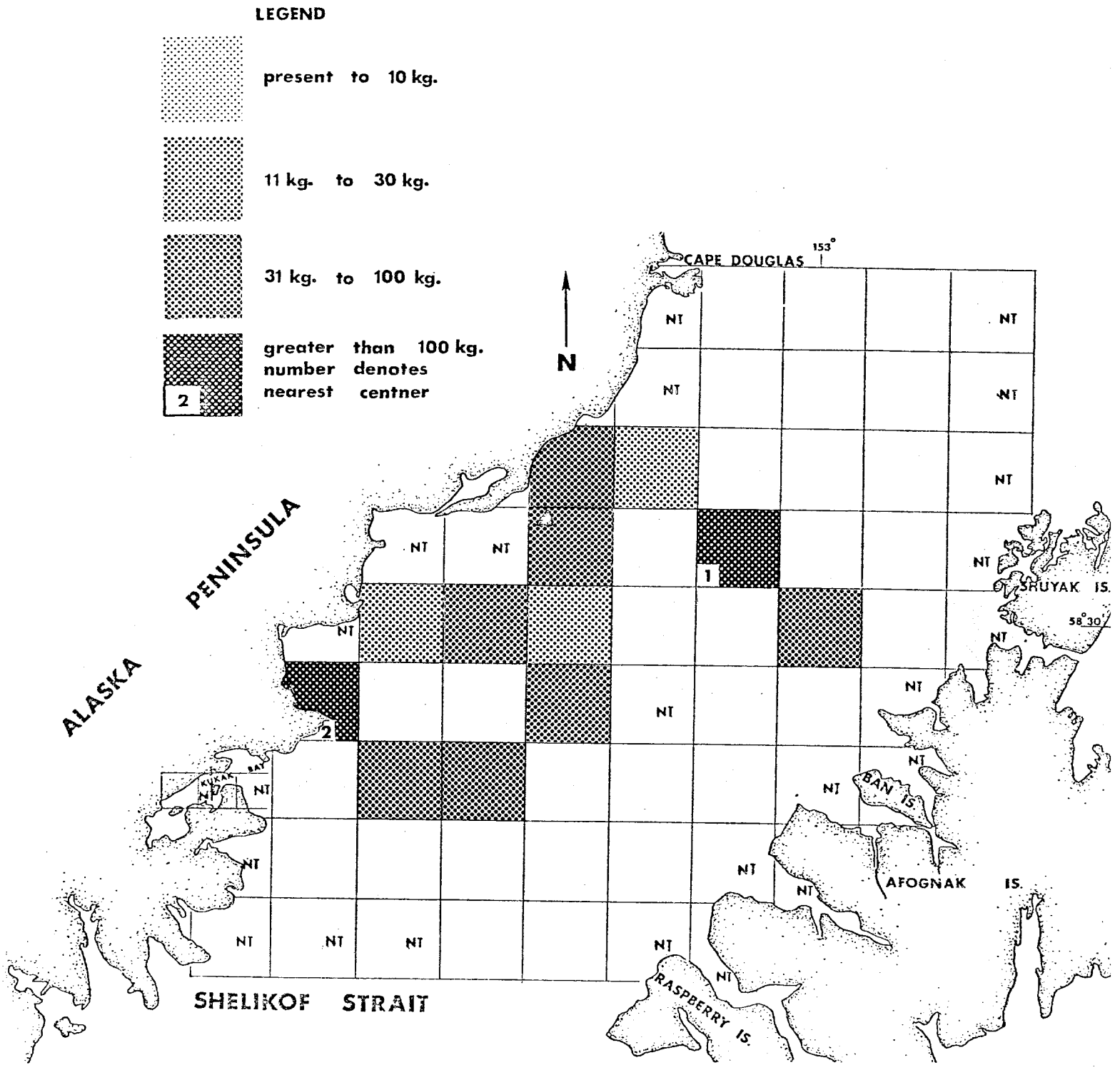
Appendix Figure 7. Distribution of sablefish in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



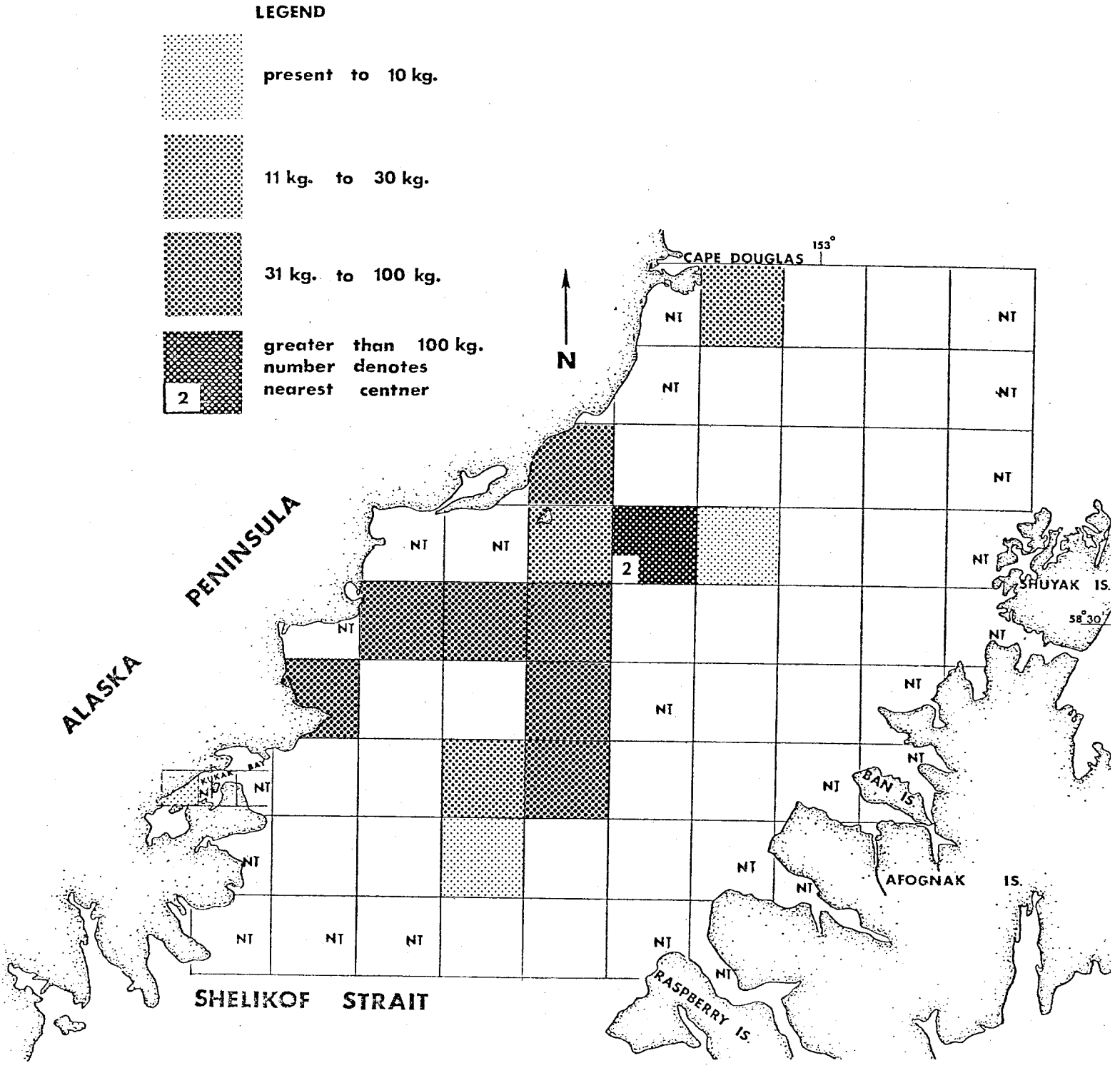
Appendix Figure 8. Distribution of eelpouts in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



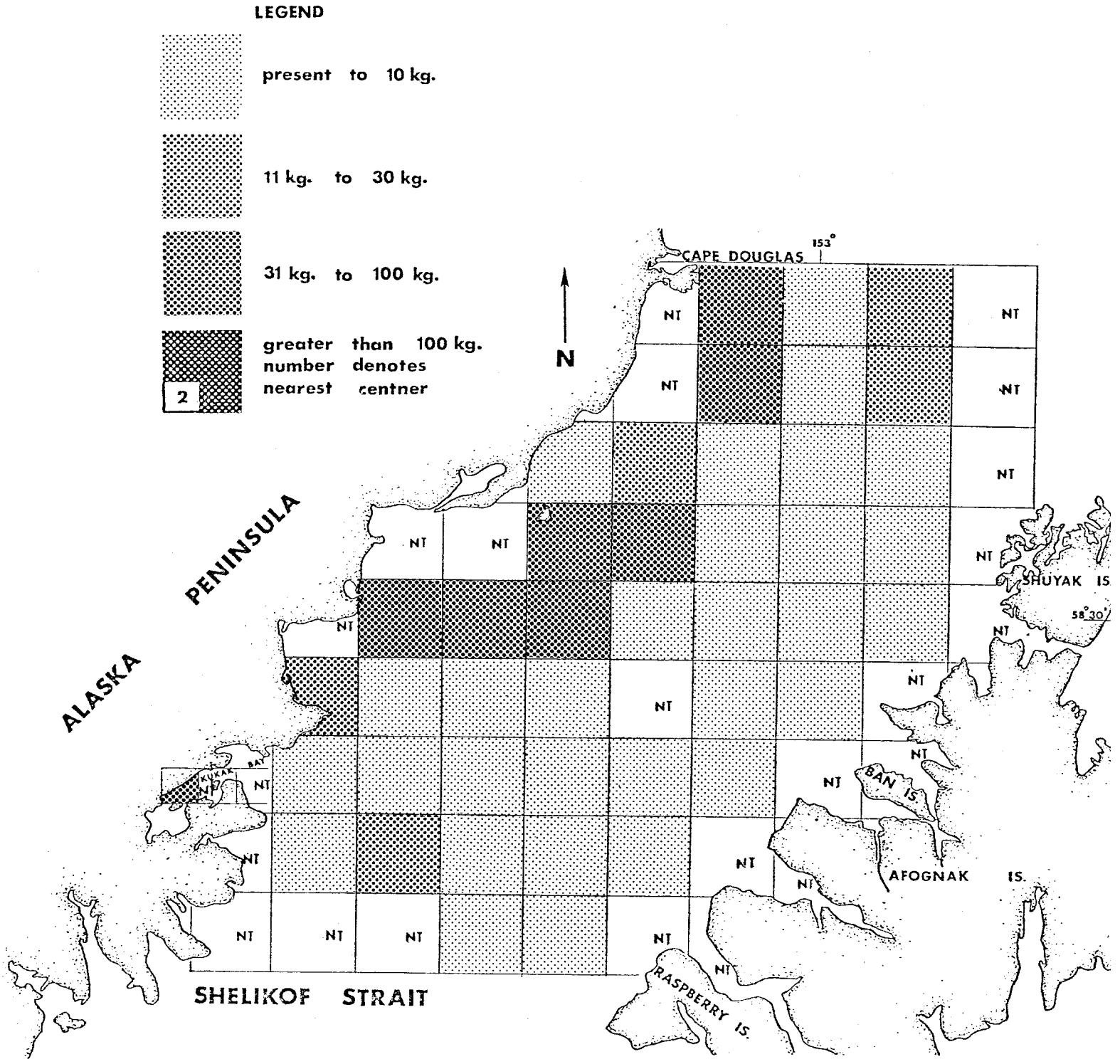
Appendix Figure 9. Distribution of sponge in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



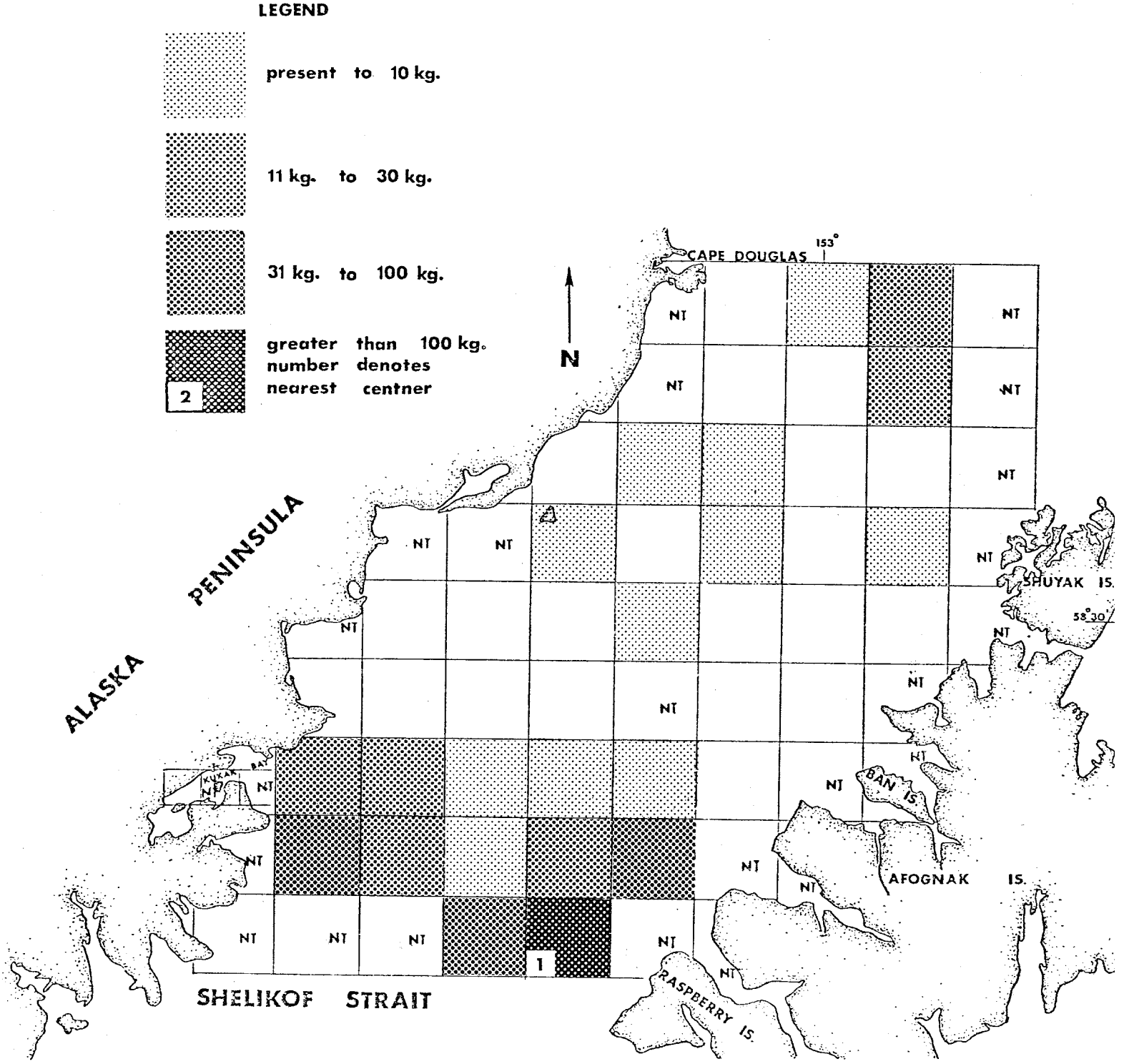
Appendix Figure 10. Distribution of big skate in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



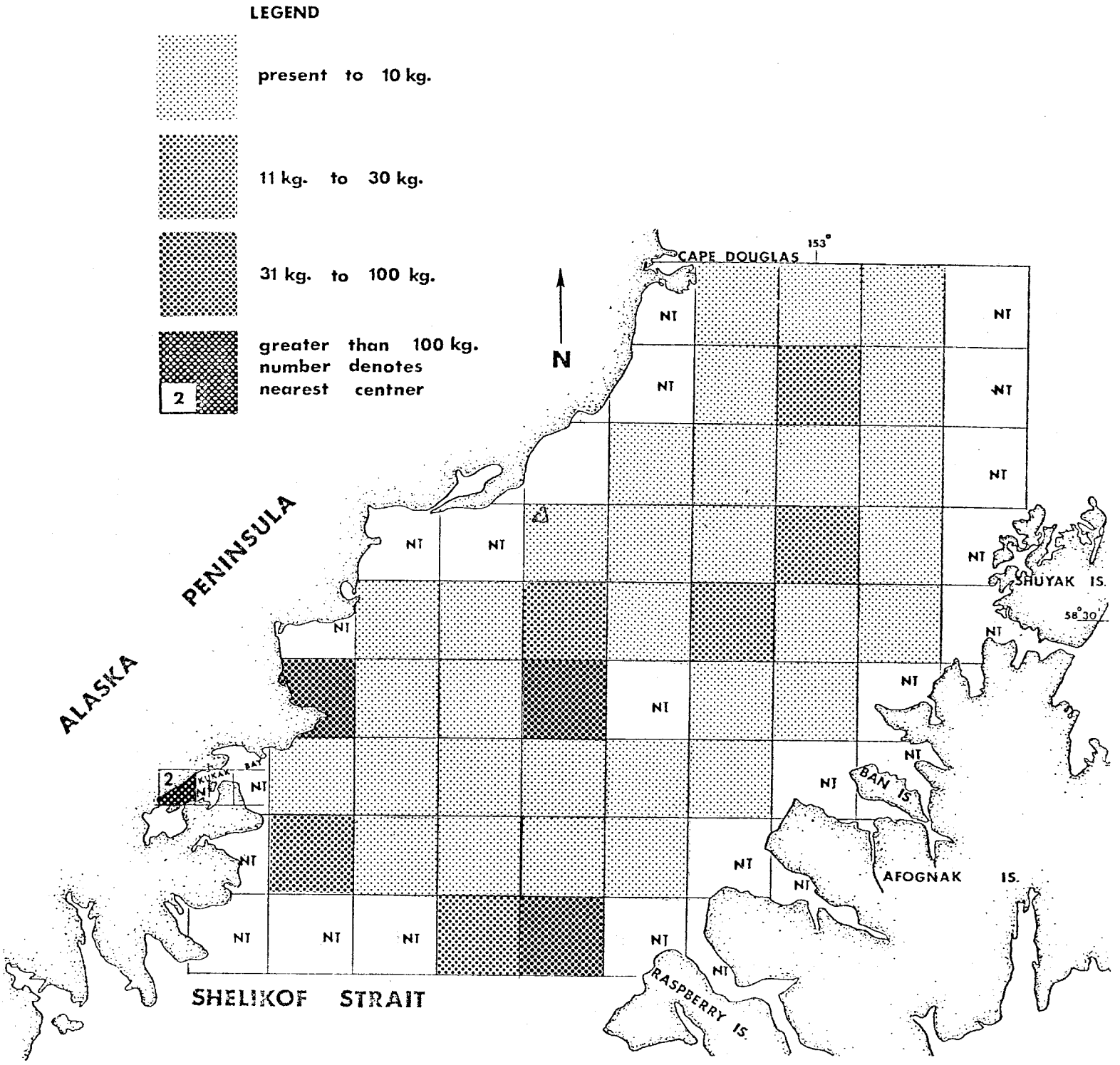
Appendix Figure 11. Distribution of great sculpin in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



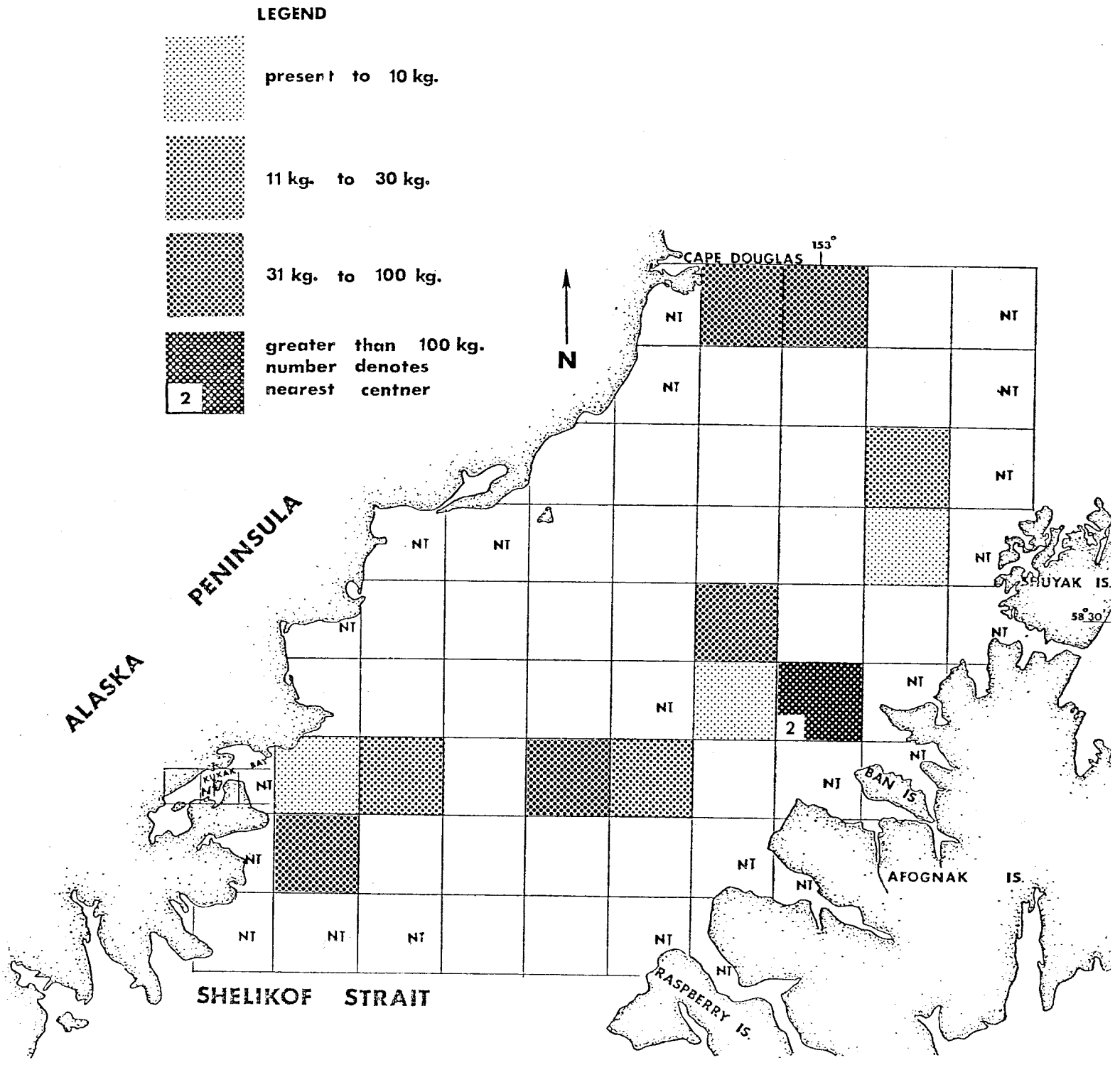
Appendix Figure 12. Distribution of female Tanner crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



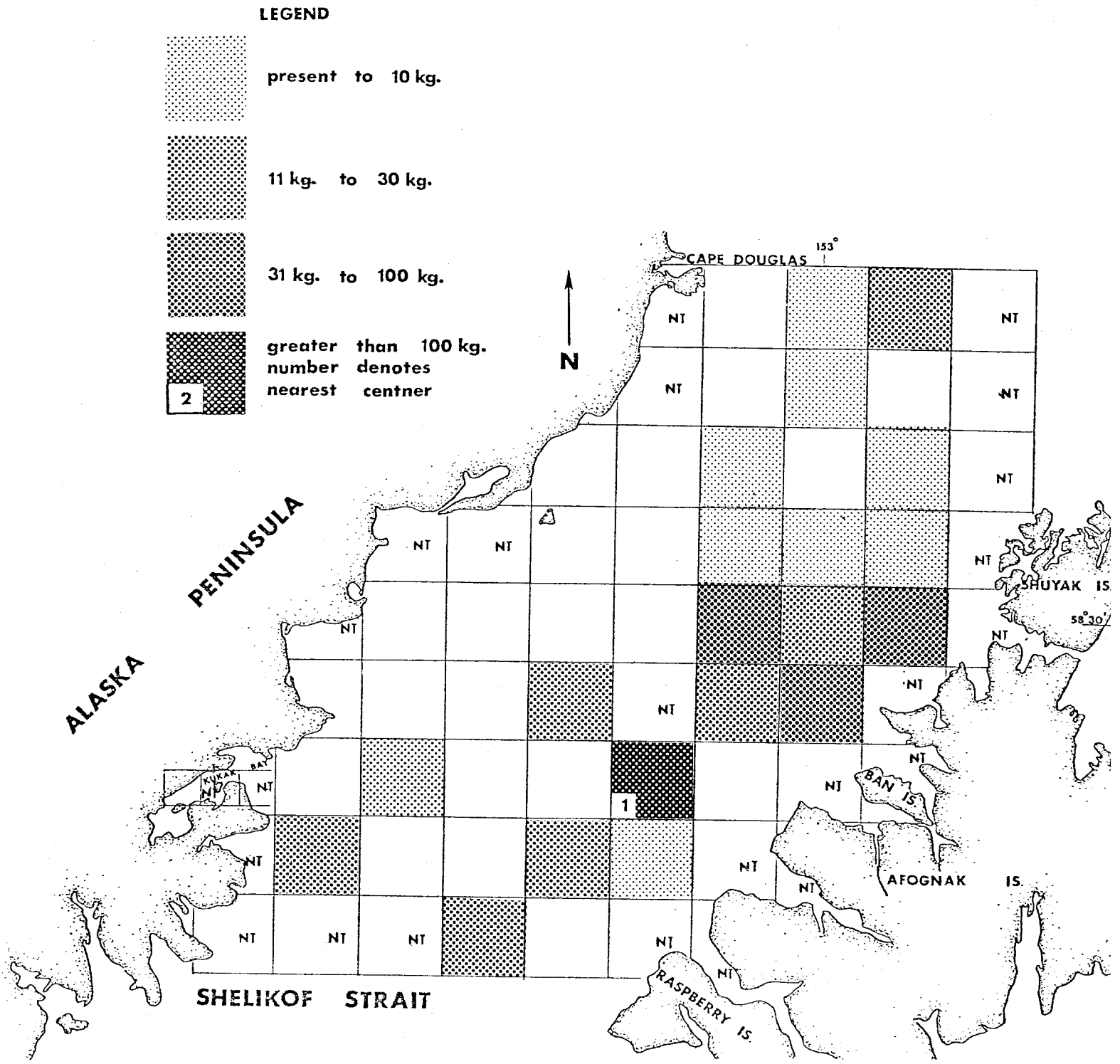
Appendix Figure 13. Distribution of basket starfish in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



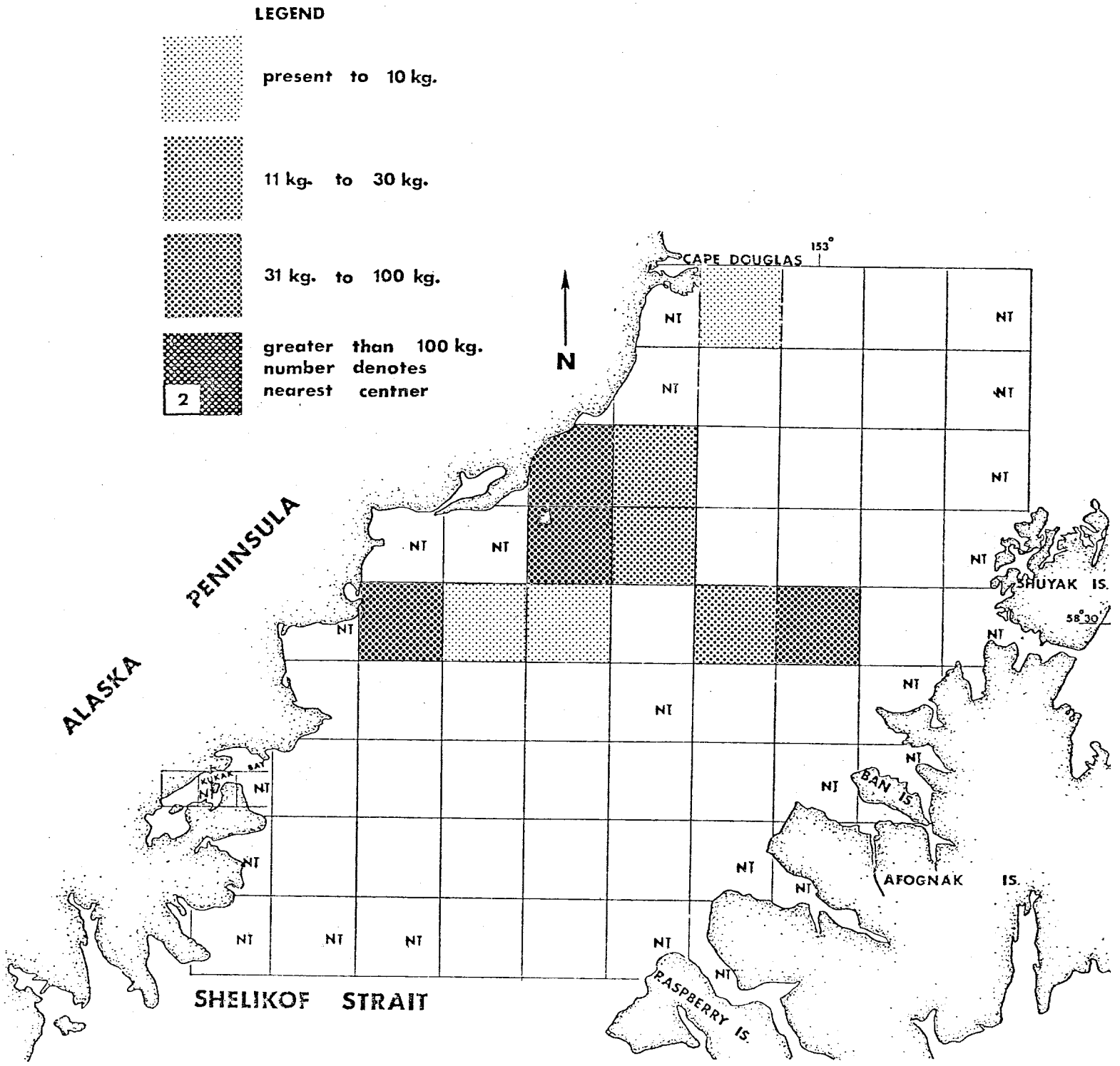
Appendix Figure 14. Distribution of shrimp in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



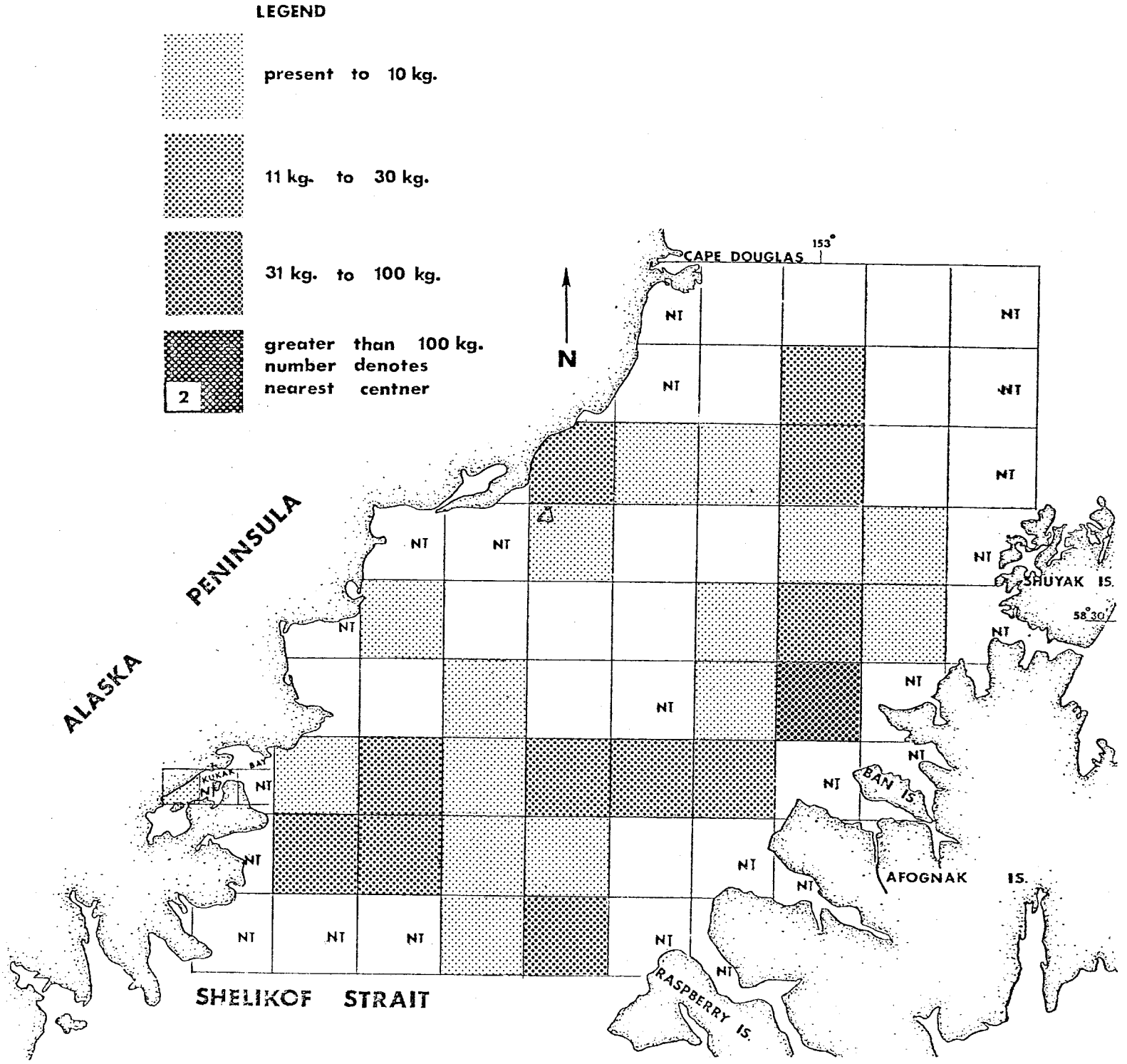
Appendix Figure 15. Distribution of skate (unident.) in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



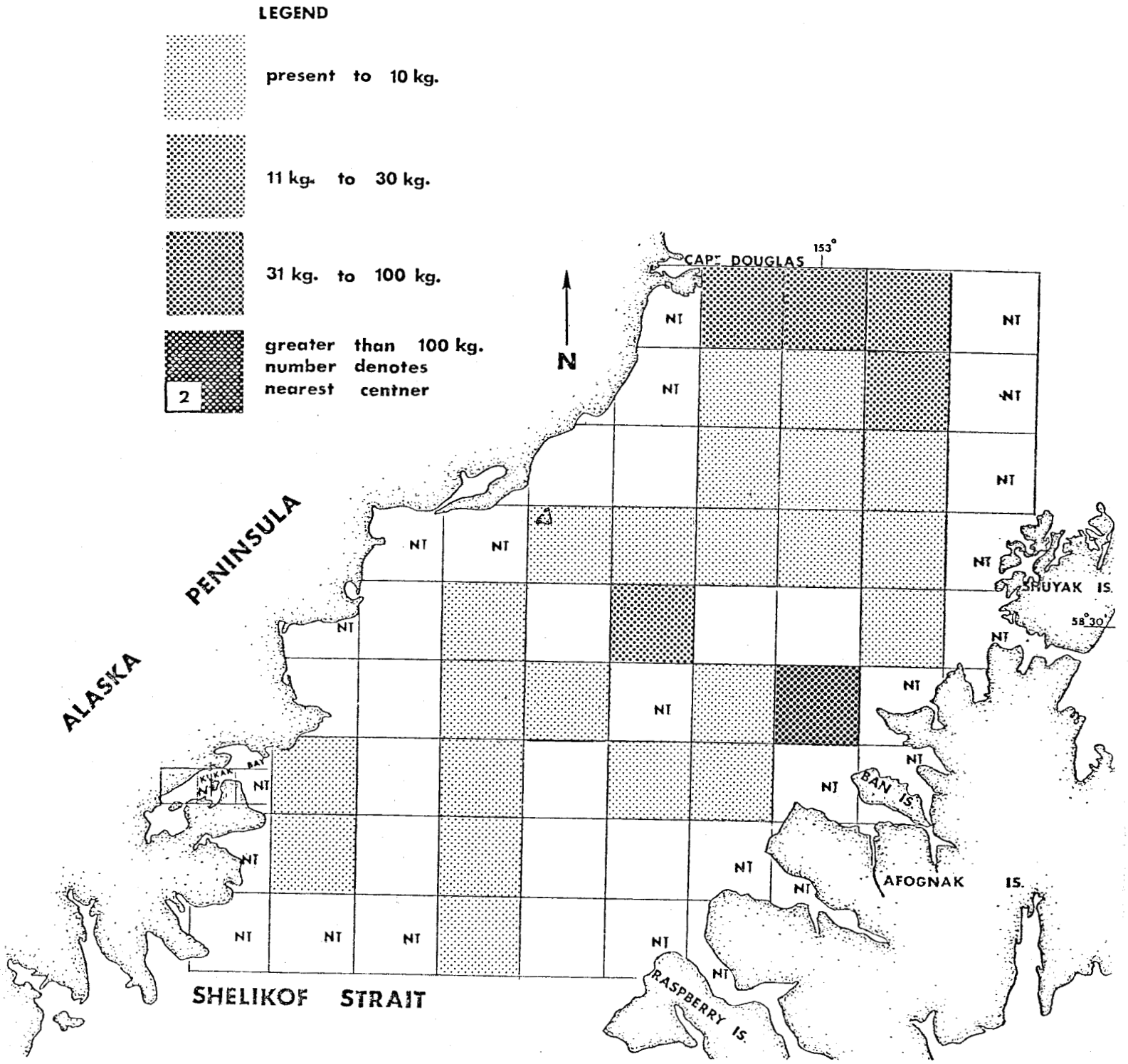
Appendix Figure 16. Distribution of rockfish spp. in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



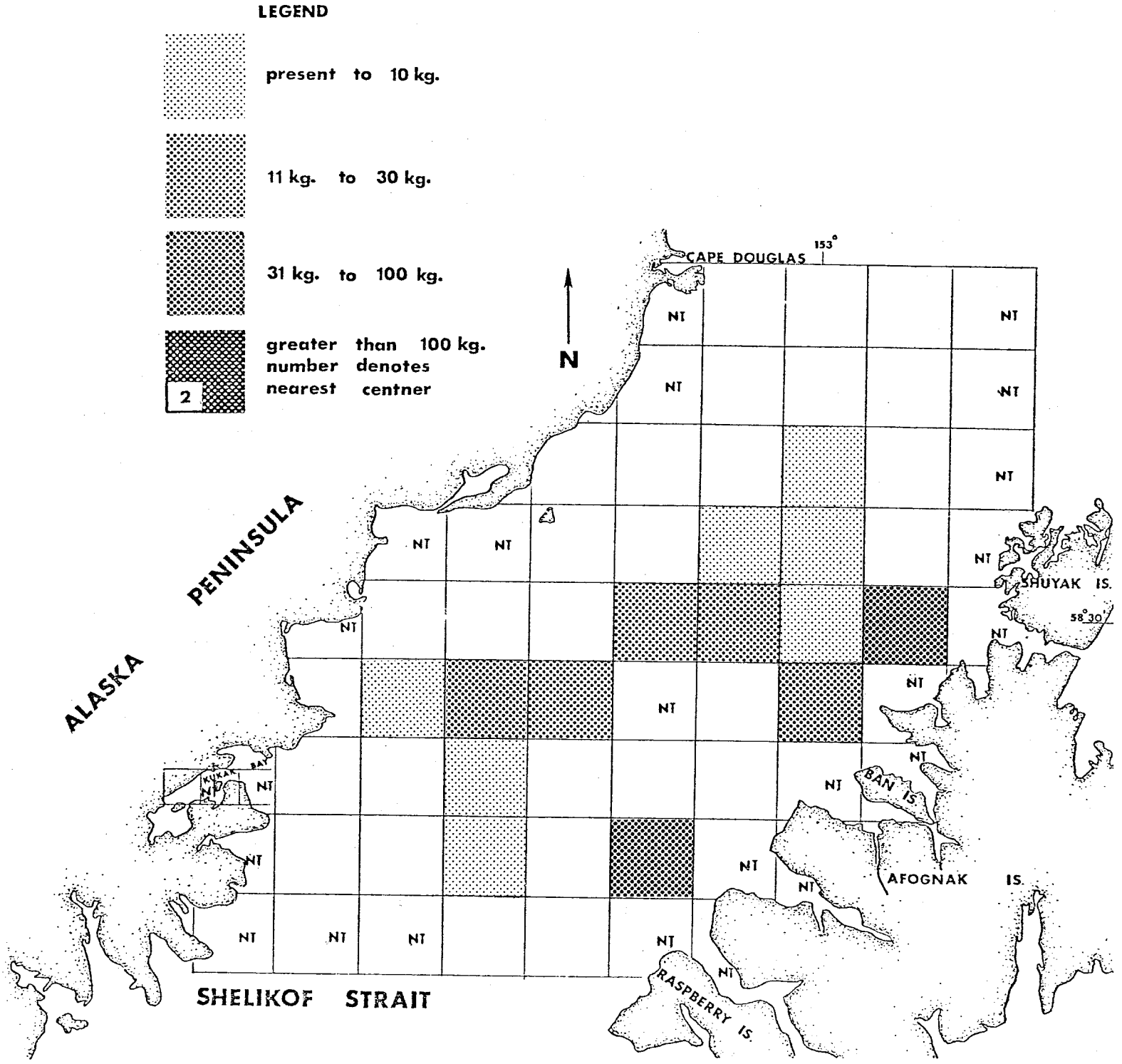
Appendix Figure 17. Distribution of Alaska plaice in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



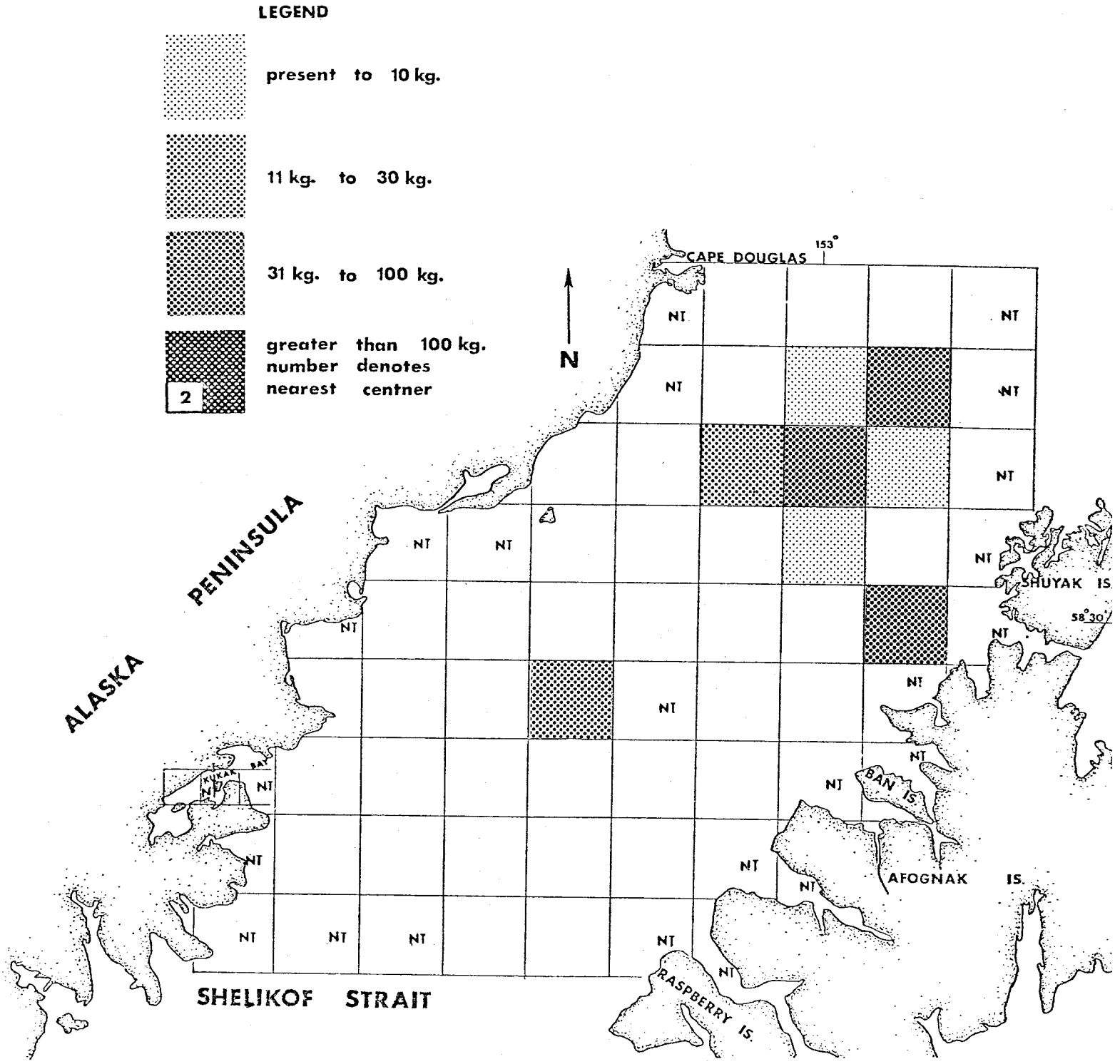
Appendix Figure 18. Distribution of starfish (unident.) in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



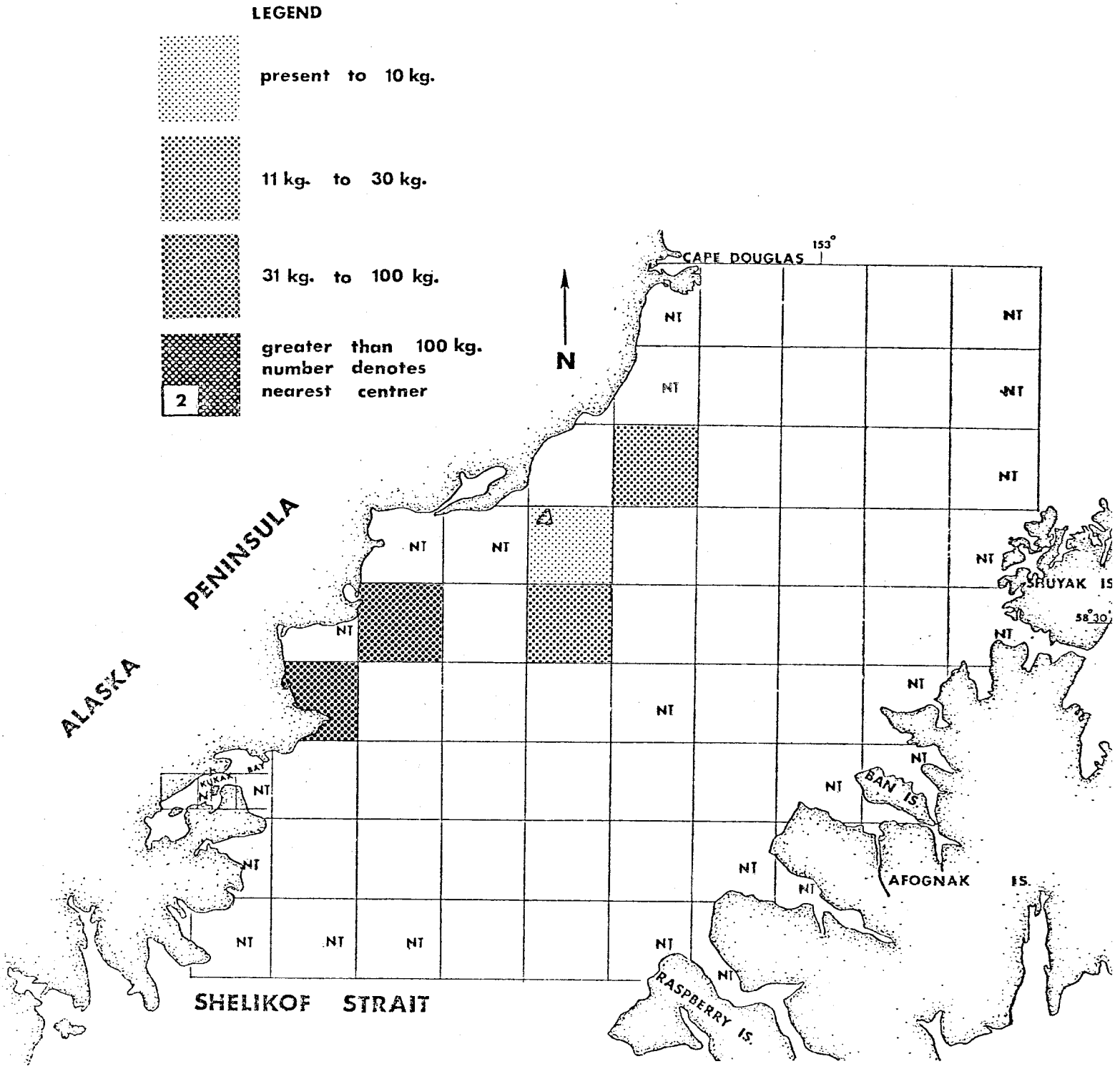
Appendix Figure 19. Distribution of snails in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



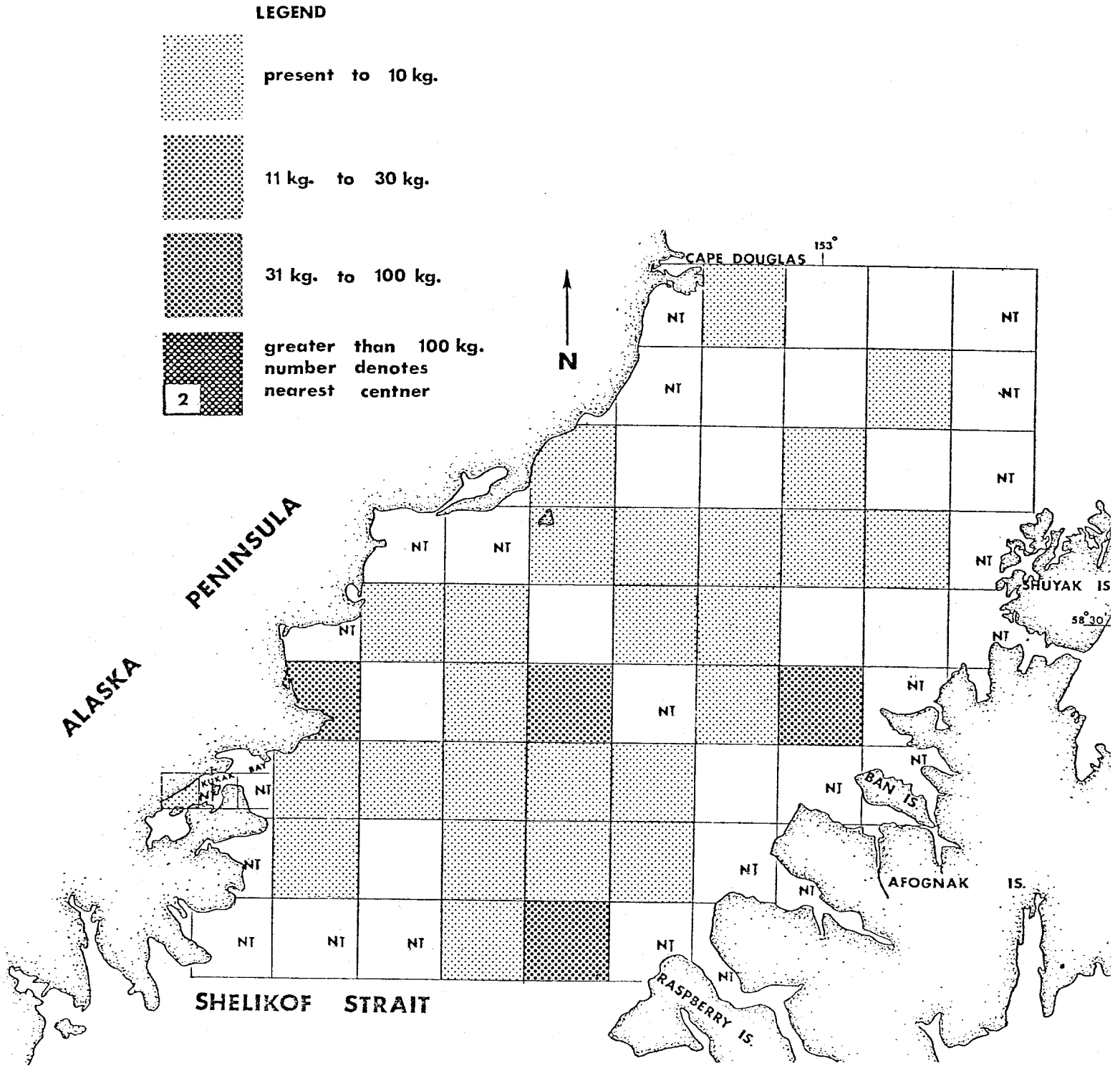
Appendix Figure 20. Distribution of Dover sole in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



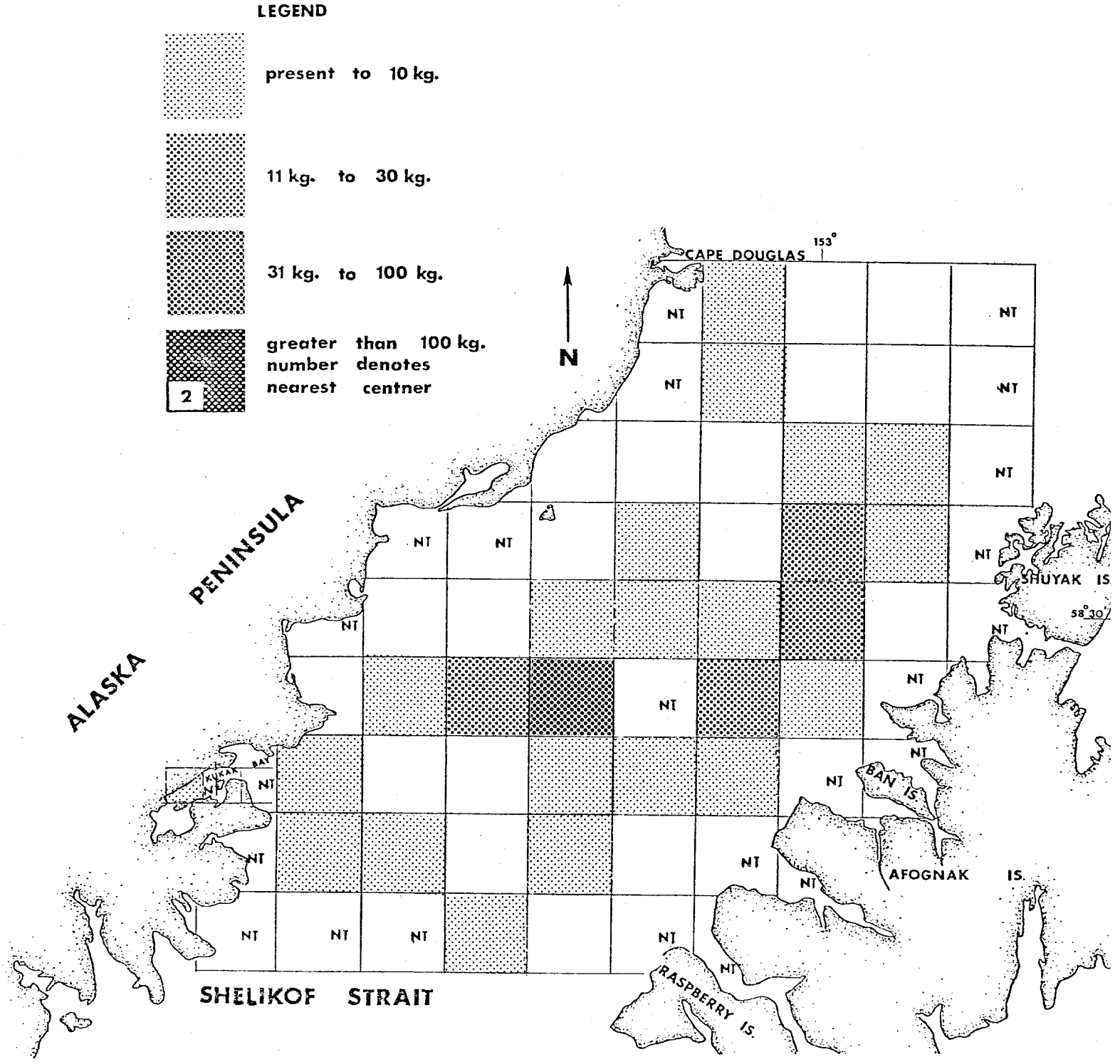
Appendix Figure 21. Distribution of sea urchins in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



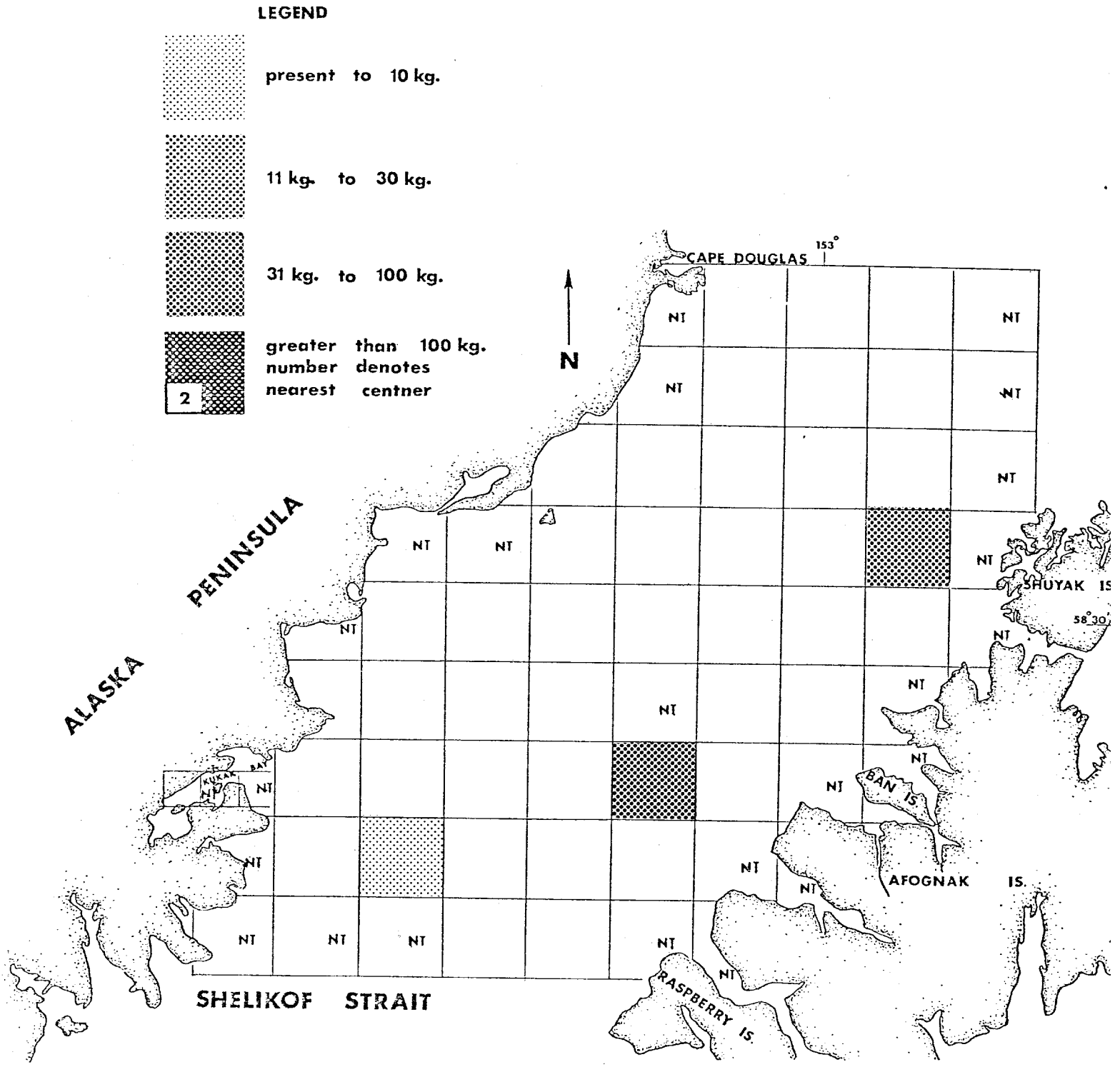
Appendix Figure 22. Distribution of male king crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



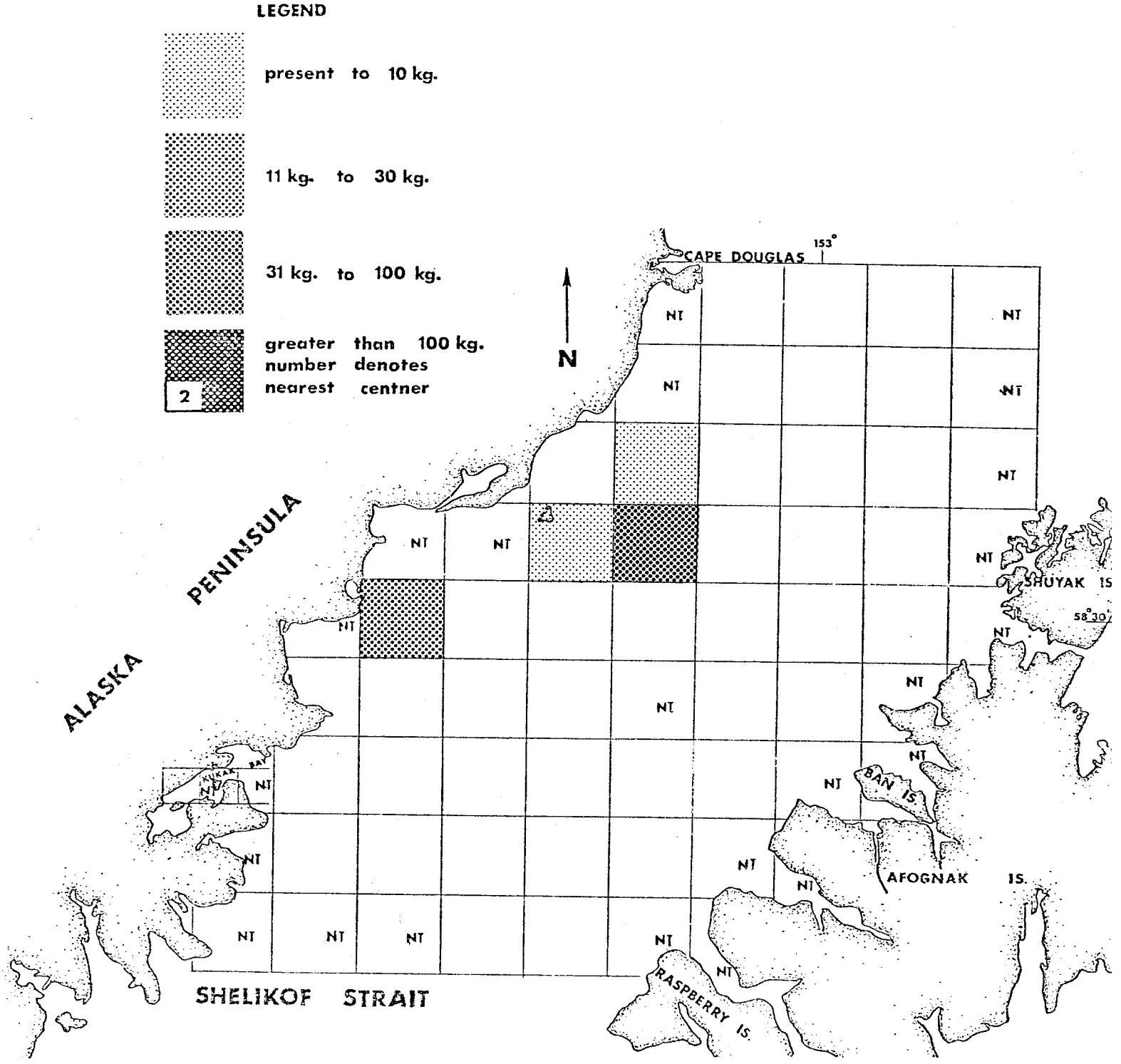
Appendix Figure 23. Distribution of spinyhead sculpin in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



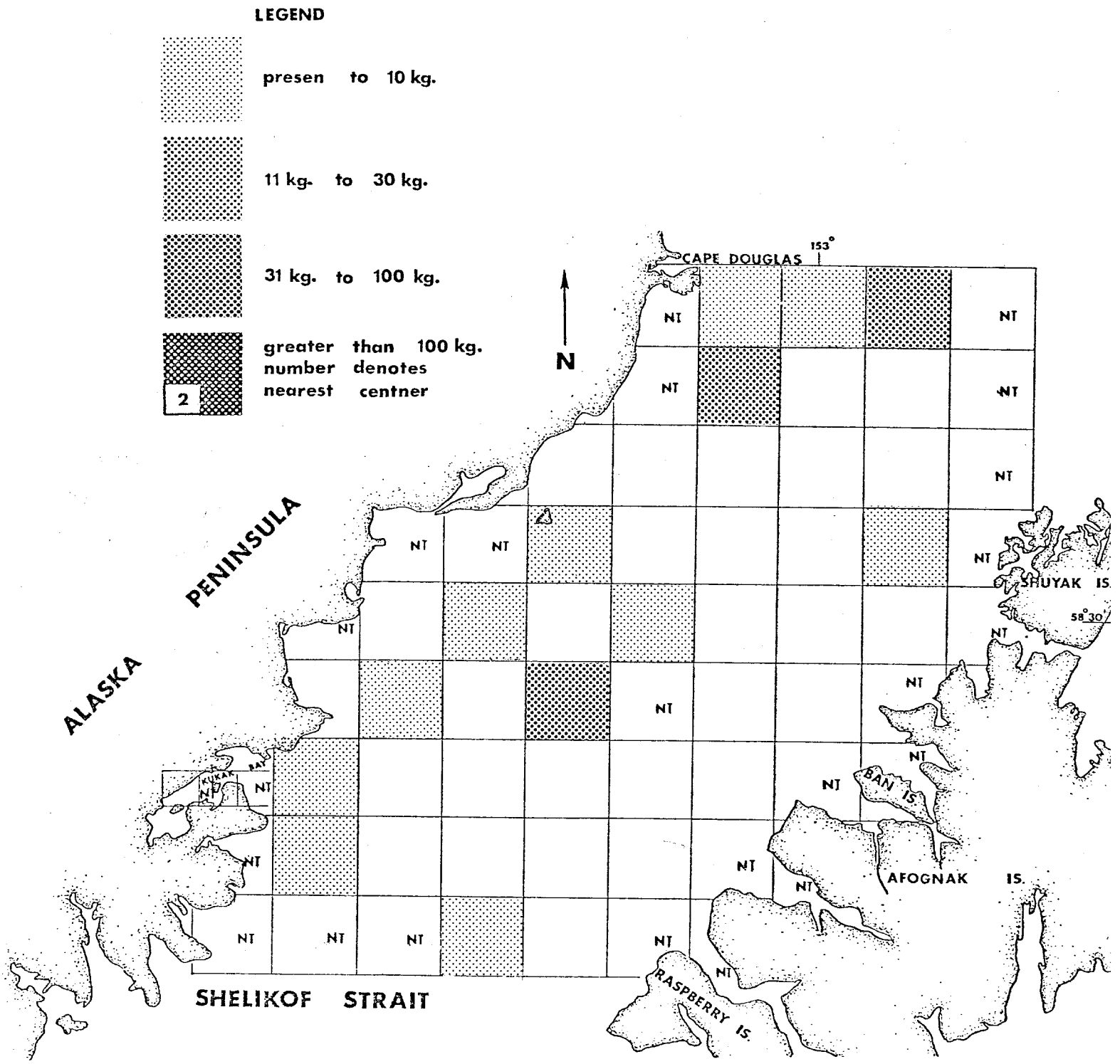
Appendix Figure 24. Distribution of eulachon in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



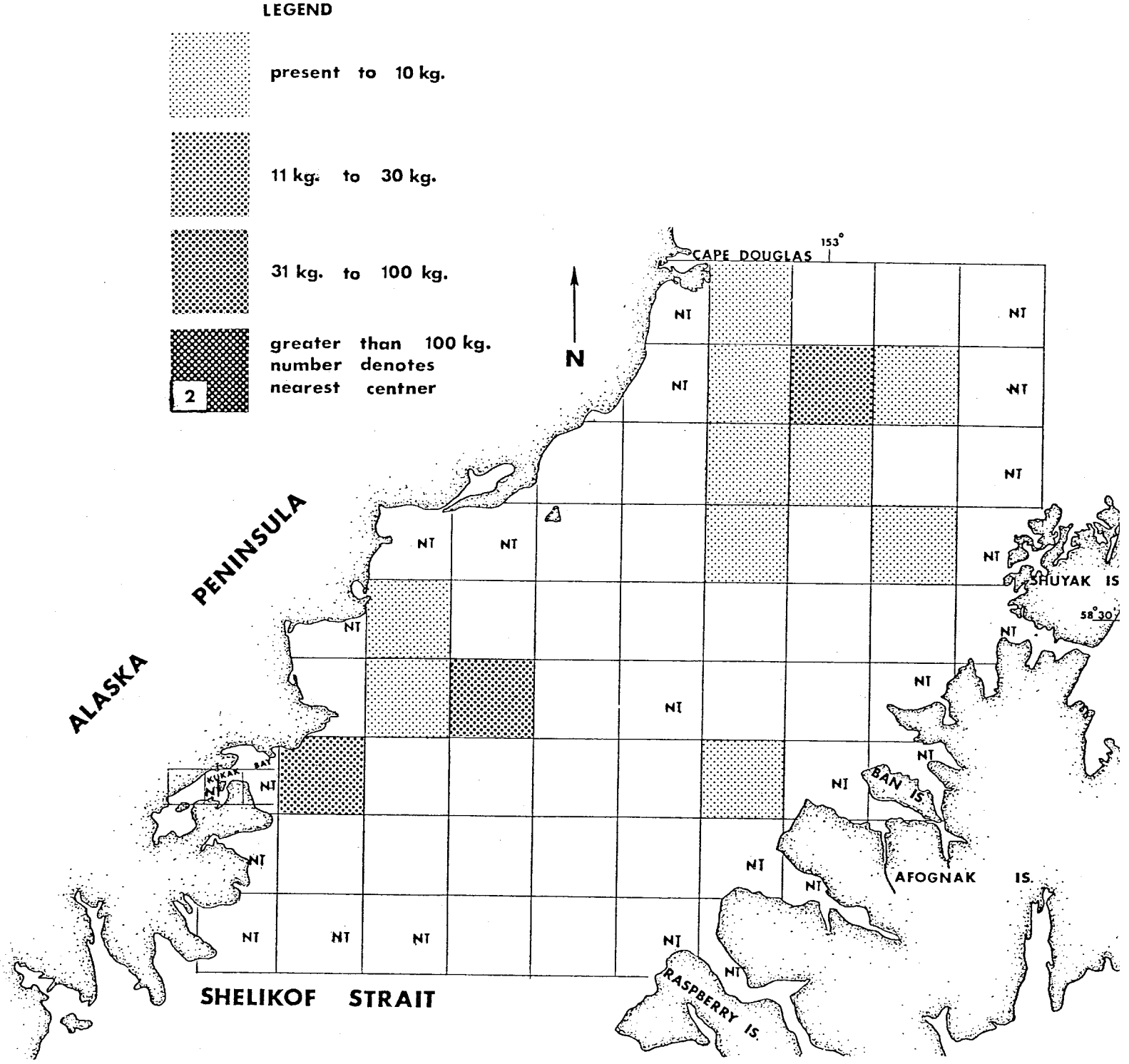
Appendix Figure 25. Distribution of giant wrymouth in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



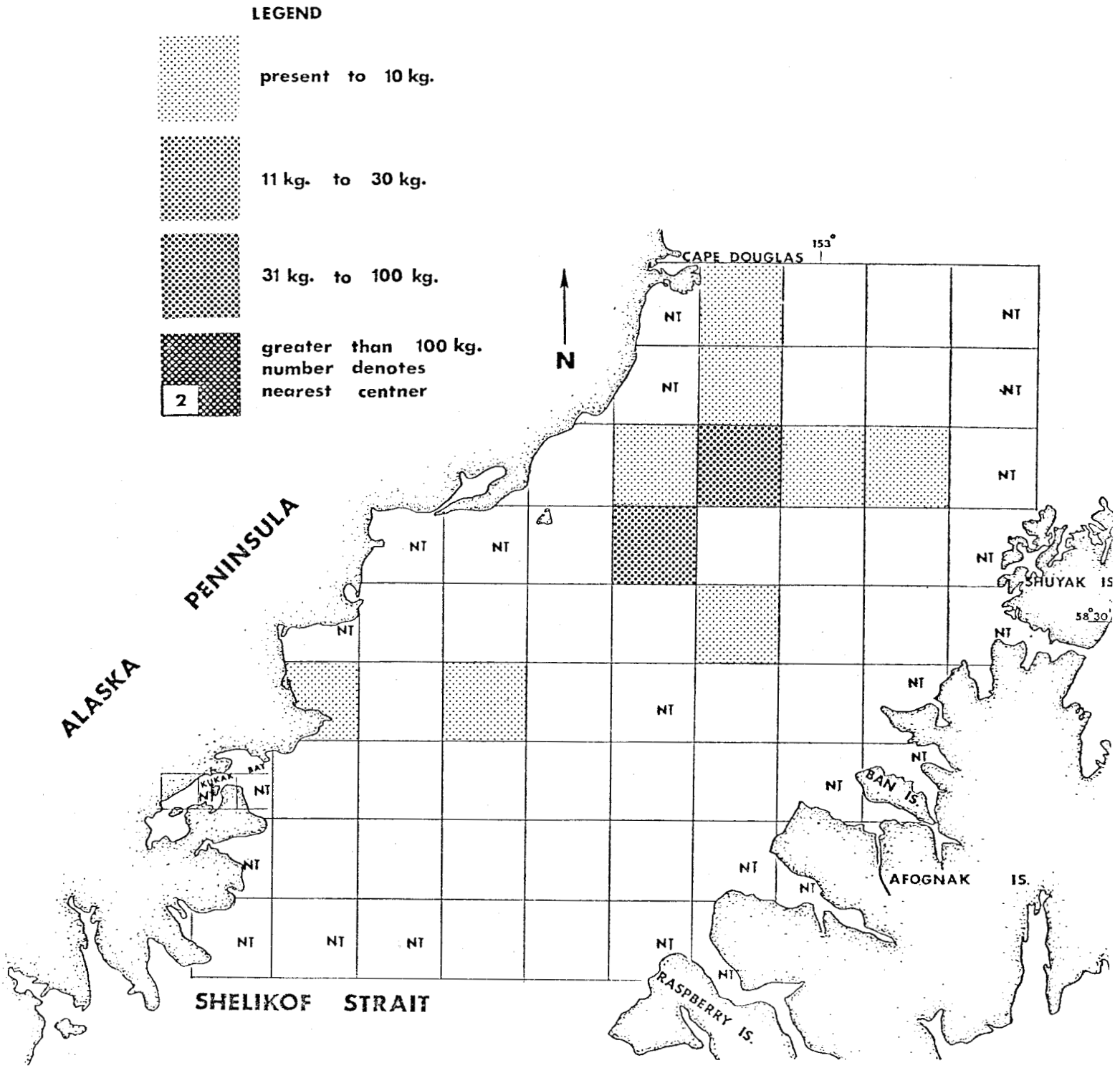
Appendix Figure 26. Distribution of female king crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes centner, which is 100 kg. NT indicates that area was not trawled.



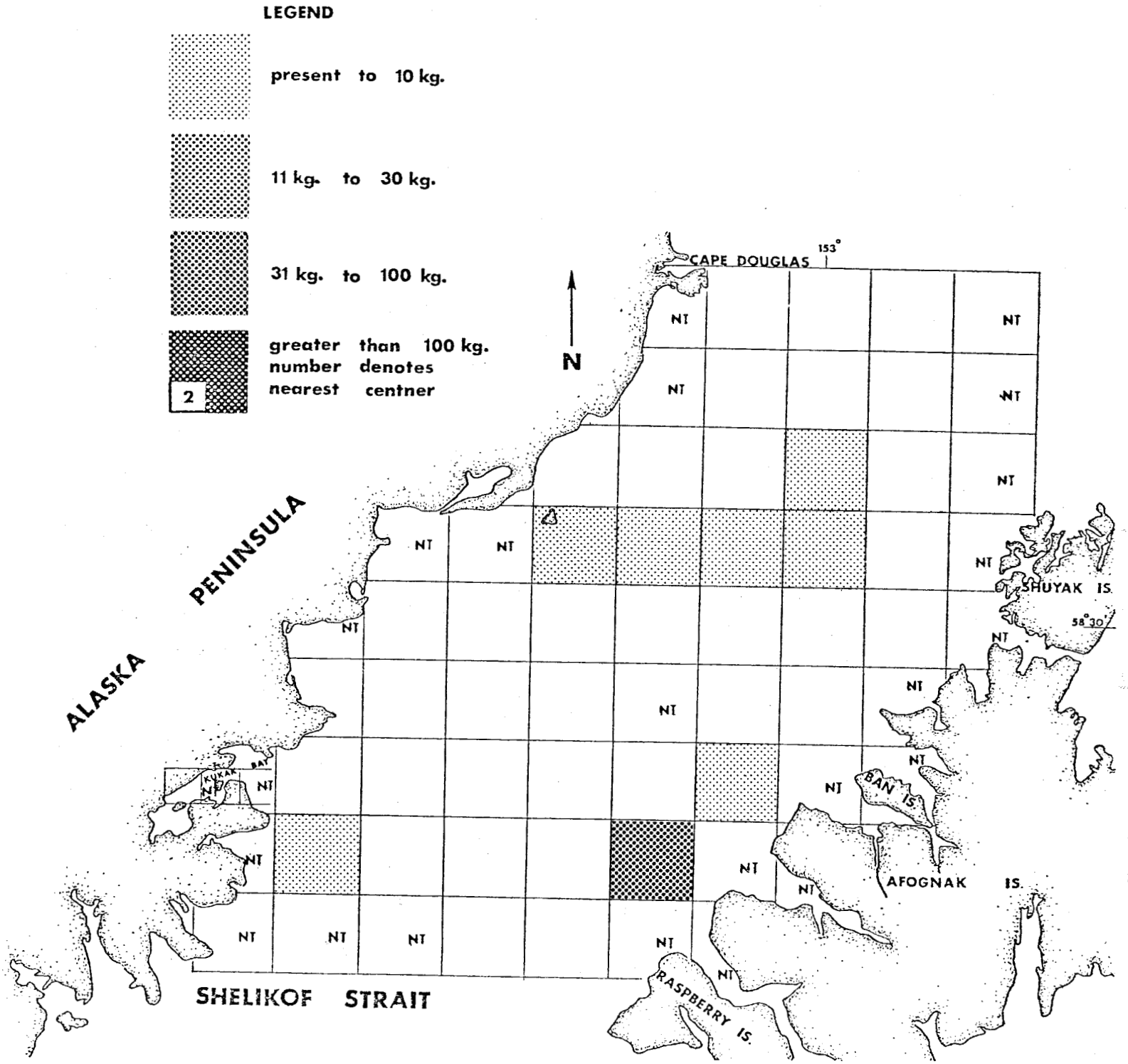
Appendix Figure 27. Distribution of hermit crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



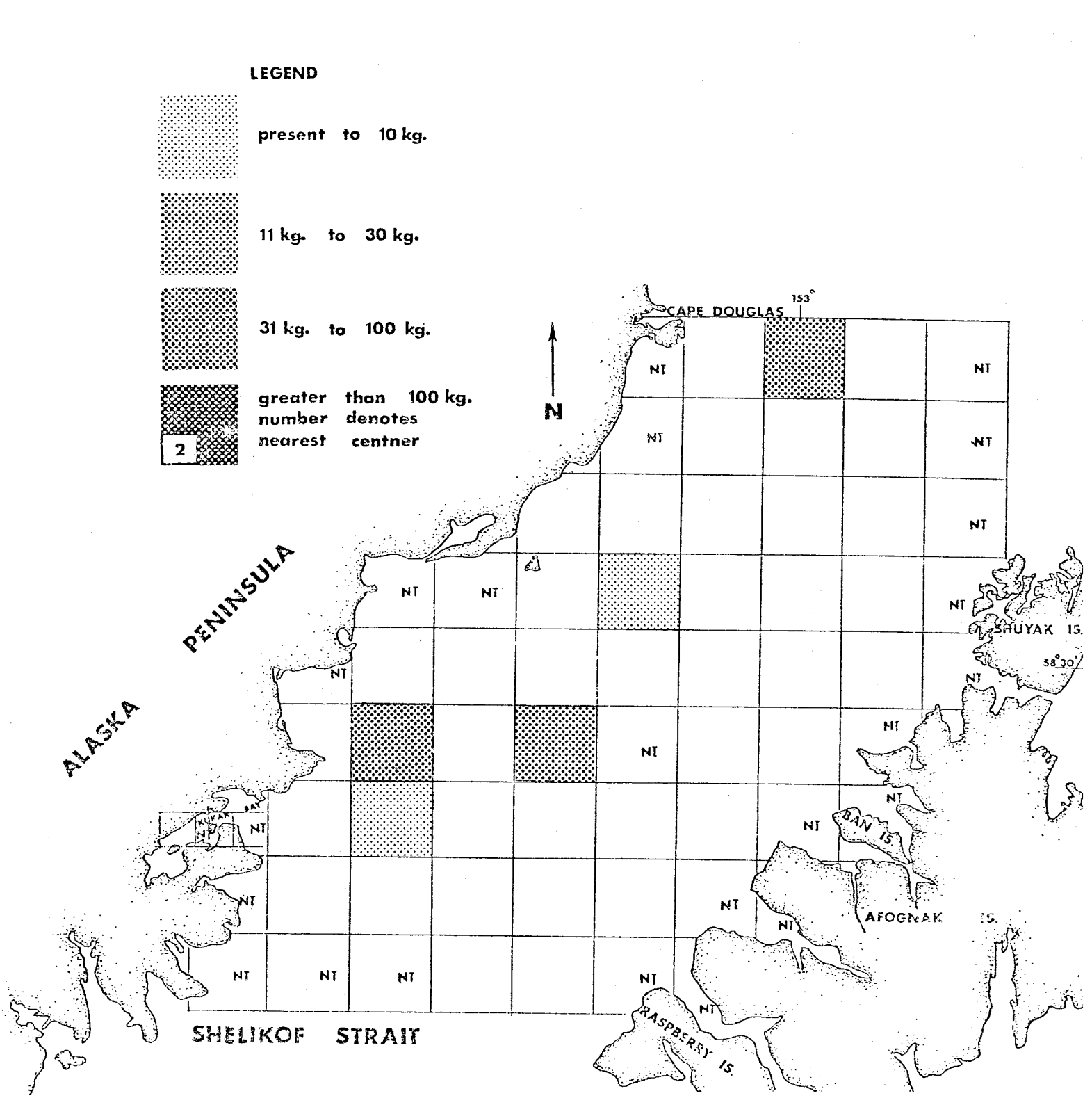
Appendix Figure 28. Distribution of sea anemone in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



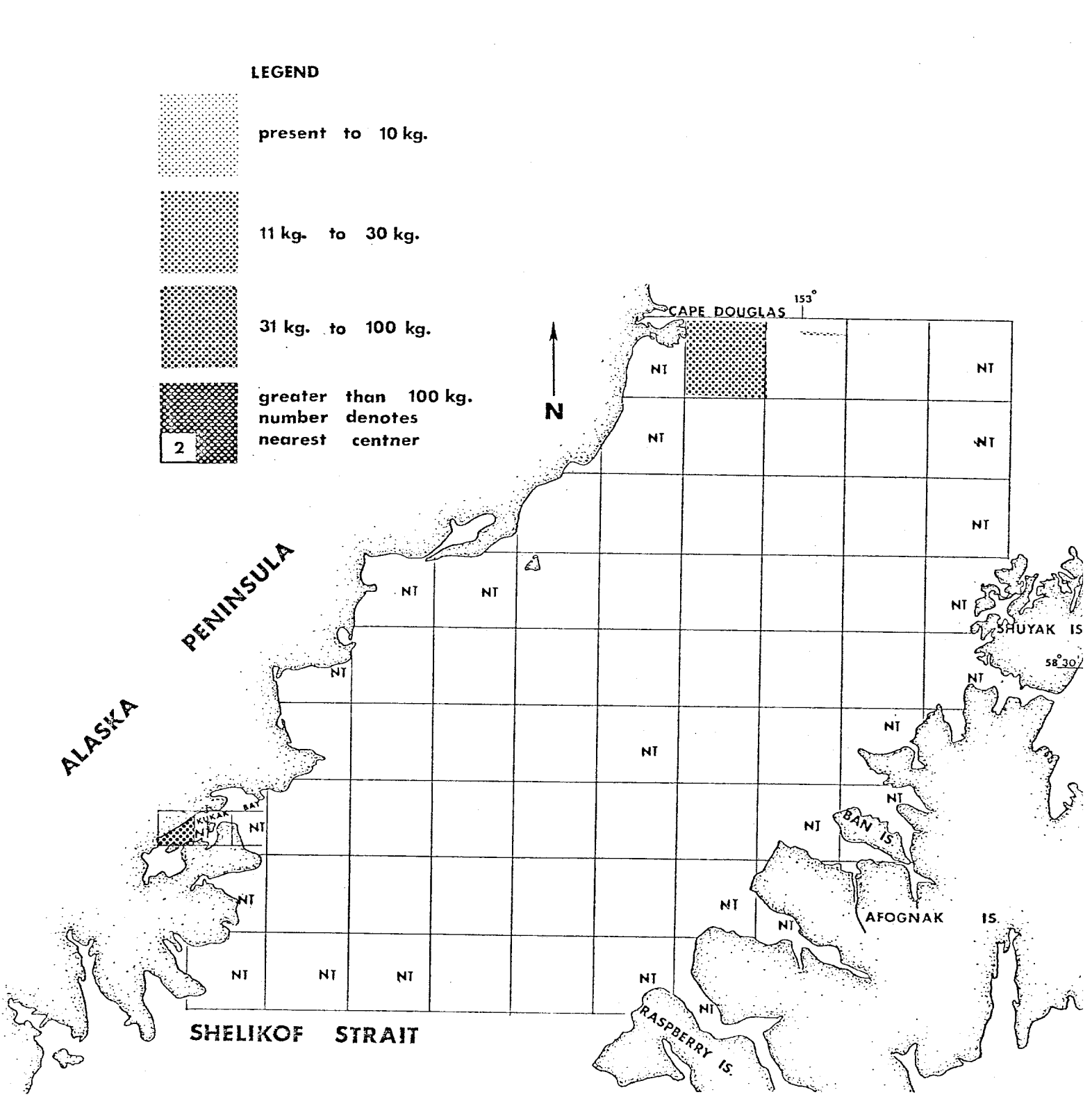
Appendix Figure 29. Distribution of rock sole in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



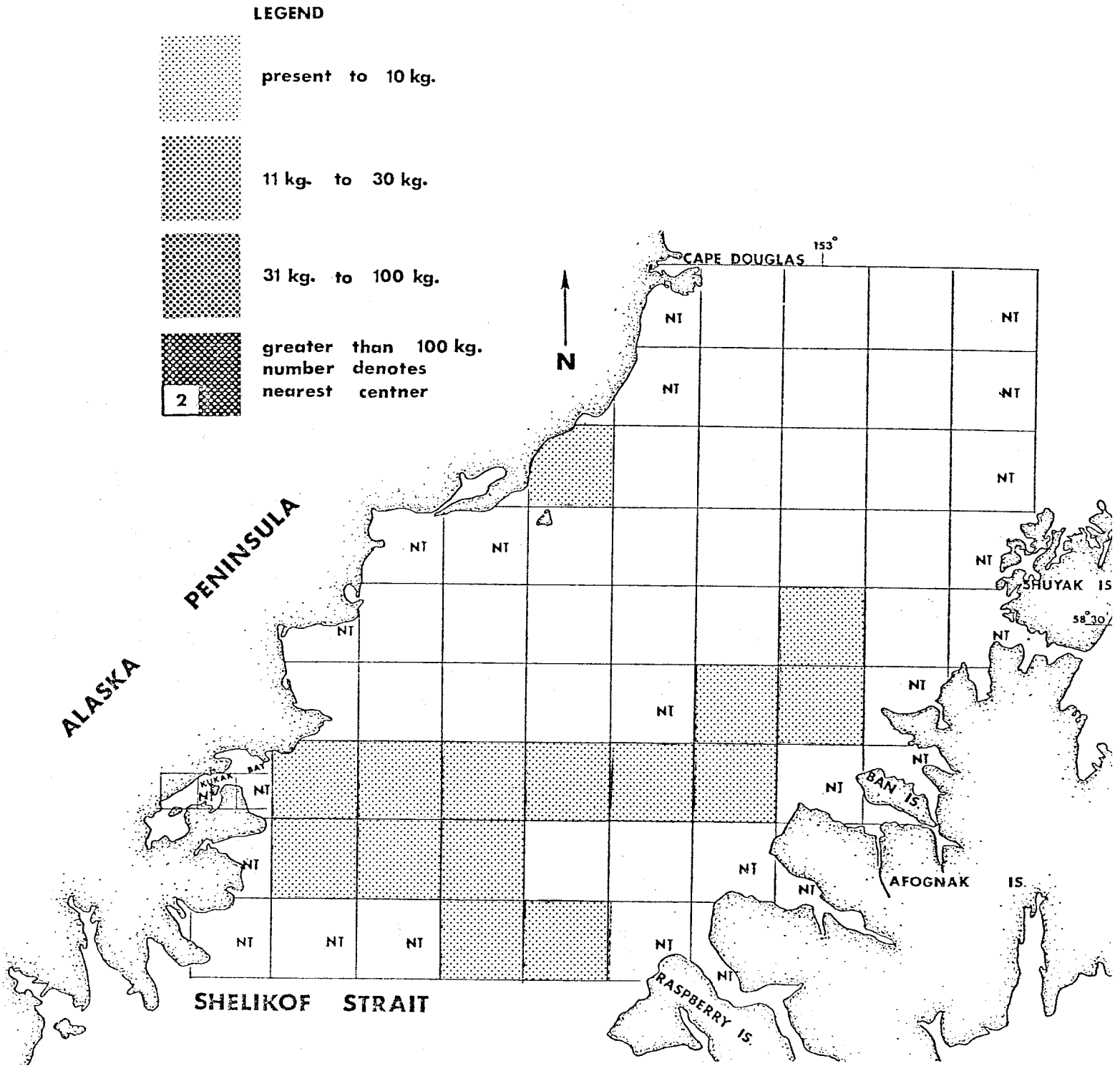
Appendix Figure 30. Distribution of rex sole in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



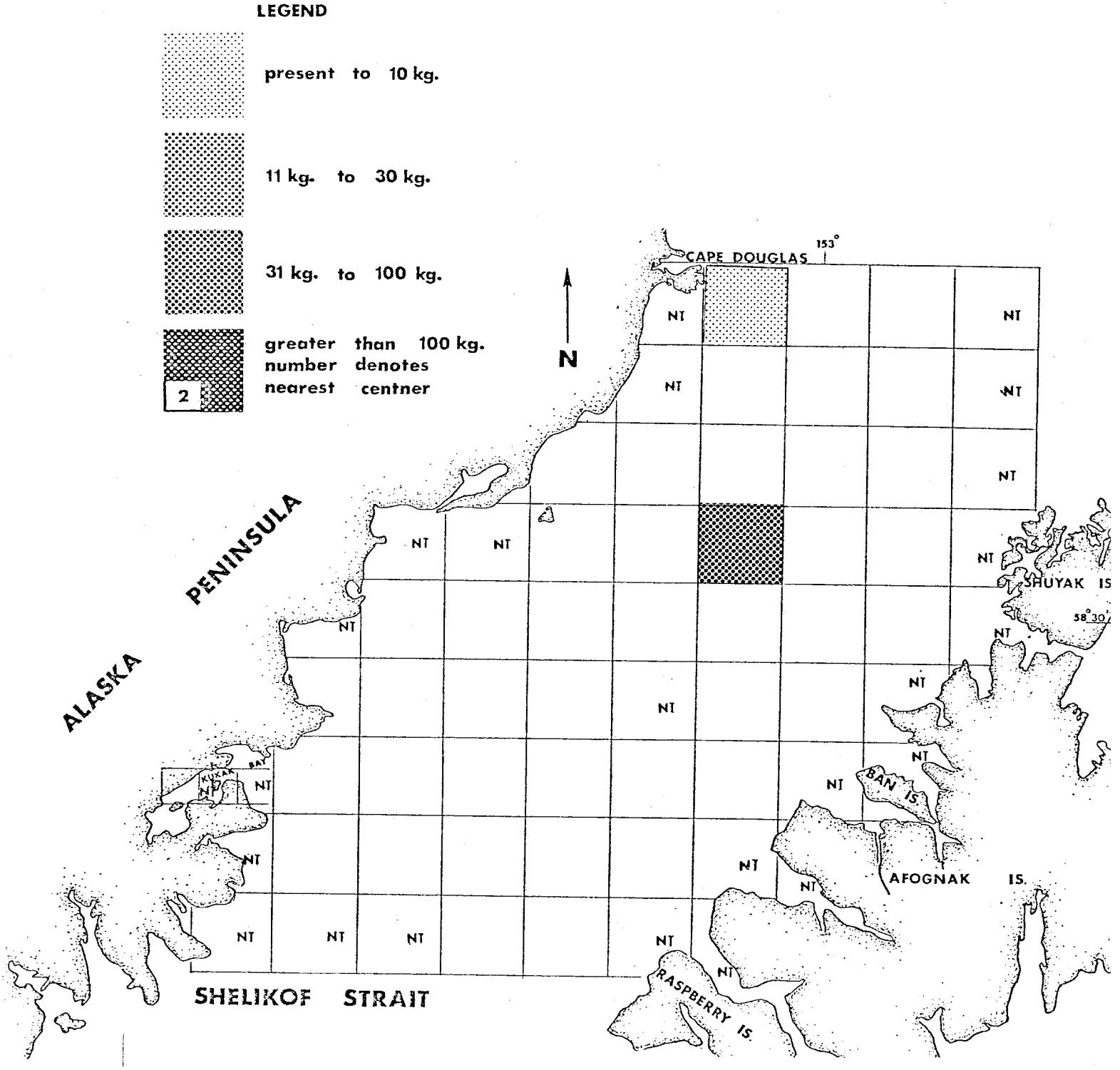
Appendix Figure 31. Distribution of longnose skate in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



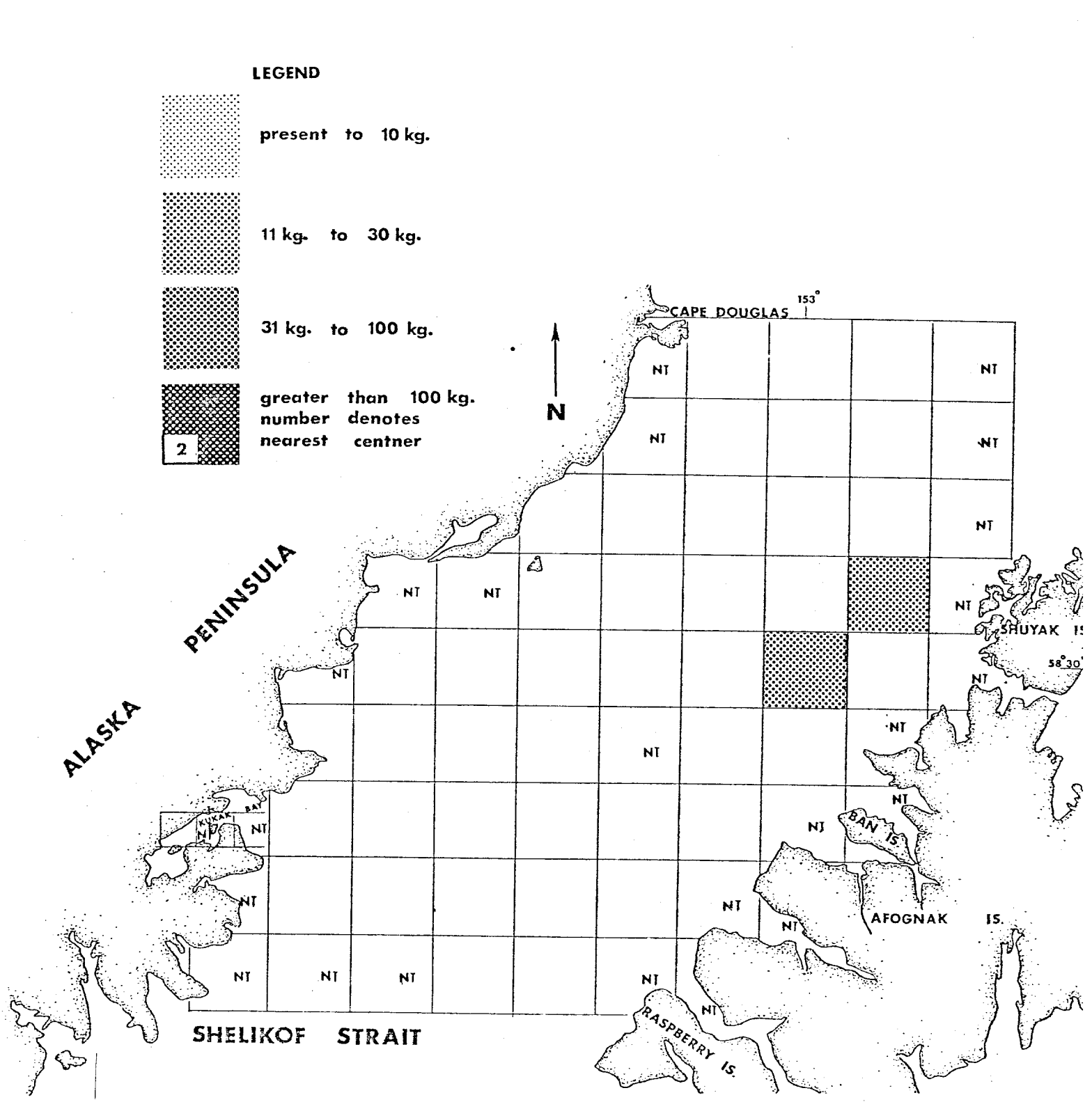
Appendix Figure 32. Distribution of yellowfin sole in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



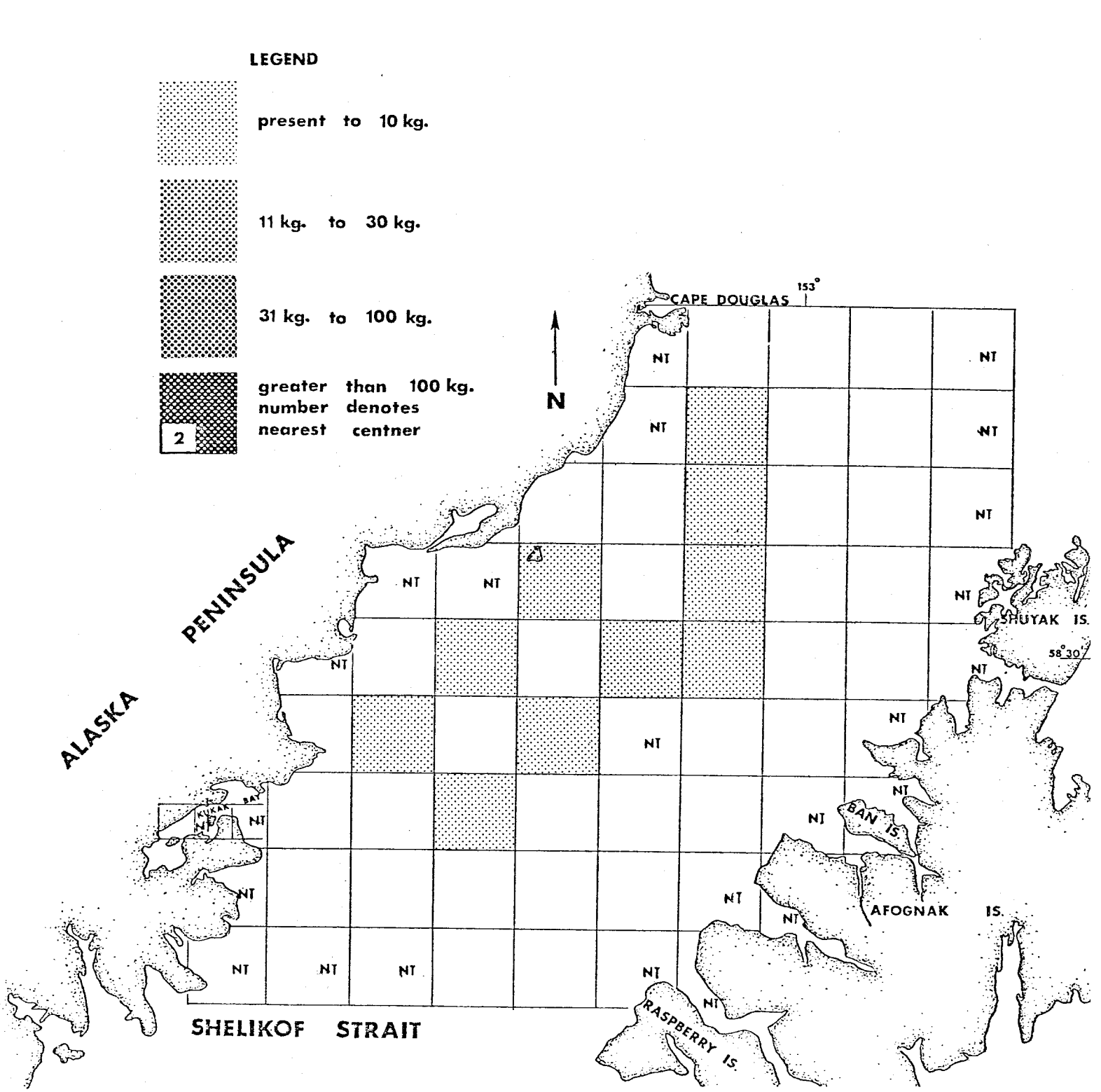
Appendix Figure 33. Distribution of longsnout prickleback in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



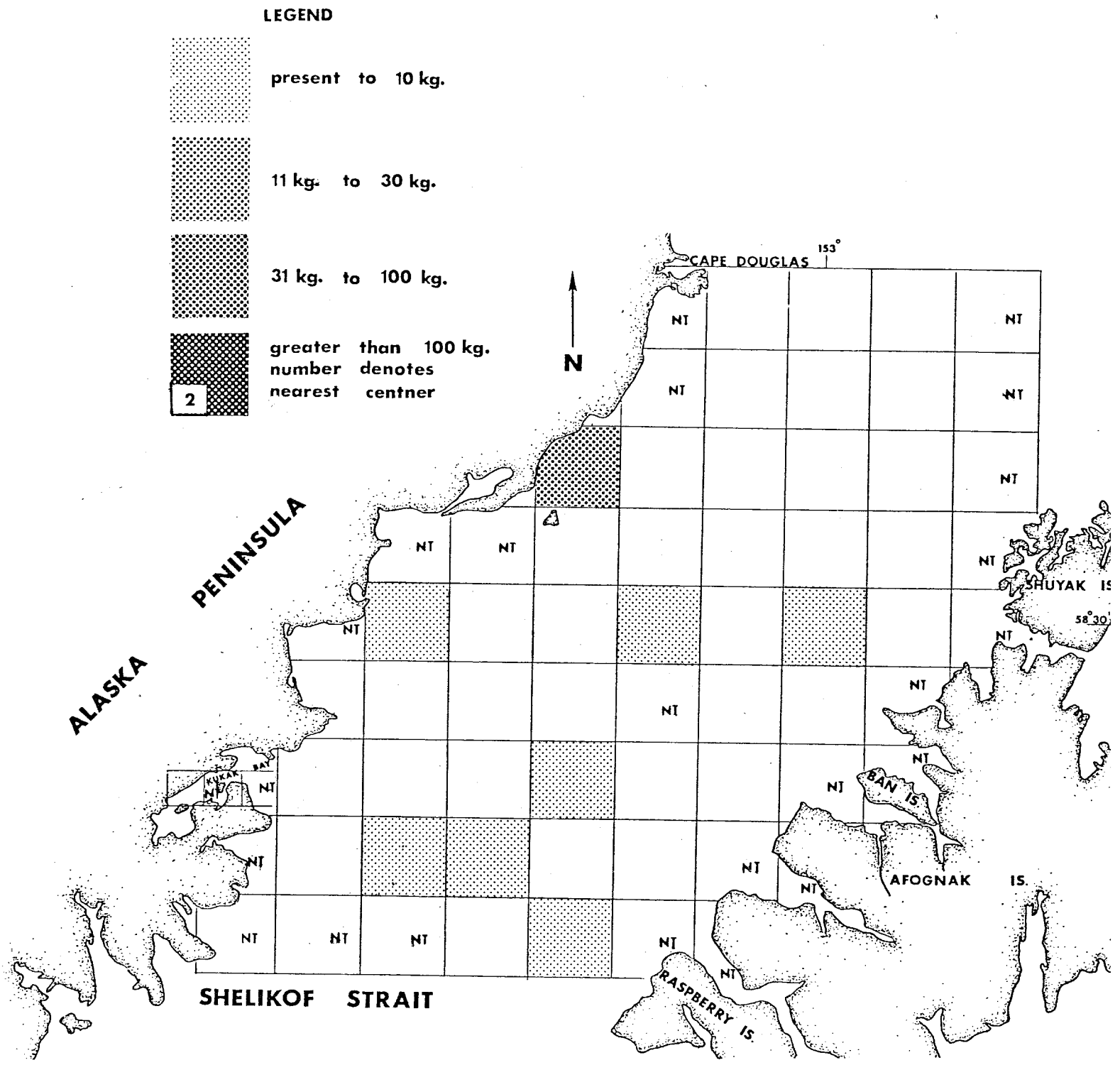
Appendix Figure 34. Distribution of barnacles (unident.) in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



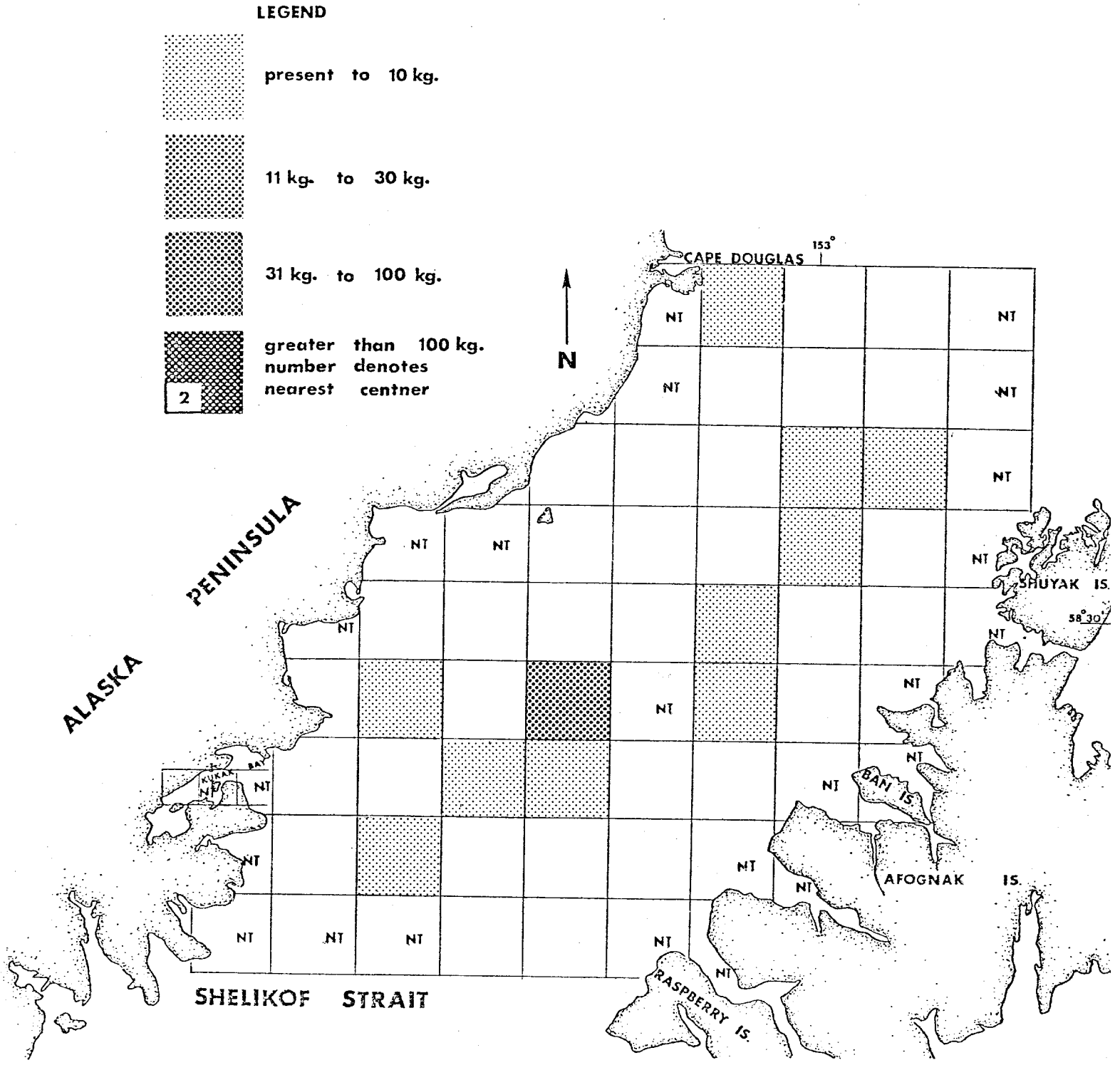
Appendix Figure 35. Distribution of male golden king crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



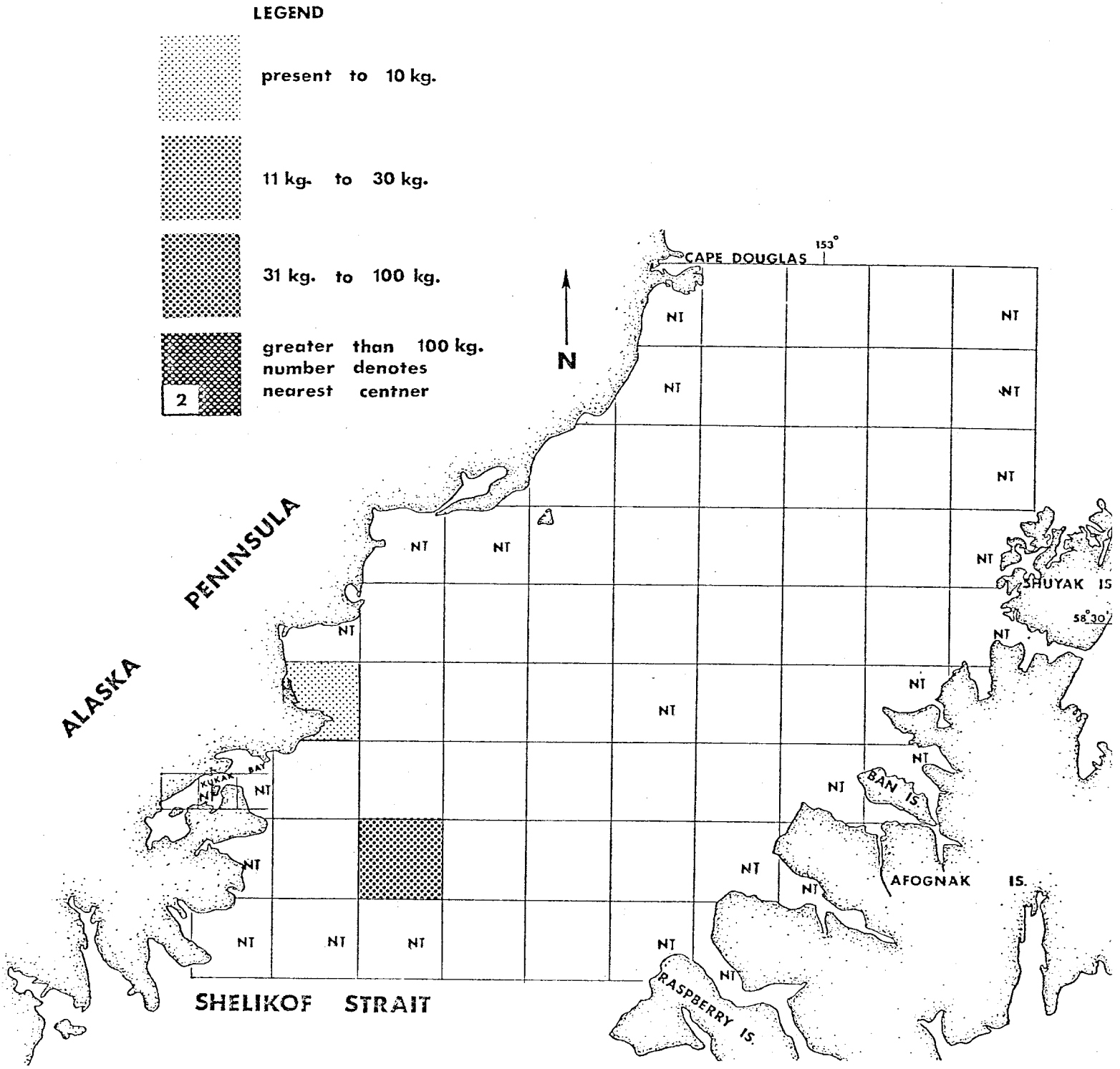
Appendix Figure 36. Distribution of yellow irish lord in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



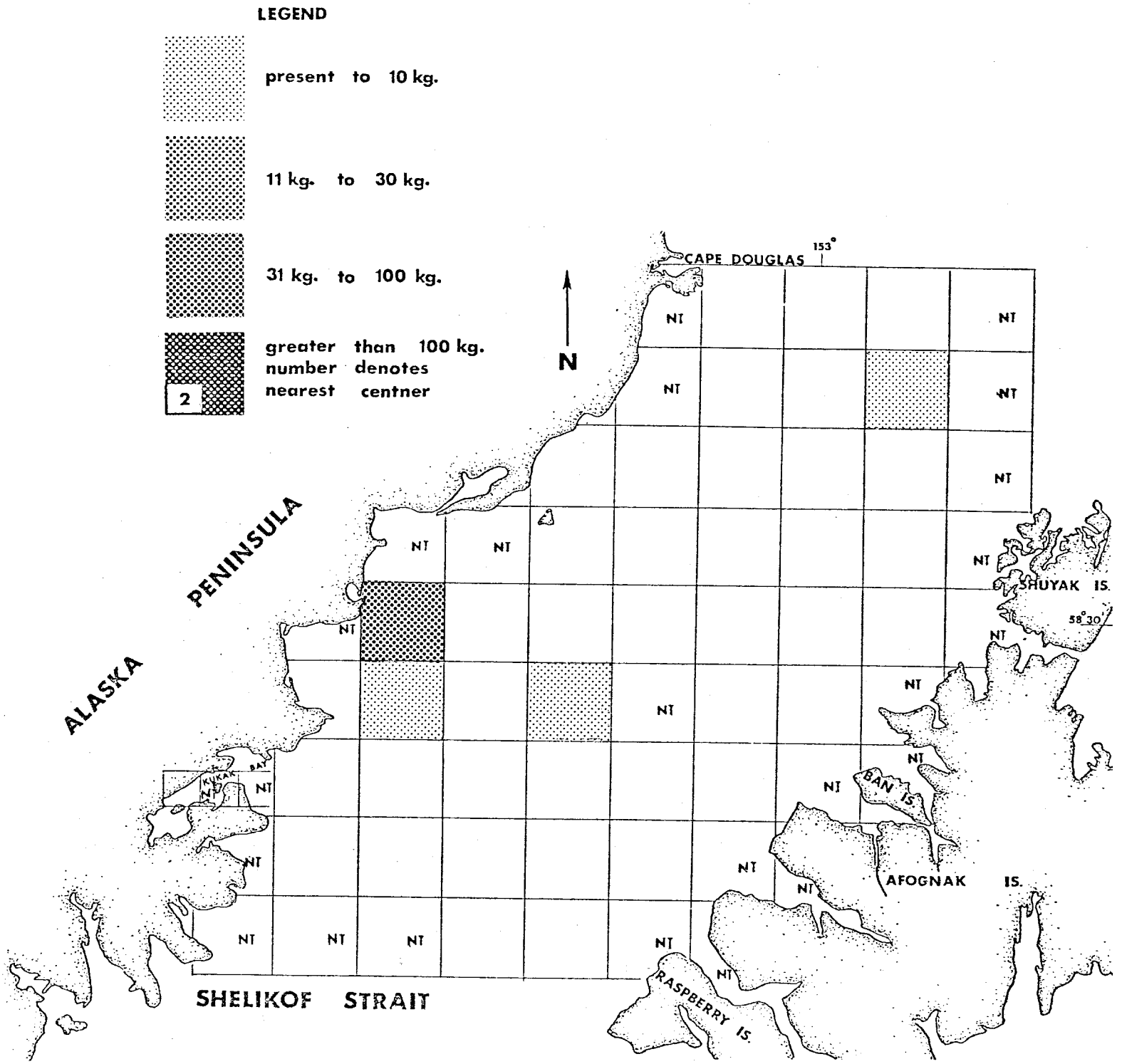
Appendix Figure 37. Distribution of sea pen in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



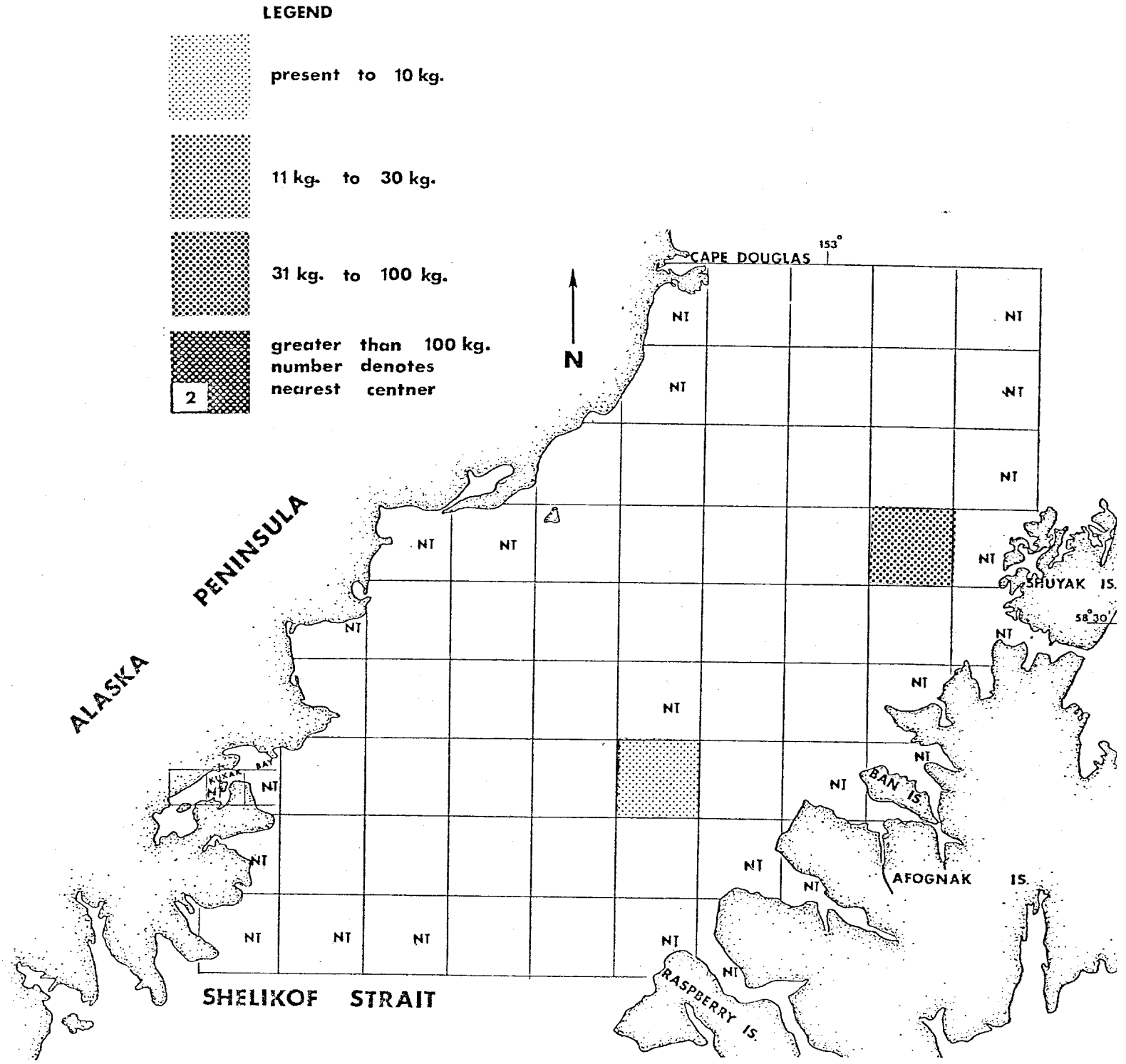
Appendix Figure 38. Distribution of sturgeon poacher in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



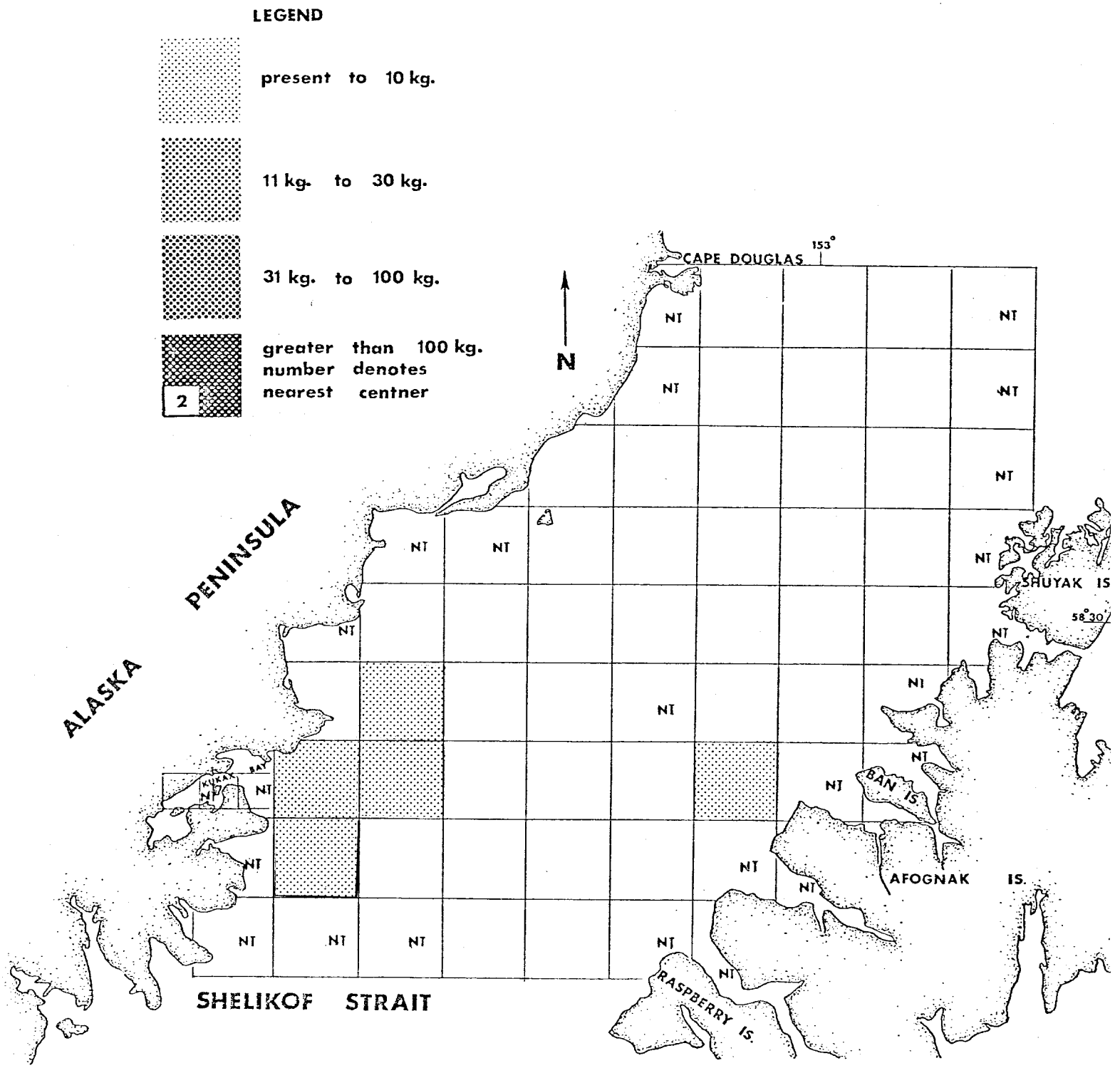
Appendix Figure 39. Distribution of bigmouth sculpin in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



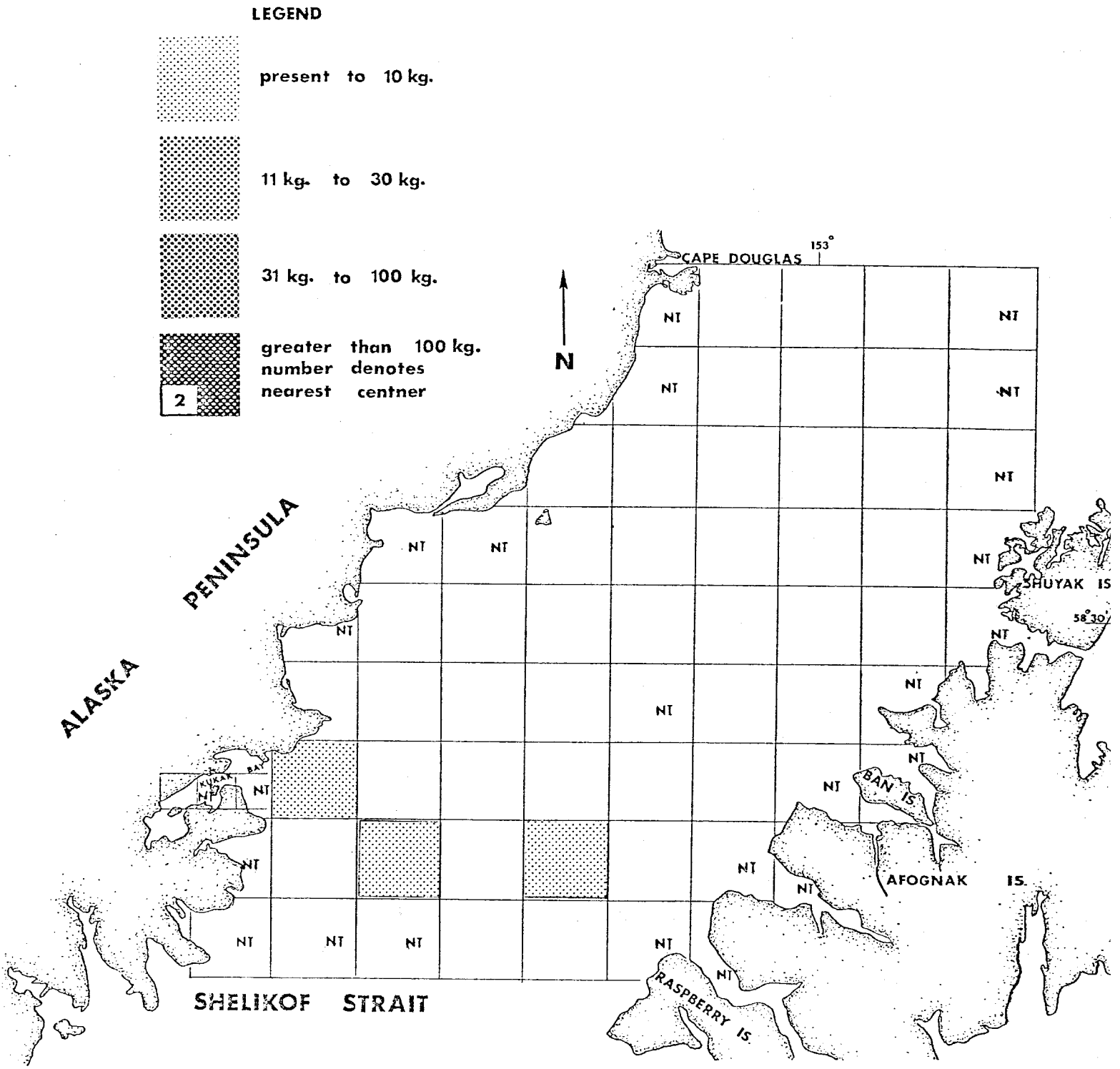
Appendix Figure 40. Distribution of scallops in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



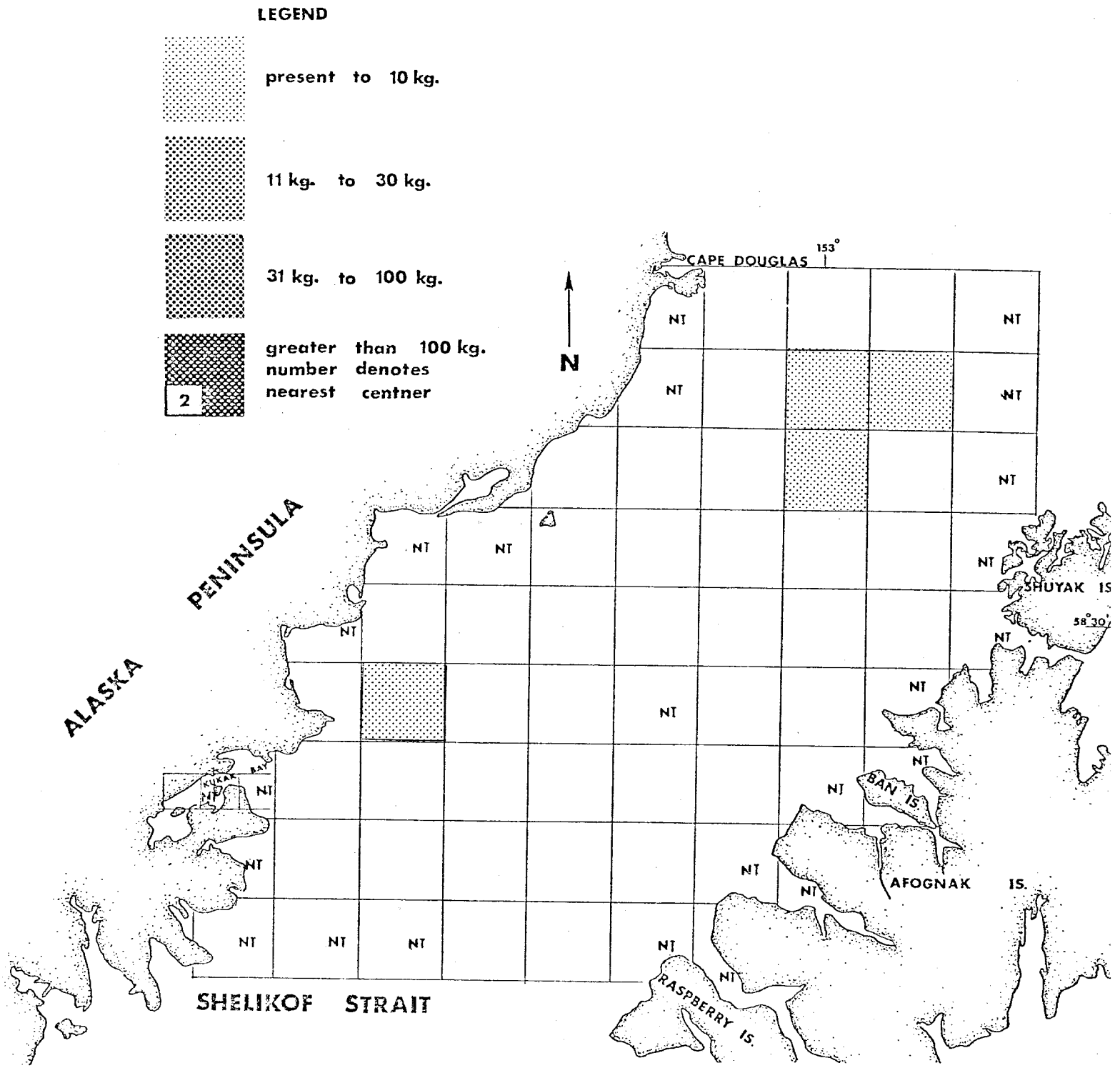
Appendix Figure 41. Distribution of female golden king crab in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



Appendix Figure 42. Distribution of squid (unident.) in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



Appendix Figure 43. Distribution of atka mackeral in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.



Appendix Figure 44. Distribution of sea cucumber in kg/hr taken by trawl in Shelikof Strait during the summer of 1980. Number denotes nearest centner, which is 100 kg. NT indicates that area was not trawled.

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