

ADF&G TECHNICAL DATA REPORT NO. 82  
(Limited Distribution)

STATE OF ALASKA  
Bill Sheffield, Governor

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**BOTTOMFISH CATCH AND TRAWL DATA FROM AN OTTER TRAWL SURVEY  
IN NORTHERN SHELIKOF STRAIT, CHIGNIK AREA, AND CHINIYAK  
GULLY, ALASKA, JULY AND AUGUST 1981**

By:

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and  
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January 1983

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ALASKA DEPARTMENT OF FISH AND GAME  
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Don Collinsworth  
Acting Commissioner

## ADF&G TECHNICAL DATA REPORTS

This series of reports is designed to facilitate prompt reporting of data from studies conducted by the Alaska Department of Fish and Game, especially studies which may be of direct and immediate interest to scientists of other agencies.

The primary purpose of these reports is presentation of data. Description of programs and data collection methods is included only to the extent required for interpretation of the data. Analysis is generally limited to that necessary for clarification of data collection methods and interpretation of the basic data. No attempt is made in these reports to present analysis of the data relative to its ultimate or intended use.

Data presented in these reports is intended to be final, however, some revisions may occasionally be necessary. Minor revisions will be made via errata sheets. Major revisions will be made in the form of revised reports.

BOTTOMFISH CATCH AND TRAWL DATA FROM AN OTTER TRAWL SURVEY IN  
NORTHERN SHELIKOF STRAIT, CHIGNIK AREA, AND CHINIAC GULLY, ALASKA  
JULY AND AUGUST 1981

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January 1983

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## ABSTRACT

During July and August of 1981 an otter trawl survey was successfully conducted in three areas, northern Shelikof Strait, Chignik, and in Chiniak gully. The primary objective was to evaluate use of trawls in assessing commercial Tanner crab populations (*Chionoecetes bairdi*) and recruitment trends. Secondary objectives, and prime concern of this report, were to determine the abundance, distribution, and size-age-sex composition of bottomfish stocks in the study areas.

Average depth, cod end weight, and species composition was recorded and bottom temperatures were attempted for each of the 93 trawls successfully completed. Pacific cod (*Gadus macrocephalus*) was the principal species of investigation, but length-weight relationships were also determined for other species. Incidence of parasitic skin lesions on Pacific cod was calculated.

Total catch rates were 2,147 kg/hr offshore of Chignik, 1,817 kg/hr in Chiniak gully, 1,291 kg/hr in Shelikof Strait, and 1,242 kg/hr in Chignik and Kujulik Bays. Principal species caught were pollock (*Theragra chalcogramma*), flathead sole (*Hippoglossoides elassodon*), arrowtooth flounder (*Atheresthes stomias*), and Pacific cod. Tables and figures are presented that illustrate distribution taxa caught in each study area.

## INTRODUCTION

During the summer of 1981 (23 July - 22 August) otter trawl surveys were completed by the Alaska Department of Fish and Game (ADF&G) in northern Shelikof Strait, Chignik area, and Chiniak gully, Alaska. The primary objective was to test the feasibility, reproducibility, and cost effectiveness of using an otter trawl survey to estimate commercial Tanner crab (*Chionoecetes bairdi*) populations and recruitment trends. Survey areas were chosen on Tanner crab fishery grounds where prior assessment work has been minimal or lacking, or in areas where simultaneous trawl and pot survey results could be compared. The secondary objective, and prime concern of this report, was to determine the distribution, abundance, and composition of bottomfish stocks in the study areas. Pacific cod (*Gadus macrocephalus*) was the principal species investigated because of increasing commercial interest.

Starting in 1948 exploratory and resource assessment cruises have been conducted to locate and assess commercially important fish and shellfish species in various areas throughout the Gulf of Alaska by the Bureau of Commercial Fisheries (BCF), its successor the National Marine Fisheries Service (NMFS), and the International Pacific Halibut Commission (IPHC). These cruises 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). In 1980 a survey was conducted by the ADF&G to assess Tanner crab populations and secondarily to assess distribution, abundance, and other biological information of bottomfish stocks in northern Shelikof Strait (Owen and Blackburn 1981).

## METHODS AND MATERIALS

The R/V ALASKA [30 m (98 ft)] towed a 400 mesh eastern otter trawl net similar to that used previously by the IPHC in 1961-62, the NMFS in 1973-76, and the ADF&G in 1980 during surveys trawled in the Gulf of Alaska. The net had a 21 m (70 ft) long headrope with 18 floats 20 cm (8 in) in diameter. The footrope was 29 m (95 ft) long without roller gear or ticklers. The two dandylines were 46 m (25 fm) long with an 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 were of Astoria "V" type weighing 340 kg (750 lb) apiece and measured 1.5 m x 2.1 m (4.9 ft x 6.9 ft). The triangular flounder plates were made of 16 mm (5/8 in) steel and had a base of 23 cm (9 in) and a height of 28 cm (11 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 liner. The net was designed to sweep a 12 m (40 ft) path.

The sample areas were in northern Shelikof Strait (Figure 1), offshore of the Alaska Peninsula near Chignik Bay (Figure 2), in Chignik and Kujulik Bays

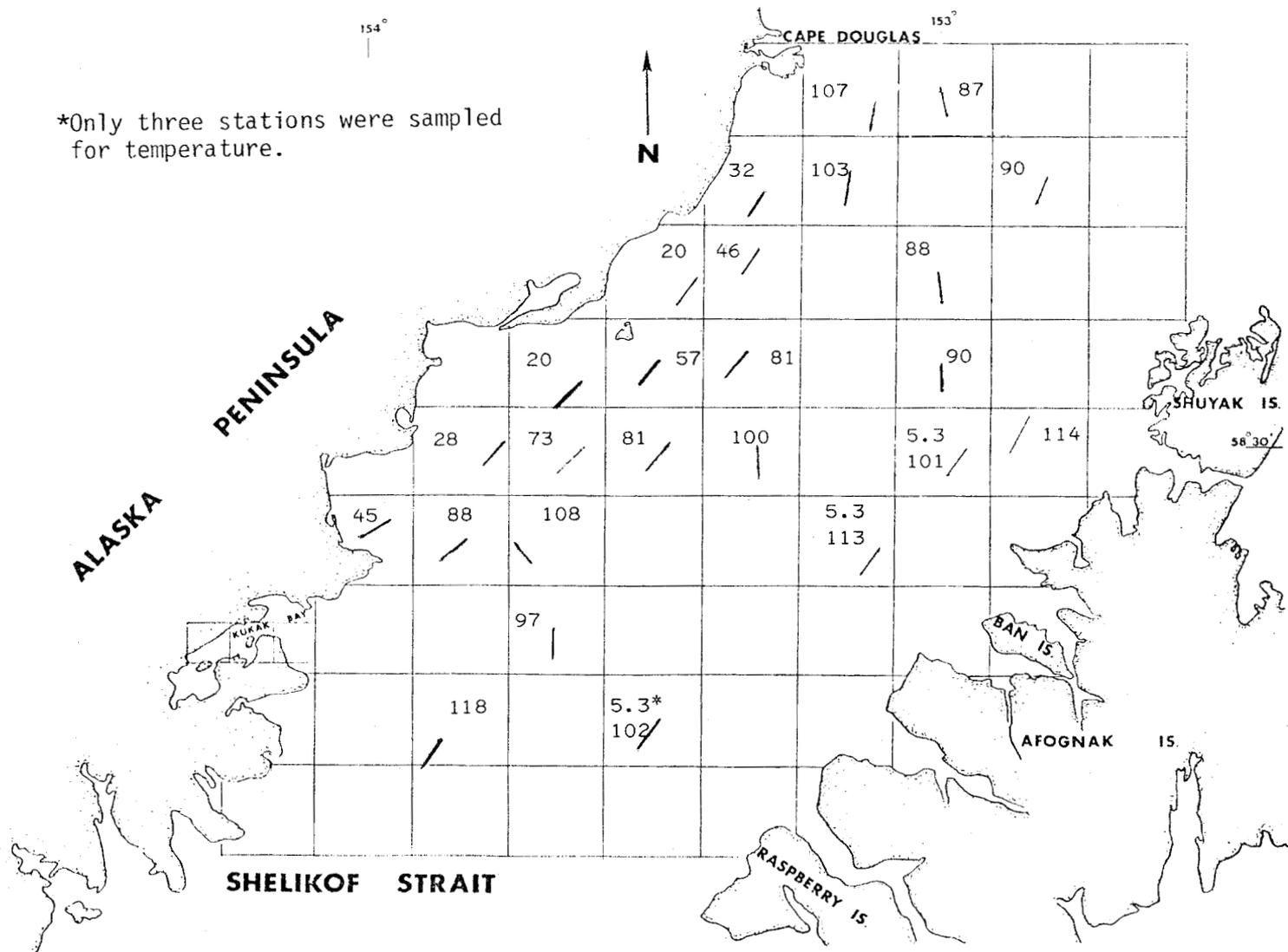


Figure 1. Position, length, direction, depth (in fathoms), and bottom temperature (decimal numbers in degrees celsius) for each trawl in northern Shelikof Strait during the summer of 1981. Blank grids were not trawled.

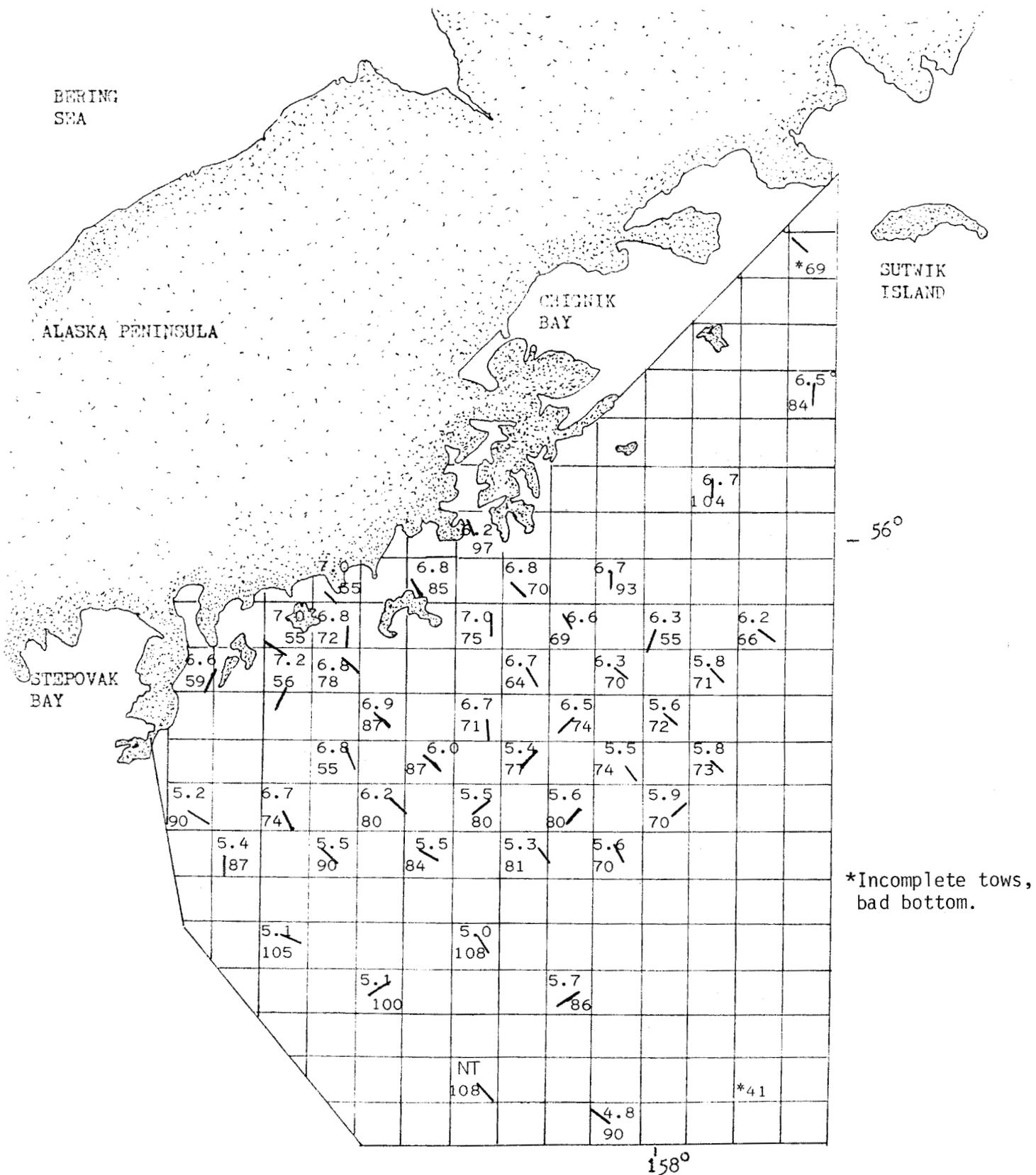


Figure 2. Position, length, direction, depth (in fathoms) and bottom temperature (decimal numbers in degrees celsius) for each trawl in the offshore portion of the Chignik area during the summer of 1981.

(Figure 3), near the Semidi Islands<sup>1</sup>, and in Chiniak gully (Figure 4). A stratified, systematic sampling design was used. Ocean stations were divided into 25 square nautical mile grids and bay stations into 6 nmi<sup>2</sup> grids. Where possible, trawls were attempted near the midpoint of selected squares for 30 minutes at 3 knots. All catch rates were standardized to 1 hour. For each trawl, average depth in fathoms and temperature to the nearest 0.1 degree Celsius was recorded<sup>2</sup>. Some stations within each study area were forfeited because of a lack of time.

After each tow was brought on board, the cod end was weighed, released into bins, and then sorted. The large or commercially important species, e.g., cod, sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes sp.*), halibut (*Hippoglossus stenolepis*), skates (*Raja sp.*), wrymouth (*Delolepis gigantea*), were separated from the haul and the rest of the catch was subsampled. Organisms were identified to species and weighed to the nearest 0.1 kilogram, and when measured, to the nearest centimeter. Fork lengths were used for all fish species except skates which were measured from the snout to the anterior notch of the pelvic fin.

Otoliths and backbones were collected for aging purposes. Ten otoliths were collected for each centimeter size grouping for Pacific cod in Shelikof Strait and offshore of the Alaskan Peninsula. All cod measured were examined for parasitic skin lesions. Otoliths were collected randomly from roughey rockfish (*S. aleutianus*), Pacific ocean perch (*S. alutus*), and dusky rockfish (*S. ciliatus*). Backbones were collected randomly from big skate (*R. binoculata*) and longnose skate (*R. rhina*).

## RESULTS AND DISCUSSION

A total of 93 trawls was successfully completed: 25 tows were completed in northern Shelikof Strait, 55 in the Chignik area, 3 in the Semidi Island<sup>3</sup> area and 10 in the Chiniak gully (Figures 1-4). Tables 1 and 2 list the common and scientific names of all marine life found in the trawl and Tables 3-7 list the catch by depth and survey area for all taxa caught.

Average total catches were 2,147 kg/hr along the Alaska Peninsula offshore of Chignik Bay 1,817 kg/hr in Chiniak gully, 1,291 kg/hr in Shelikof Strait, and 1,242 kg/hr in Chignik and Kujulik Bays. Distribution and depth patterns for the total catches were not apparent within each study area (Figures 5-8, Tables 3-7).

Depth and distribution patterns are apparent between and within each study area for some of the taxa (Tables 3-7, Appendix Figures 1-40). Principal species caught during the survey were pollock (*Theragra chalcogramma*), flat-head sole (*Hippoglossoides elassodon*), arrowtooth flounder (*Atheresthes stomias*),

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<sup>1</sup> Map was not shown because only three tows were made in this area.

<sup>2</sup> Technical difficulties prevented temperatures from being recorded for each trawl.

<sup>3</sup> Bad bottom conditions prevented more sampling to be completed in this area.

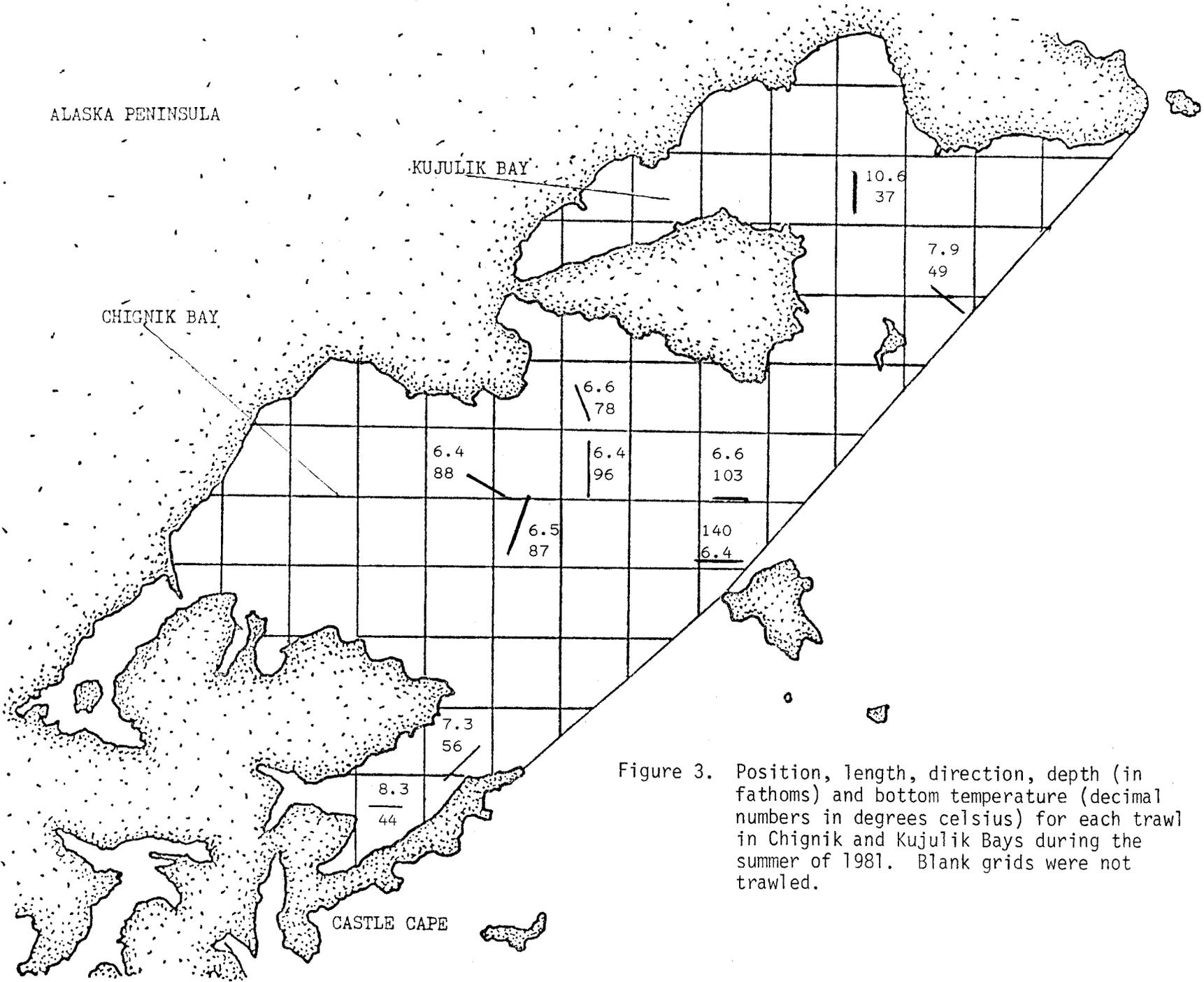


Figure 3. Position, length, direction, depth (in fathoms) and bottom temperature (decimal numbers in degrees celsius) for each trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

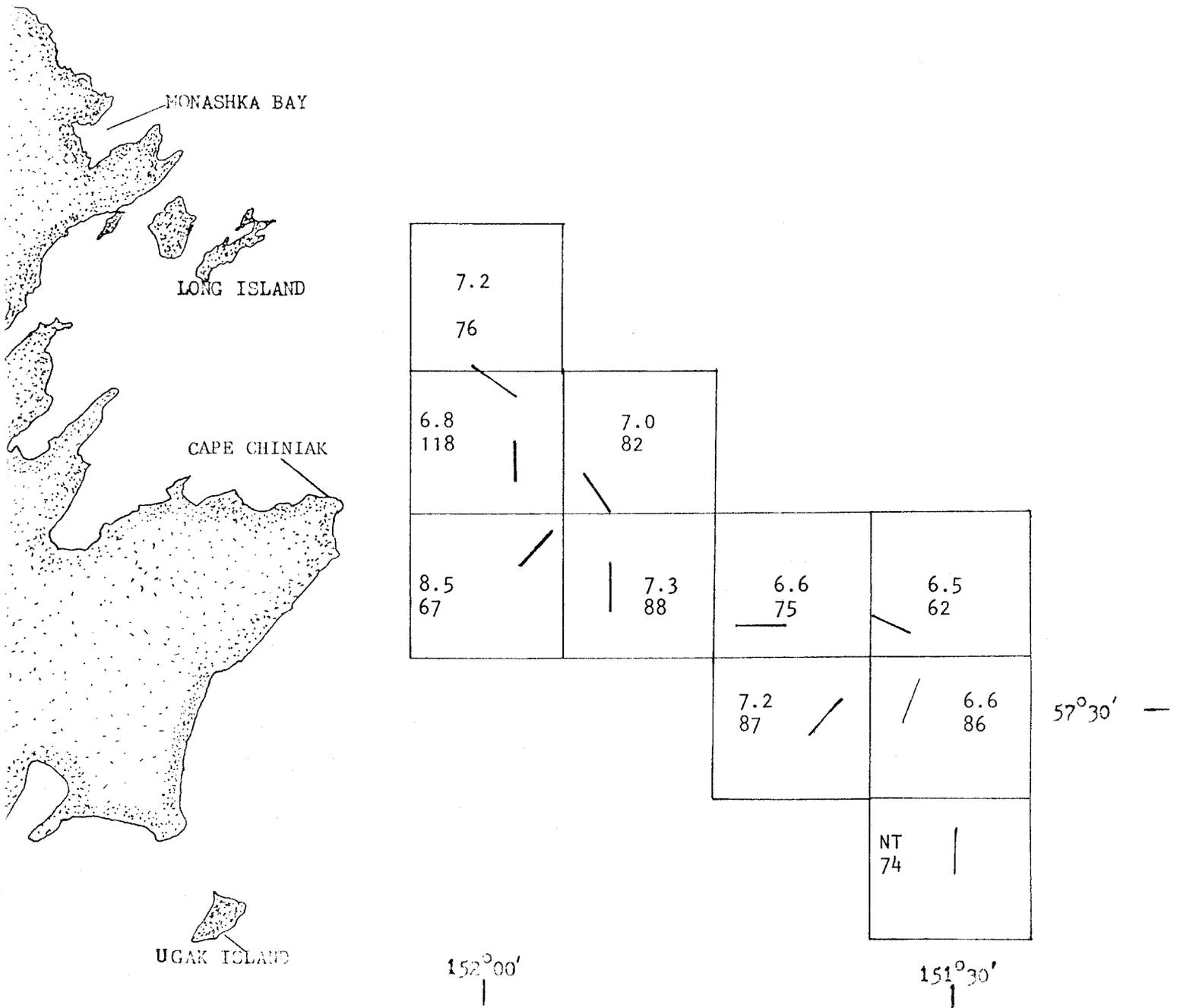


Figure 4. Position, length, direction, depth (in fathoms) and bottom temperature (decimal number in degrees celsius) for each trawl in Chiniak gully during the summer of 1981. NT means Not Taken.

Table 1. Invertebrate classification and species caught by otter trawl in northern Shelikof Strait, along the Alaska Peninsula offshore of Chignik Bay, near the Semidi Islands, in Chignik and Kujulik Bays and in Chiniak gully during the summer of 1981.

Scientific name	Common Name
Phylum Porifera	Sponges
Phylum Cnidaria	
Class Hydrozoa/Scyphozoa	Jelly fishes
Class Anthozoa	Sea anemone
Family Pennatulaceae	Sea pen
Phylum Mollusca	
Class Pelecypoda	Clams
Family Pectinidae	Scallops
<i>Chlamys</i> spp	
<i>Pecten</i> spp	
Class Gastropoda	
Subclass Prosobranchia	Snails
Family Cymatiidae	
<i>Fusitriton oregonensis</i>	Oregon triton
Family Buccinidae	
<i>Beringius kennicottii</i>	Kennicott's buccinum
<i>Neptunea lyrata</i>	Northwest neptune
<i>Neptunea pribiloffensis</i>	Pribilof neptune
<i>Pyrolofuses harpa</i>	Left-handed buccinum
Family Volutidae	
<i>Arctomelon stearnsii</i>	Stearns' volute
Subclass Opisthobranchia	
Order Nudibranchia	Sea slug
Class Cephalopoda	
Family unknown	Squid
Family Octopodidae	
<i>Octopus dofleini</i>	Octopus
Phylum Arthropoda	
Class Crustacea	
Order Decapoda	
Family unknown	Shrimp
Family Pandalidae	
<i>Pandalus borealis</i>	Pink shrimp
<i>Pandalus platyceros</i>	Spot shrimp
<i>Pandalus goniurus</i>	Humpy shrimp
<i>Pandalopsis dispar</i>	Sidestripe shrimp
Family Hippolytidae	Hypolytid shrimp
Family Crangonidae	Rock shrimp
Family Paguridae	Hermit crab
Family Lithodidae	
<i>Paralithodes camtschatica</i>	Red king crab
<i>Lithodes aequispina</i>	Golden king crab

-Continued-

Table 1. Invertebrate classification and species caught by otter trawl in northern Shelikof Strait, along the Alaska Peninsula offshore of Chignik Bay, near the Semidi Islands, in Chignik and Kujulik Bays and in Chiniak gully during the summer of 1981 (continued).

Scientific Name	Common Name
Family Majidae	
<i>Hyas lyrata</i>	Lyre crab
<i>Chionoecetes bairdi</i>	Tanner crab
Family Canceridae	
<i>Cancer magister</i>	Dungeness crab
Phylum Brachiopoda	Lamp shells
Phylum Echinodermata	Starfish
Class Asteroidea	
Family Porcellanasteridae	
<i>Ctenodiscus crispatus</i>	Mud starfish
Family Goniasteridae	
<i>Pseudarchaster parelii alascensis</i>	Red mud starfish
Class Ophiuroidea	Brittle starfish
Family Gorgonocephalidae	
<i>Gorgonocephalus caryi</i>	Basket starfish
Class Echinoidea	Sea urchins
Class Holothuroidea	Sea cucumbers

Table 2. Fish families and species caught by otter trawl in northern Shelikof Strait, along the Alaska Peninsula offshore of Chignik Bay, near the Semidi Islands, in Chignik and Kujulik Bays, and in Chiniak gully during the summer of 1981.

Scientific Name	Common Name
<i>Squalidae</i>	
<i>Squalus acanthias</i>	Spiny dogfish shark
<i>Rajidae</i>	Skates
<i>Raja binoculata</i>	Big skate
<i>Raja rhina</i>	Longnose skate
<i>Clupeidae</i>	
<i>Clupea harengus pallasii</i>	Pacific herring
<i>Salmonidae</i>	
<i>Oncorhynchus keta</i>	Chum (dog) salmon
<i>Osmeridae</i>	
<i>Mallotus villosus</i>	Capelin
<i>Thaleichthys pacificus</i>	Eulachon
<i>Gadidae</i>	
<i>Gadus macrocephalus</i>	Pacific cod
<i>Microgadus proximus</i>	Pacific tomcod
<i>Theragra chalcogramma</i>	Walleye pollock
<i>Zoarcidae</i>	
<i>Lycodes</i> spp	Eelpouts
<i>Trichodontidae</i>	
<i>Trichodon trichodon</i>	Pacific sandfish
<i>Bathymasteridae</i>	
<i>Bathymaster signatus</i>	Searcher
<i>Stichaeidae</i>	
<i>Lumpenella longirostris</i>	Longsnout prickleback
<i>Lumpenus maculatus</i>	Daubed shanny
<i>Lumpenus sagitta</i>	Snake prickleback
<i>Cryptacanthodidae</i>	
<i>Delolepis gigantea</i>	Giant wrymouth
<i>Zaproridae</i>	
<i>Zaprora silenus</i>	Prowfish

-Continued-

Table 2. Fish families and species caught by otter trawl in northern Shelikof Strait, along the Alaska Peninsula offshore of Chignik Bay, near the Semidi Islands, in Chignik and Kujulik Bays, and in Chiniak gully during the summer of 1981 (continued).

Scientific Name	Common Name
<i>Scorpaenidae</i>	Rockfish
<i>Sebastes aleutianus</i>	Rougeye rockfish
<i>Sebastes alutus</i>	Pacific ocean perch
<i>Sebastes babcocki</i>	Redbanded rockfish
<i>Sebastes ciliatus</i>	Dusky rockfish
<i>Sebastes polyspinis</i>	Northern rockfish
<i>Sebastes zacentrus</i>	Sharpchin rockfish
<i>Anoplopomatidae</i>	
<i>Anoplopoma fimbria</i>	Sablefish
<i>Hexagrammidae</i>	
<i>Hexagrammos stelleri</i>	Whitespotted greenling
<i>Pluerogrammus monoptygius</i>	Atka mackeral
<i>Cottidae</i>	Sculpins
<i>Dasycottus setiger</i>	Spinyhead sculpin
<i>Gymnocanthus galeatus</i>	Armorhead sculpin
<i>Gymnocanthus spp</i>	
<i>Hemilepidotus jordani</i>	Yellow Irish Lord
<i>Hemitripterus bolini</i>	Bigmouth sculpin
<i>Myoxocephalus spp</i>	Great sculpin
<i>Malloccottus kincaidi</i>	Blackfin sculpin
<i>Triglops forficata</i>	Scissortail sculpin
<i>Triglops pingeli</i>	Ribbed sculpin
<i>Agonidae</i>	Poacher
<i>Agonopsis emmelane</i>	Northern spearnose poacher
<i>Agonus acipenserinus</i>	Sturgeon poacher
<i>Ocella verrucosa</i>	Warty poacher
<i>Cyclopteridae</i>	Snailfishes
<i>Aptocyclus ventricosus</i>	Smooth Lumpsucker
<i>Plueronectidae</i>	
<i>Atheresthes stomias</i>	Arrowtooth flounder
<i>Glytocephalus zachirus</i>	Rex sole
<i>Hippoglossoides elassodon</i>	Flathead sole
<i>Hippoglossus stenolepis</i>	Pacific halibut
<i>Isopsetta isolepis</i>	Butter sole
<i>Lepidopsetta bilineata</i>	Rock sole
<i>Limanda aspera</i>	Yellowfin sole
<i>Micostomus pacificus</i>	Dover sole
<i>Parophrys vetulus</i>	English sole

-Continued-

Table 2. Fish families and species caught by otter trawl in northern Shelikof Strait, along the Alaska Peninsula offshore of Chignik Bay, near the Semidi Islands, in Chignik and Kujulik Bays, and in Chiniak gully during the summer of 1981 (continued).

Scientific Name	Common Name
<i>Platichthys stellatus</i>	Starry flounder
<i>Pleuronectes quadrituberculatus</i>	Alaska plaice

Table 3. Catch in kg/hr by species and depth for the entire catch taken by otter trawl in northern Shelikof Strait during the summer of 1981.

Common Name	Rank	Mean	Depth as the Center of (Ten Fathom) Intervals										
			M FM	27 15	46 25	64 35	82 45	101 55	137 75	155 85	174 95	192 105	210 115
Walleye pollock	1	236	.9	15	65	175	296	402	522	37	115	117	
Flathead sole	2	205	.2	317	753	1188	161	114	61	83	112	77	
Arrowtooth flounder	3	132	40	98	105	121	116	183	177	83	133	130	
Pacific cod	4	127	7	96	51	205	133	206	193	46	90	110	
Big skate	5	93	265	108	462	466	245	39	0	0	0	0	
Pacific halibut	6	88	100	183	58	205	65	185	65	22	108	27	
Tanner crab (male)	7	81	3	34	3	205	158	186	82	29	111	14	
Yellowfin sole	8	44	407	146	129	3	0	0	.1	0	0	0	
Sablefish	9	35	2	0	1	10	0	3	38	46	64	60	
Tanner crab (female)	10	32	2	0	4	15	75	62	35	11	71	7	
Sponge	11	29	0	0	0	0	0	0	100	0	0	0	
Basket starfish	12	24	0	0	0	0	0	0	74	1	12	.6	
Great sculpin	13	21	8	67	39	0	0	361	5	0	.8	0	
Alaska plaice	14	18	49	0	22	40	116	0	11	1	0	0	
Dungeness crab	15	12	15	101	33	51	30	3	0	0	0	0	
Sea urchin	16	11	1	0	0	0	0	0	36	0	1	0	
Rock sole	17	9	62	13	43	12	4	0	.3	0	2	0	
Eelpout	18	7	0	0	1	9	19	7	12	4	8	2	
Pink shrimp	19	7	0	0	0	38	2	6	8	4	2	.4	
Red king crab (male)	20	7	0	0	0	44	0	8	2	0	7	5	
Starry flounder	21	5	55	14	0	0	0	0	0	0	0	0	
Giant wrymouth	22	4	0	0	0	4	0	0	2	6	3	19	
Eulachon	23	4	T	0	0	0	0	8	11	.4	1	2	
Skate	24	4	0	0	0	0	0	7	4	3	8	4	
Bigmouth sculpin	25	4	0	0	0	0	0	0	0	8	4	17	
Hermit crab	26	3	4	3	0	1	2	4	3	.9	6	3	
Rougheye rockfish	27	3	0	0	0	0	0	0	1	4	3	14	
Sea anemone	27	3	7	0	0	T	0	0	7	T	2	.2	
Starfish	29	2	.9	0	0	13	12	0	2	0	T	0	
Dover sole	30	2	.9	0	0	0	0	0	4	3	.6	.9	
Longnose skate	31	2	0	0	0	11	0	0	2	0	0	0	
Northwest neptune	32	1	0	0	3	0	0	T	1	T	5	0	
Oregon triton	33	1	1	0	1	T	1	T	.7	.2	4	1	
Sea cucumber	33	1	0	0	4	0	0	3	2	0	1	0	
Dusky rockfish	35	1	0	0	0	0	0	0	0	0	6	0	
Red king crab (female)	36	.8	0	0	0	10	0	0	0	0	0	0	
Spinyhead sculpin	37	.5	0	0	0	0	0	3	.3	0	1	.9	
Sea pen	37	.5	1	8	T	T	0	T	T	T	0	.5	
Kennicott's buccinum	39	.4	0	0	0	0	0	0	1	.2	.7	0	
Yellow Irish lord	39	.4	0	0	0	0	0	0	.8	0	.7	0	
Poacher	41	.3	0	0	0	0	0	0	1	T	0	0	
Spiny dogfish shark	41	.3	0	8	0	0	0	0	0	0	0	0	
Sculpin	41	.3	3	0	0	0	0	0	0	0	0	0	
Pacific ocean perch	44	.2	0	0	0	0	0	0	.4	0	.7	0	
Searcher	44	.2	3	T	0	0	0	0	0	0	.1	0	
Mud starfish	44	.2	0	0	0	0	0	0	0	T	.5	1	
Stearns' volute	44	.2	0	0	0	0	0	0	.5	0	T	.2	
Red mud starfish*	44	.2	0	0	0	0	0	0	.2	0	.4	.4	
Longsnout prickleback	44	.2	0	0	0	0	0	0	0	0	.3	.9	
Snailfish	44	.2	0	0	0	0	0	0	0	T	1	0	
Smooth lumpsucker	44	.2	0	0	0	0	0	0	0	0	1	0	
Whitespotted greenling	44	.2	.7	3	0	0	0	0	0	0	0	0	
Golden king crab	44	.2	0	0	0	0	0	0	0	0	0	1	
Clams	44	.2	0	0	0	0	0	0	.5	0	T	0	
Sidestripe shrimp	44	.2	0	0	0	0	0	0	T	T	.6	.4	
Lyre crab	56	.1	.6	0	0	0	0	0	.2	0	.1	.2	
Squid	56	.1	0	0	0	0	0	0	0	T	.4	0	
Scallop	56	.1	1	0	0	0	0	0	0	0	T	0	
Pacific herring	56	.1	0	0	1	0	0	0	0	0	.1	0	
Blackfin sculpin	56	.1	0	0	0	0	0	0	0	0	T	.7	
Sea slug	56	.1	T	0	0	0	0	0	.3	T	0	0	
Rock shrimp	62	T	0	0	0	0	0	0	.2	0	T	0	
Skate egg case	62	T	0	0	0	0	0	0	T	0	T	.2	
Armorhead sculpin	62	T	0	0	0	0	0	0	0	0	.1	0	
Snail	62	T	T	0	0	0	0	0	0	T	.1	0	
Shrimp	62	T	0	0	0	0	0	0	T	0	T	0	
Pacific sandfish	62	T	0	T	0	0	0	0	0	0	0	0	
Redbanded rockfish	62	T	0	0	0	0	0	0	0	0	0	.1	
Ribbed sculpin	62	T	T	0	T	0	0	0	0	0	0	0	
Capelin	62	T	T	0	0	0	0	0	0	0	0	0	
Snake prickleback	62	T	.2	0	0	0	0	0	0	0	0	0	
Pribilof neptune	62	T	0	0	0	0	0	0	0	0	.1	0	
Warty poacher	62	T	0	0	0	0	0	0	0	0	T	0	
TOWS		25	2	1	1	2	1	1	7	2	5	3	
Total kg/hr		1291	1047	1230	1814	2839	1452	1842	1528	401	920	621	

Table 4. Catch in kg/hr by species and depth for the entire catch taken by otter trawl offshore of the Alaska Peninsula near Chignik Bay during the summer of 1981.

Common Name	Rank	Mean	Depth as the center of (Ten Fathoms) Intervals					
			M EM	101 55	119 65	137 75	155 85	174 95
Walleye pollock	1	719	451	283	921	750	1890	313
Arrowtooth flounder	2	358	134	208	407	383	337	745
Flathead sole	3	333	629	162	394	260	228	268
Pacific cod	4	297	353	472	226	141	248	638
Sablefish	5	76	26	28	65	46	34	386
Pacific halibut	6	66	41	59	89	65	13	81
Tanner crab (male)	7	41	177	16	16	21	19	41
Great Sculpin	8	21	14	11	29	14	7	55
Yellow Irish lord	9	20	50	5	22	5	53	13
Searcher	10	17	42	1	14	26	2	0
Flpout	11	15	6	7	22	25	3	3
Rock sole	12	15	63	29	6	.5	0	0
Eulachon	13	14	19	.1	23	3	.1	41
Pacific ocean perch	14	13	.1	.6	4	2	124	0
Mud starfish	15	10	0	.6	4	14	0	61
Basket starfish	16	8	10	4	0	20	10	7
Bigmouth sculpin	17	8	.1	T	4	13	50	0
Starfish	18	7	7	8	9	2	27	2
Sea anemone	19	6	.3	3	7	2	0	37
Rex sole	20	6	.8	7	4	13	0	0
Hermit crab	21	5	6	8	3	5	3	4
Oregon triton	22	5	1	6	4	7	2	8
Rougheye rockfish	23	4	1	0	10	5	0	.2
Dusky rockfish	24	4	6	7	.7	.5	1	18
Spinyhead sculpin	25	4	17	.5	1	2	3	T
Skate	26	3	0	2	1	2	15	15
Tanner crab (female)	27	3	10	1	.7	4	4	5
Northwest neptune	28	3	T	10	1	3	3	5
Dover sole	28	3	0	0	0	6	15	4
Big skate	30	2	10	0	2	2	0	0
Yellowfin sole	31	2	12	.9	0	0	.7	0
Pink shrimp	31	2	.2	3	T	4	.4	5
Sea urchin	33	1	1	T	.5	3	T	2
Northern rockfish	34	1	3	.4	.7	1	0	.9
Giant wrymouth	35	.8	0	0	0	0	0	9
Chum (dog) salmon	36	.7	0	4	.4	0	0	0
Scissortail sculpin	37	.6	.3	.4	0	0	0	0
Dungeness crab	37	.6	4	0	0	0	0	0
Stearns' volute	37	.6	.3	0	0	1	0	3
Sponge	40	.5	0	0	2	0	0	0
Longsnout prickleback	40	.5	T	0	0	.4	.4	2
Sculpin	42	.4	.7	.7	.1	.5	0	0
King crab (male)	43	.3	2	0	0	0	0	0
Spiny dogfish	44	.2	.5	.9	0	0	0	0
Alaska plaice	44	.2	0	0	.7	0	0	0
Kennicott's buccinum	44	.2	T	0	.6	.1	0	0
Sea slug	44	.2	T	.8	.1	.1	0	0
Lyre crab	48	.1	.4	.2	T	T	T	.6
Scallop	48	.1	.1	.5	0	0	0	.2
Left-handed buccinum	48	.1	0	0	0	0	0	2
English sole	48	.1	0	0	.3	0	0	0
Snailfish	48	.1	0	0	0	.3	0	0
Sea cucumber	48	.1	.4	0	0	0	0	.3
Blackfin sculpin	48	.1	0	0	.2	0	0	0
King crab (female)	48	.1	0	0	0	.2	0	0
Sea pen	56	T	0	.3	T	0	0	0
Snail	56	T	T	T	T	T	.6	0
Red mud starfish	56	T	0	0	0	T	0	.6
Spot shrimp	59	T	0	0	0	.1	0	0
Longnose skate	59	T	0	T	0	0	.4	0
Pacific herring	59	T	0	0	0	.1	0	0
Sidestripe shrimp	59	T	0	0	0	0	.1	T
Rock shrimp	59	T	0	0	T	T	T	0
Atka mackerel	59	T	0	0	0	0	0	0
Prowfish	59	T	0	0	0	0	.1	0
Rockfish	59	T	0	0	0	.1	0	0
Sturgeon poacher	59	T	0	0	0	0	0	0
Spearnose poacher	59	T	T	0	T	T	T	0
Capelin	59	T	0	0	0	T	0	0
Brittle starfish	59	T	0	0	0	0	0	0
Brachlopods	59	T	0	0	0	T	0	0
Number of tows		45	6	7	14	11	3	4
Total kg/hr		2155	2188	1369	2323	1952	3001	2959

Table 5. Catch in kg/hr by species and depth for the entire catch taken by otter trawl near the Semidi Islands during the summer of 1981.

Common Name	Rank	Mean	Actual Depth			
			M FM	201 110	206 113	225 123
Walleye pollock	1	720		2149	143	12
Pacific cod	2	476		1320	178	5
Arrowtooth flounder	3	311		23	634	195
Flathead sole	4	101		191	66	54
Pacific halibut	5	45		50	64	15
Sablefish	6	43		0	76	44
Great sculpin	7	26		86	0	0
Bigmouth sculpin	8	23		0	53	9
Tanner crab (male)	9	23		19	31	16
Yellow Irish lord	10	16		52	0	0
Rock sole	11	10		34	0	0
Rougheye rockfish	12	8		0	14	7
Dover sole	13	7		0	19	0
Northwest neptune	14	3		0	7	.7
Pacific ocean perch	14	3		0	8	0
Sidestripe shrimp	16	3		T	6	1
Basket starfish	17	2		0	6	0
Starfish	18	2		0	5	0
Pribilof neptune	18	2		0	5	0
Eulachon	20	2		0	4	0
Spinyhead sculpin	21	1		5	0	0
Eelpout	21	1		0	2	2
Tanner crab (female)	21	1		T	2	2
Left-handed buccinum	24	1		0	2	.5
Oregon triton	25	.8		0	1	1
Skate	26	.7		0	2	0
Pink shrimp	27	.6		T	T	2
Hermit crab	28	.4		0	0	1
Northern rockfish	29	.2		0	.4	0
Kennicott's buccinum	29	.2		0	0	.5
Number of tows		3		1	1	1
Total kg/hr		2024		4535	1342	365

Table 6. Catch in kg/hr by species and depth for the entire catch taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981.

Common Name	Rank	Kg/hr	Depth as the center of 10 fathom Depth Interval								
			M FM	64 35	82 45	101 55	137 75	155 85	174 95	192 105	247 135
Flathead sole	1	378		96	405	781	703	375	163	261	165
Walleye pollock	2	190		11	66	372	135	152	109	640	163
Tanner crab (male)	3	137		7	50	385	407	132	48	35	97
Pacific cod	4	100		181	9	434	16	68	82	75	76
Pacific halibut	5	84		138	150	22	71	13	20	173	103
Great sculpin	6	73		231	111	0	135	38	67	23	12
Arrowtooth flounder	7	43		28	111	45	5	10	4	70	35
Yellowfin sole	8	39		291	62	26	0	0	0	0	0
Eelpout	9	37		11	20	45	145	7	109	6	2
Tanner crab (female)	10	24		5	3	205	4	5	1	.6	2
Yellow Irish Lord	11	24		103	16	0	90	3	14	7	2
Pink shrimp	12	18		32	27	30	40	6	9	5	T
Dungeness crab	13	17		18	23	63	40	0	0	0	0
Longsnout prickleback	14	12		0	0	0	70	.5	23	9	13
Spinyhead sculpin	15	12		9	10	7	55	7	7	0	2
Rock sole	16	9		88	2	0	0	0	7	5	2
Hermit crab	17	7		19	20	15	0	0	0	0	T
Sablefish	18	6		14	3	41	0	1	0	.8	0
Alaska plaice	19	6		0	0	0	60	0	0	0	0
Bigmouth sculpin	20	6		0	2	22	0	4	5	0	15
Pacific herring	21	4		0	20	0	0	0	0	0	0
Octopus	22	4		0	0	0	0	12	10	0	0
Sculpin*	23	3		30	.6	0	0	0	0	0	0
Sea anemone	24	2		0	4	0	0	T	7	0	1
Sea urchin	25	2		T	0	0	15	0	0	0	0
Rock shrimp	26	1		2	T	0	10	T	T	1	T
King crab (female)	27	.9		0	4	0	.4	0	0	0	0
Starfish	28	.8		T	4	0	0	0	0	0	0
Eulachon	29	.8		0	0	T	5	0	2	0	1
Rougheye rockfish	30	.6		0	0	0	0	1	3	0	0
Whitespotted greenling	31	.4		5	0	0	0	0	0	0	0
Pacific tomcod	31	.4		5	0	0	0	0	0	0	0
Butter sole	31	.4		0	2	0	0	0	0	0	0
Smooth lumpsucker	34	.3		0	0	0	0	2	0	0	0
Pacific sandfish	35	.2		0	1	0	0	0	0	0	0
Dusky rockfish	35	.2		0	0	0	0	0	0	0	2
Ribbed sculpin	37	.1		2	0	0	0	0	0	0	0
Dover sole	37	.1		2	0	0	0	0	0	0	0
Humpy shrimp	37	.1		2	0	0	0	0	0	0	0
King crab (male)	40	.1		0	.4	0	.2	0	0	0	0
Scallop	40	.1		0	0	0	0	0	1	0	0
Northern rockfish	42	.1		.5	0	0	0	0	0	0	.2
Redbanded rockfish	43	T		0	0	0	.4	0	0	0	0
Capelin	43	T		0	T	0	0	0	0	0	0
Daubed shanny	43	T		T	0	0	0	0	0	0	0
Oregon triton	43	T		T	0	0	0	0	0	0	0
Rex sole	43	T		0	0	0	0	0	T	0	0
Sidestripe shrimp	43	T		0	0	T	0	0	0	0	T
Snake prickleback	43	T		0	T	0	0	0	0	0	0
Squid	43	T		0	0	0	T	0	0	0	0
Number of tows		10		1	2	1	1	2	1	1	1
Total kg/hr		1242		1328	1124	2493	2004	836	690	1311	693

Table 7. Catch in kg/hr by species and depth for the entire catch taken by otter trawl in Chiniak gully during the summer of 1981.

Common Name	Rank	Mean	Depth as the Center of (Ten Fathom) Intervals				
			M	119	137	155	174
			FM	65	75	85	95
Walleye pollock	1	410		73	496	616	6
Flathead sole	2	347		71	526	372	262
Arrowtooth flounder	3	234		748	218	227	481
Rocksole	4	180		72	305	138	194
Pacific halibut	5	164		97	100	196	369
Pacific cod	6	146		188	97	193	18
Yellow Irish lord	7	73		129	59	74	0
Red king crab (male)	8	62		0	14	121	97
Red king crab (female)	9	59		6	3	47	381
Rex sole	10	22		6	48	15	0
Dover sole	11	15		4	26	15	0
Starry flounder	12	13		64	0	0	0
Great sculpin	13	12		61	0	0	0
Tanner crab (male)	14	9		1	9	2	56
Skate	15	6		0	5	7	19
Big skate	16	6		0	0	14	0
Sea urchins	17	5		25	0	0	0
Butter sole	18	4		20	1	0	0
Sea anemone	19	4		20	0	0	2
Sablefish	20	4		0	4	5	9
Starfish	21	3		10	1	.8	0
Eelpouts	22	3		0	2	5	0
Sturgeon poacher	23	2		4	2	2	1
Octopus	24	2		11	0	0	0
Searcher	25	2		10	0	0	0
Tanner crab (female)	26	2		.7	1	.6	11
Hermit crab	26	2		5	2	0	1
Oregon triton	28	2		6	2	0	0
Kennicott's buccinum	29	1		7	0	0	0
Scallop	30	.8		3	.7	0	0
Northwest neptune	31	.5		.5	2	0	0
Sea cucumber	32	.4		0	2	0	0
Spinyhead sculpin	32	.4		.5	1	0	0
Bigmouth sculpin	32	.4		2	0	0	0
Basket starfish	35	.3		0	1	0	0
Dusky rockfish	36	.2		0	.7	0	0
Sidestripe shrimp	36	.2		0	0	.2	1
Snail	36	.2		1	0	0	0
Sculpin	39	.1		0	.5	0	0
Pink shrimp	39	.1		0	T	.2	T
Northern rockfish	39	.1		.1	.2	0	0
Northern spearnose poacher	39	.1		.5	0	0	0
Rock sandfish	39	.1		0	.4	0	0
Number of tows		10		2	3	4	1
Total kg/hr		1817		1066	1953	2068	1914

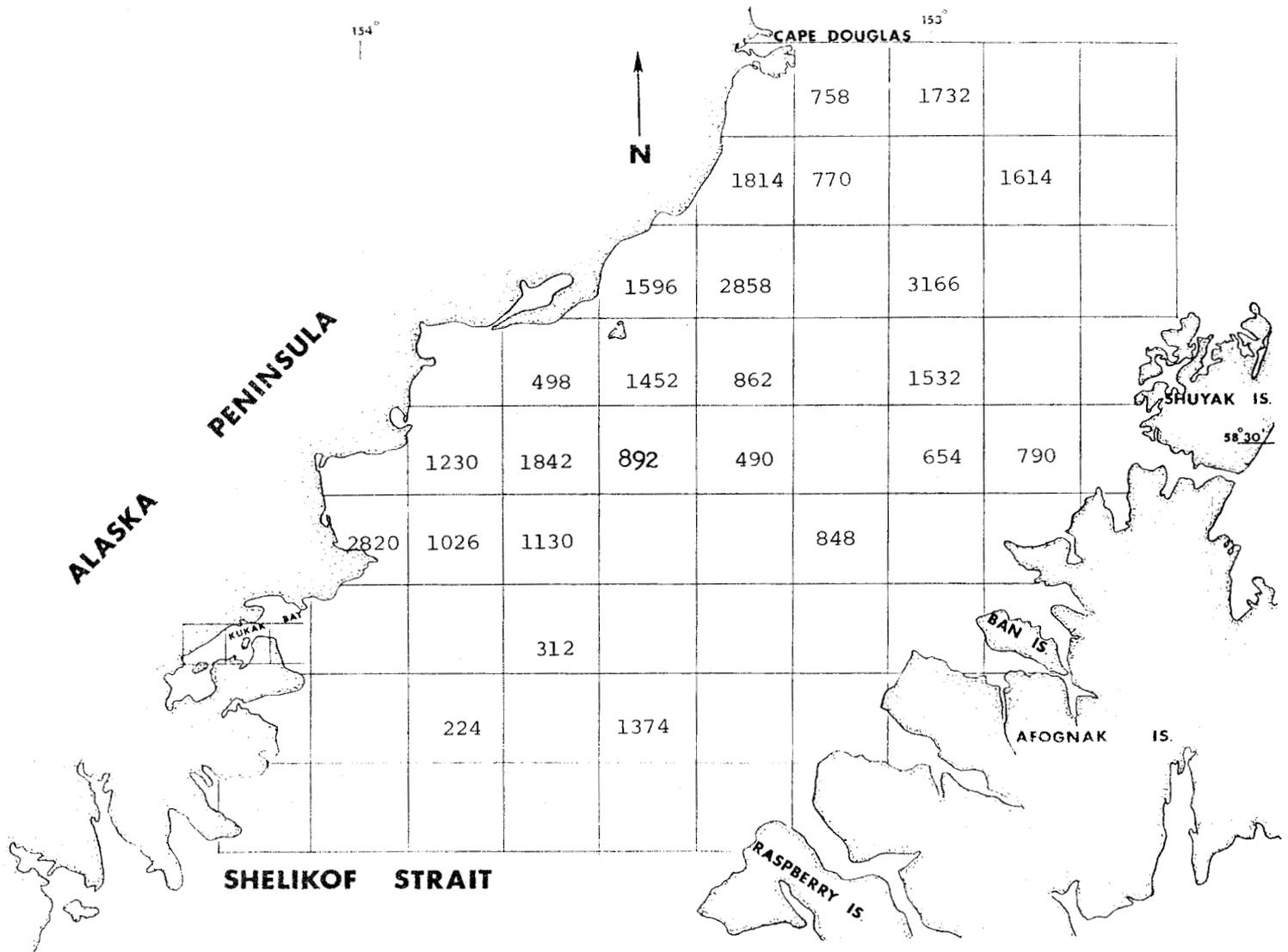
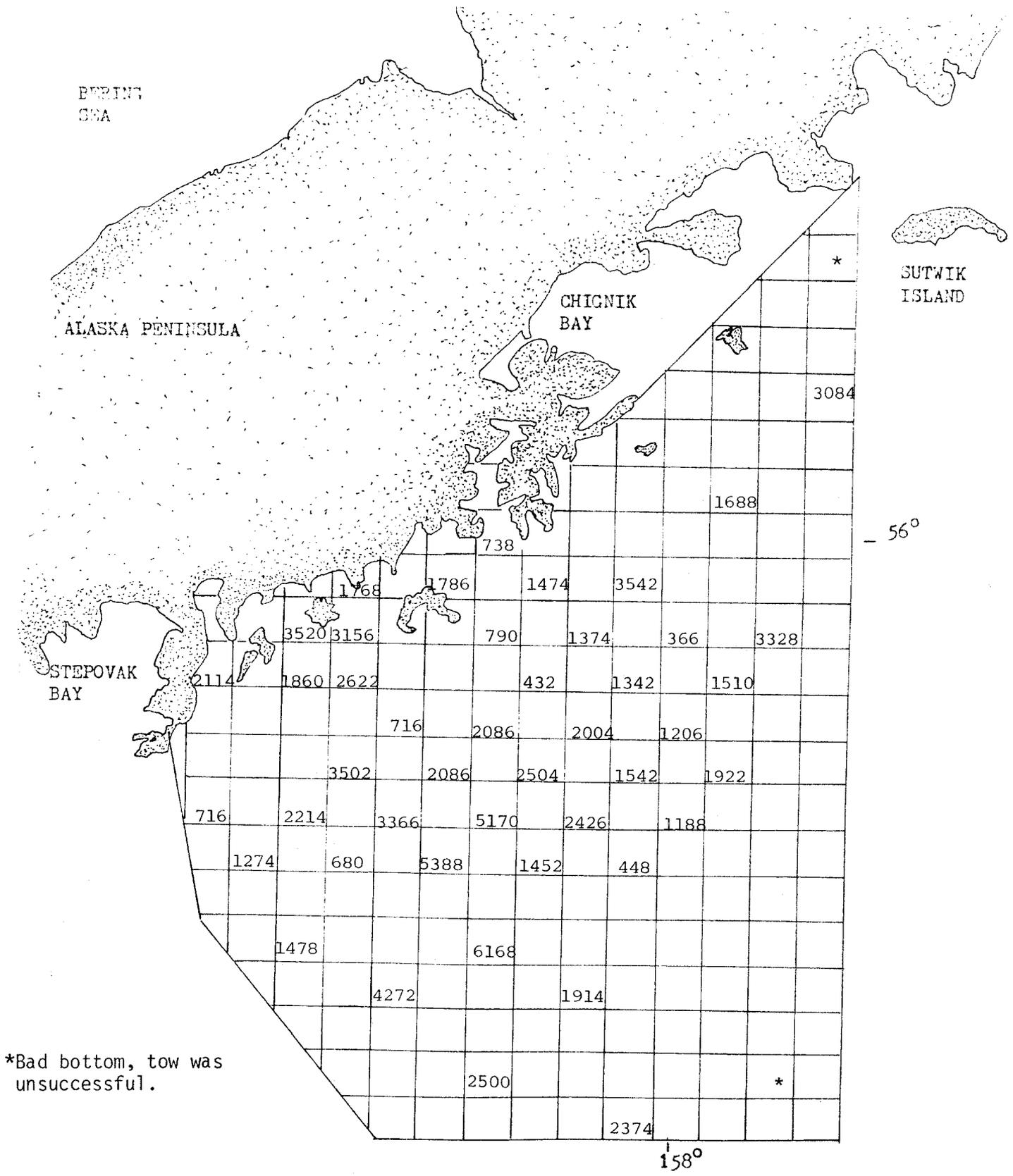


Figure 5. Distribution of total catch per unit effort, in kg/hr, taken by otter trawl in Shelikof Strait during summer of 1981. Blank grids were not trawled.



\*Bad bottom, tow was unsuccessful.

Figure 6. Distribution of total catch per unit effort, in kg/hr, taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.

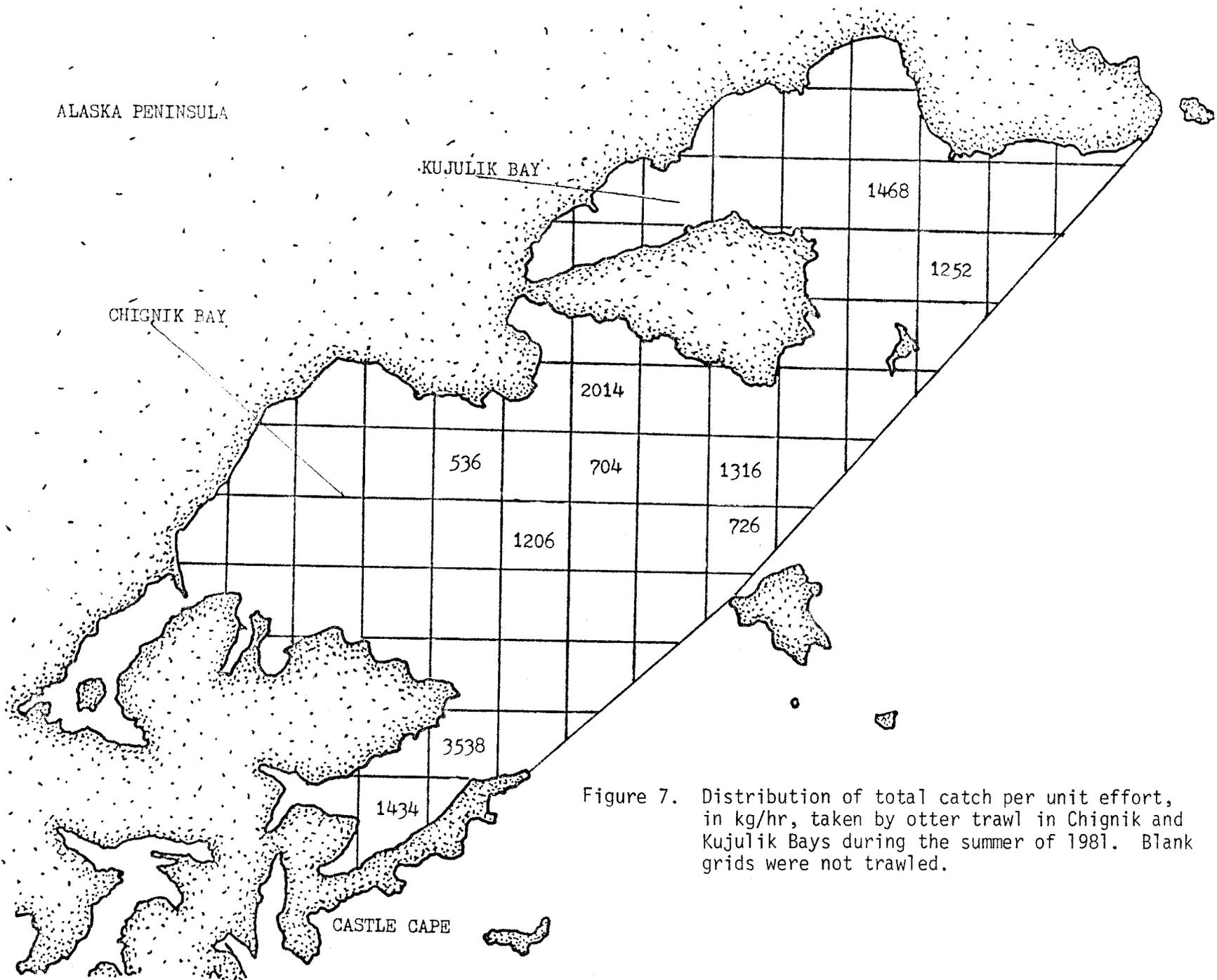


Figure 7. Distribution of total catch per unit effort, in kg/hr, taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

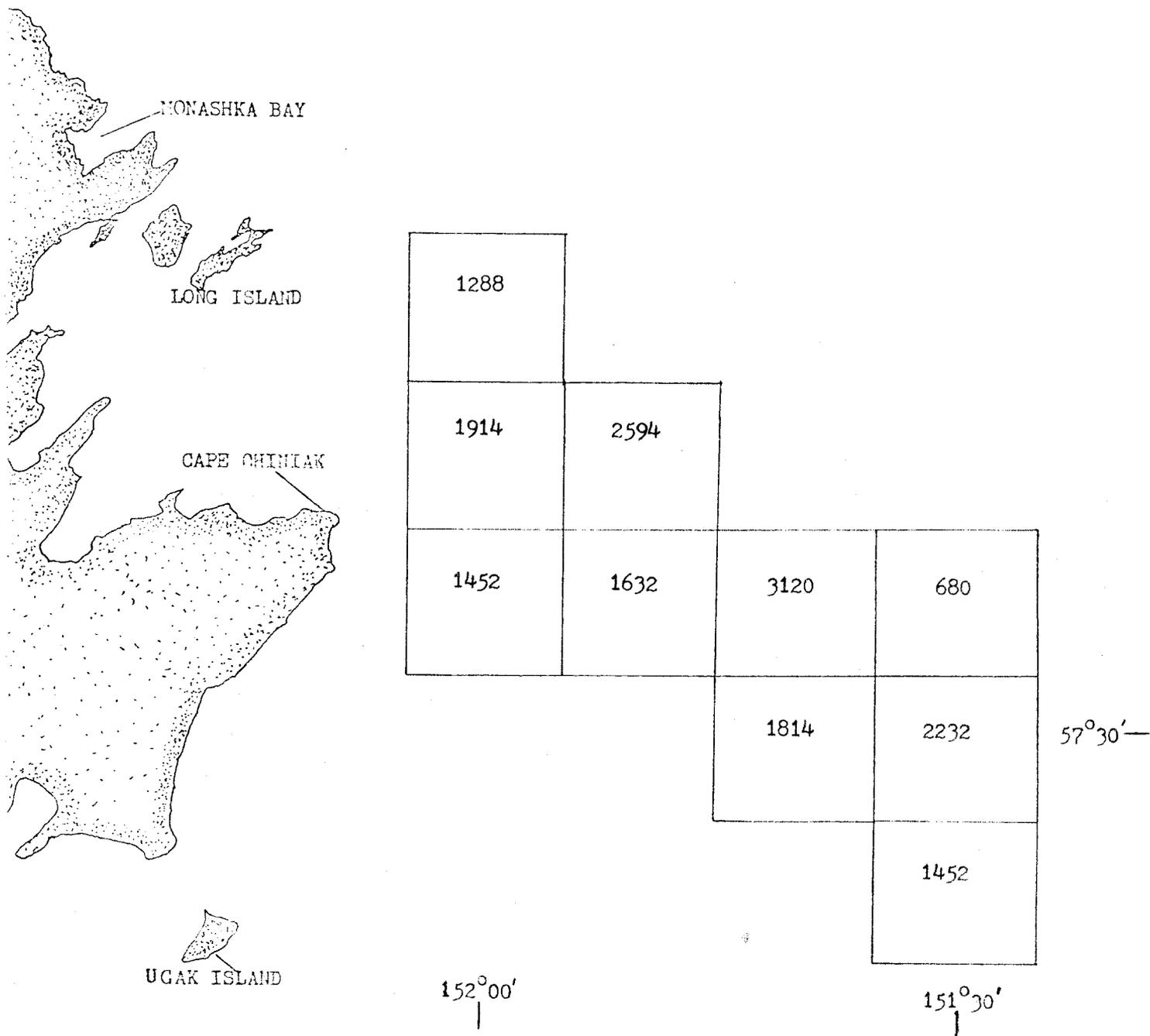


Figure 8. Distribution of total catch per unit effort, in kg/hr, taken by otter trawl in Chiniak gully during the summer of 1981.

and Pacific cod.

Depths trawled were different in each study area as were the number of trawls in each 18 m (10 fm) interval (Tables 3-7). The most complete bottom temperature profile was taken in the Chignik area where temperatures increased shoreward and into the heads of bays (Figures 1-4).

Length measurements were systematically taken for Pacific cod, Pacific halibut, and sablefish (Figures 9 and 10). Length-weight relationships were calculated for Pacific cod, sablefish, big skate, and three species of rockfish (Table 8).

Skin lesions severe enough to expose underlying tissue were observed on 7.9% of the Pacific cod sampled in 1980 and 1981 in northern Shelikof Strait. The incidence of sores increased with size ( $p < .001$ ). The frequency of sores by size class was 2% between 25 and 44 cm, 6% between 45 and 52 cm, 11% between 53 and 62 cm, and 18% in fish 63 cm and larger.

Estimates of the Pacific cod population were 6,318 to 8,881 metric tons in Shelikof Strait and 39,143 to 75,499 metric tons in the Chignik area. Age analyses of the catches allowed population estimates to be made by age class (Table 9 and 10). The most important feature is the tremendous abundance of age class 4 (1977) cohort compared to other ages in Chignik and to a lesser extent in Shelikof. This large year class has been responsible for a considerable increase in abundance of cod. Based on estimated rates of growth and survival the 1977 cohort was approximately at the size of maximum biomass during the survey and biomass should begin to decrease slowly as this cohort passes through the population. However, it appears that younger ages, 1978 and 1979 cohorts, are also more abundant than older cohorts, 1976 and earlier.

Estimates of the walleye pollock population were 10,636 to 20,851 metric tons in Shelikof Strait and 74,529 to 135,615 metric tons in the Chignik area.

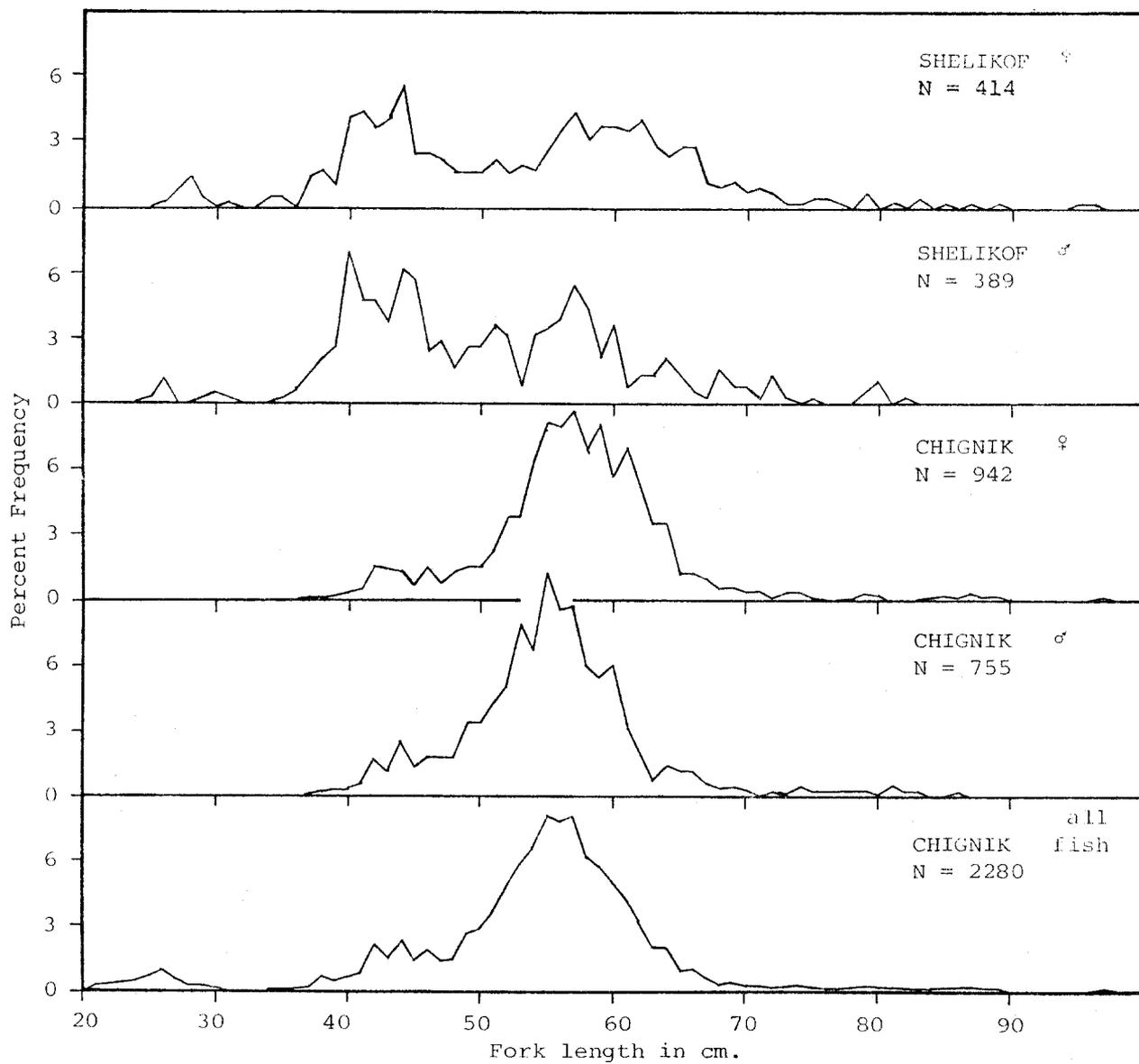


Figure 9. Relative length frequencies of Pacific cod by sex and area. Measurements were taken during a survey in Shelikof Strait and the Chignik area during July and August 1981.

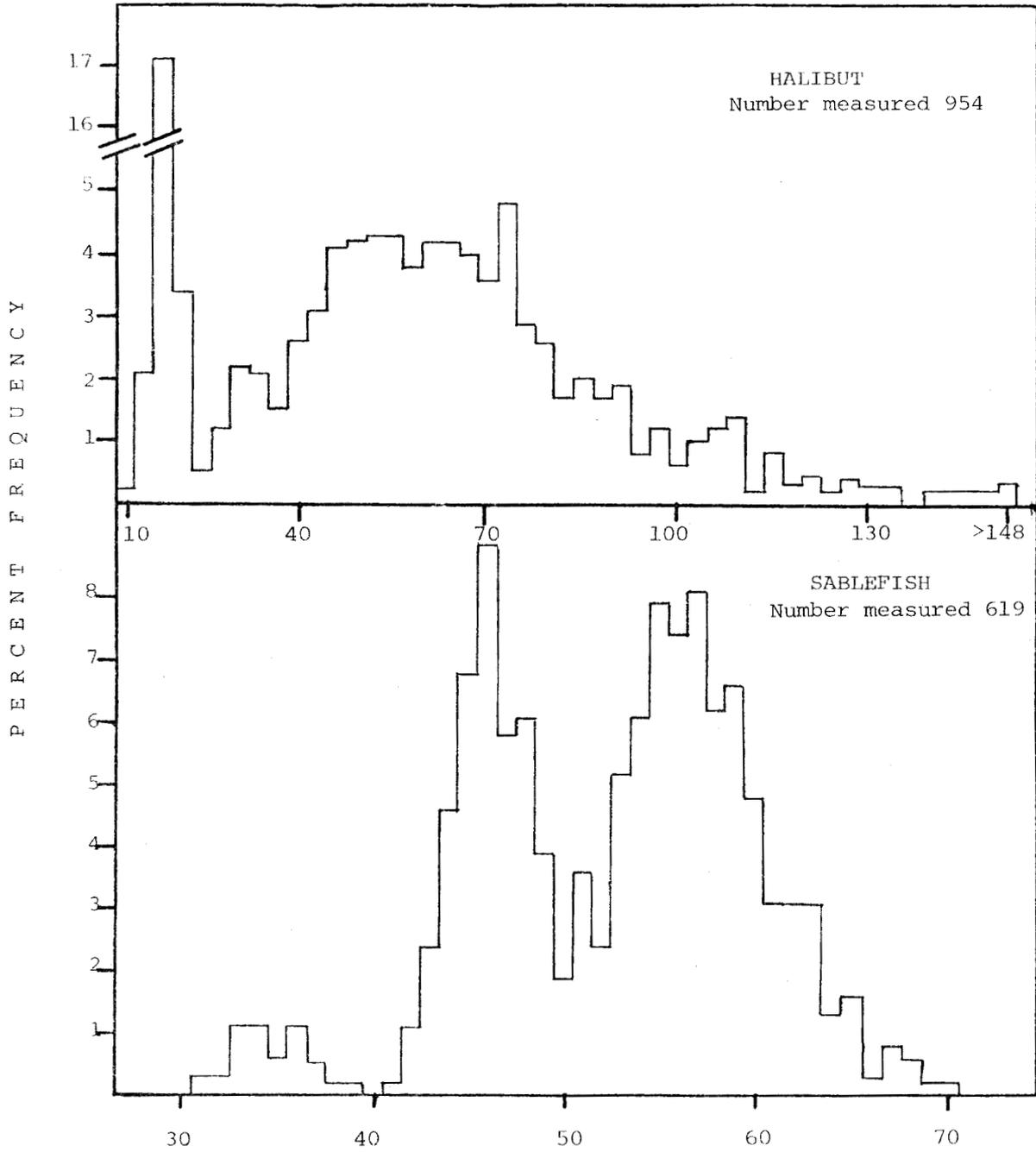


Figure 10. Length frequencies of Pacific halibut and sablefish taken as random samples from trawl catches in Shelikof Strait, Chignik area and Chiniak gully during the summer of 1981.

Table 8. Length-weight relations calculated from survey data. Fork length in cm, weight in Kg - -  $W = aL^b$ .

	a	b	N
Rougheye <sup>1</sup>	$1.34402 \times 10^{-5}$	3.04508	127
Dusky <sup>1</sup>	$9.7092 \times 10^{-6}$	3.1606	94
Northern <sup>1</sup>	$2.27097 \times 10^{-5}$	2.8666	21
Northern <sup>2</sup>	$1.6345 \times 10^{-5}$	2.9687	21
Pacific cod <sup>1</sup> (both sexes)	$5.9254 \times 10^{-6}$	3.1675	103
Sablefish <sup>1</sup>	$2.121 \times 10^{-6}$	3.3853	38
Sablefish <sup>2</sup>	$2.8769 \times 10^{-6}$	3.3088	38
Big Skate <sup>1</sup>	$5.96027 \times 10^{-5}$	2.9522	48
Big Skate <sup>2</sup>	$4.7474 \times 10^{-5}$	3.0054	48

<sup>1</sup> Using linear regression on log length and log weight.

<sup>2</sup> Using non-linear least squares.

Table 9. Number of cod per square nautical mile by age class in each stratum in northern Shelikof Strait and total population estimate by age class. Stratum II is 10 stations in shallowest water on the west side, stratum III is eight stations in deeper water and stratum IV is seven stations in deepest water in the eastern part of Shelikof Strait.

Age	Stratum			Population Estimate thousands of fish
	II	III	IV	
1	1,281		28	290
2	820	370	4,276	2,550
3	743	449	1,515	1,096
4	1,047	729	1,176	1,143
5	174	137	158	180
6	55	50	36	54
7	67	36	14	39
8	35	13	14	21
9	13	13	14	16
Area of Stratum	216.5	499.3	469.6	Total 5,389 <sup>1</sup>

<sup>1</sup> Excluding age 1.

Table 10. Number of cod per square nautical mile by age class in each stratum in the Chignik area and total population estimate by age class. Stratum III is the six stations farthest south (offshore), stratum I is 23 stations in Chignik and Kujulik Bays and farthest inshore and stratum II is the remaining 26 stations.

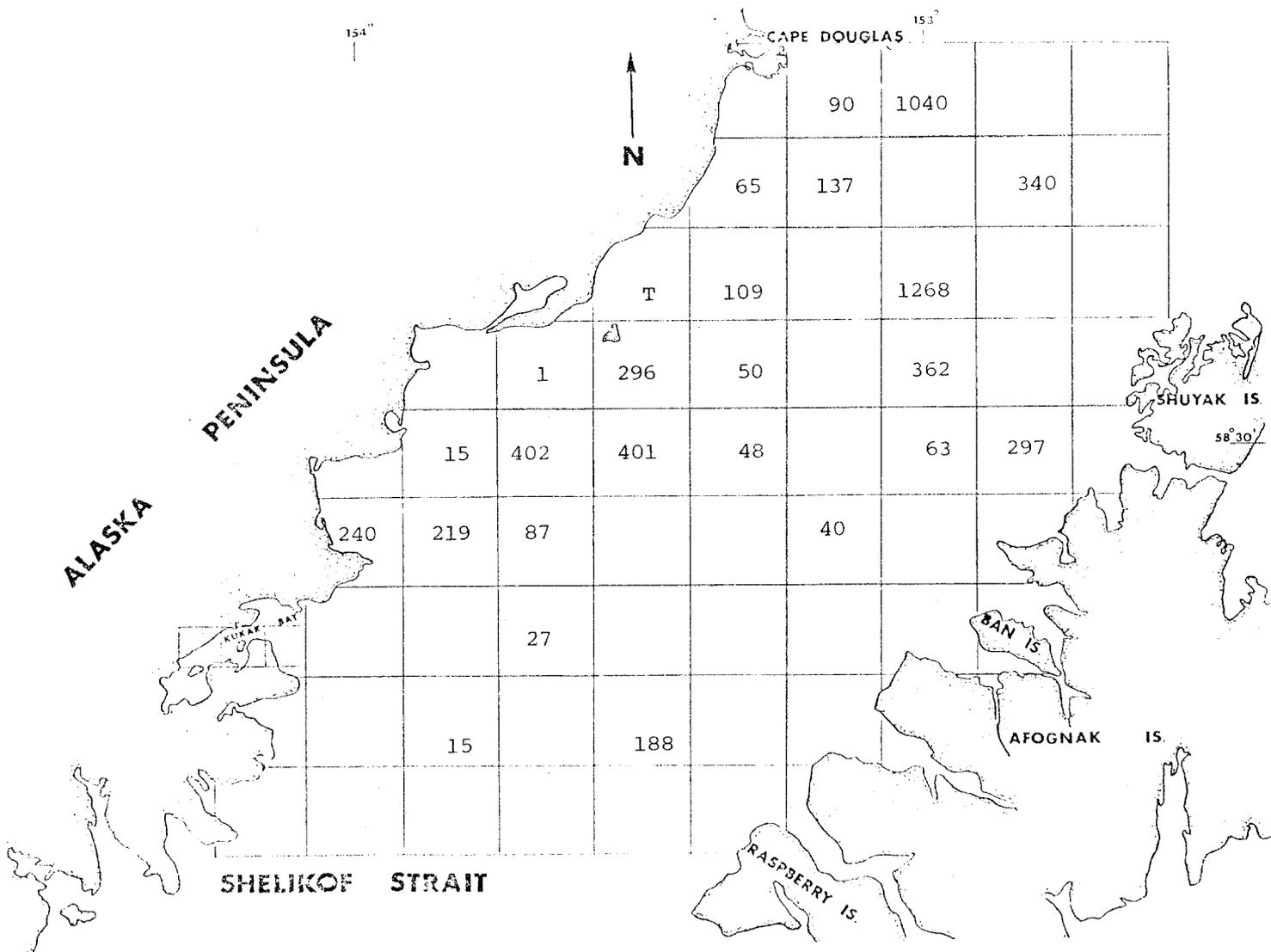
Age	Stratum			Population Estimate thousands of fish
	I	II	III	
1	2,999			2,223
2	339	1,920	131	2,633
3	274	1,920	1,061	3,613
4	2,243	8,238	10,515	22,878
5	20	109	211	376
6		51	203	284
7		43	180	248
8		32	93	140
9			48	53
Area of Stratum	741.3	1,446.3	1,105.1	Total 30,225 <sup>1</sup>

<sup>1</sup> Excluding age 1.

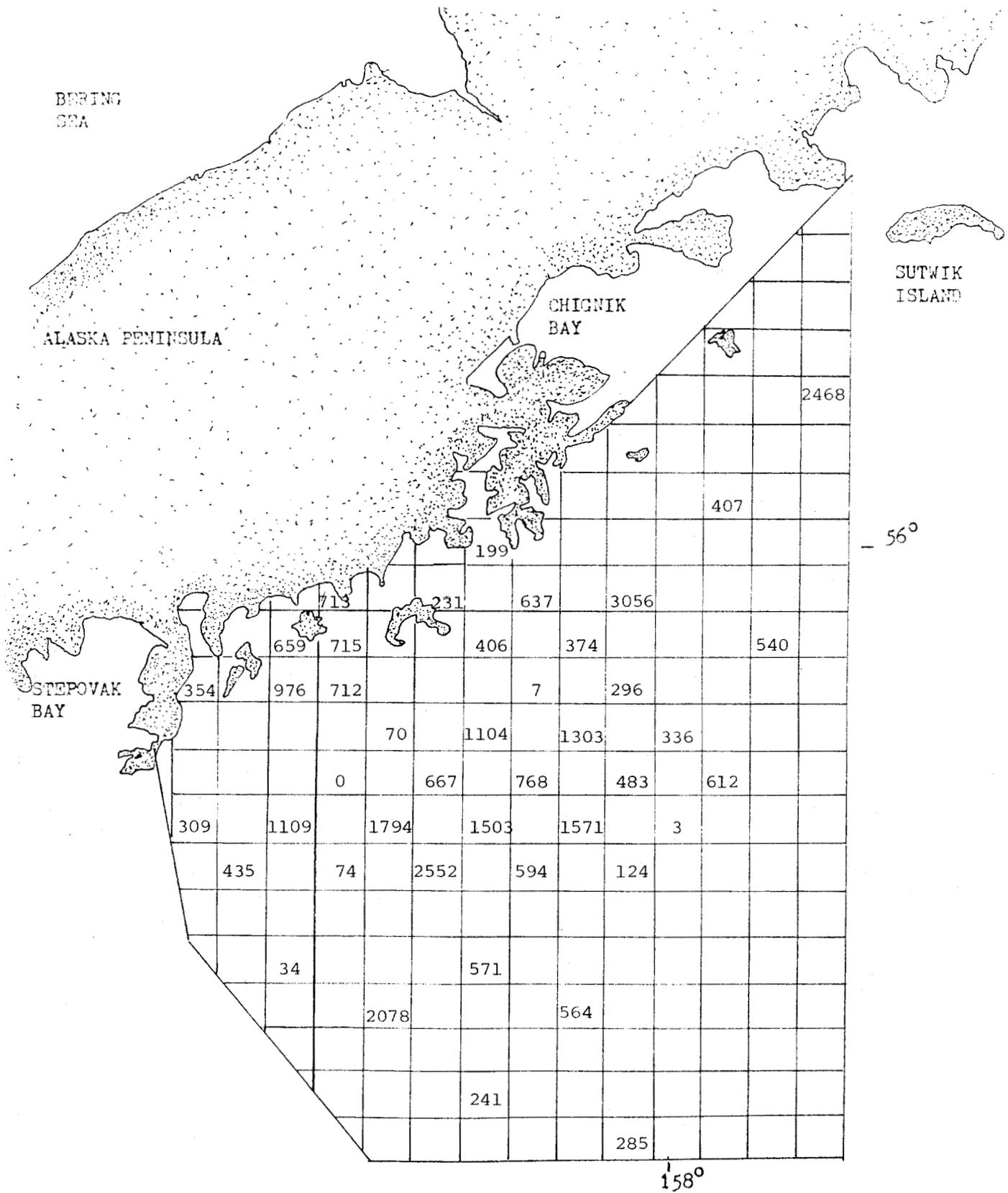
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- Owen, D.L. and J.E. Blackburn. 1981. The 1980 northern Shelikof Strait bottomfish otter trawl survey. Alaska Department of Fish and Game Technical Data Report No. 64 (limited distribution).
- Ronholt, L.L., H.H. Shippen, and E.S. Brown. 1978. Demersal 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.

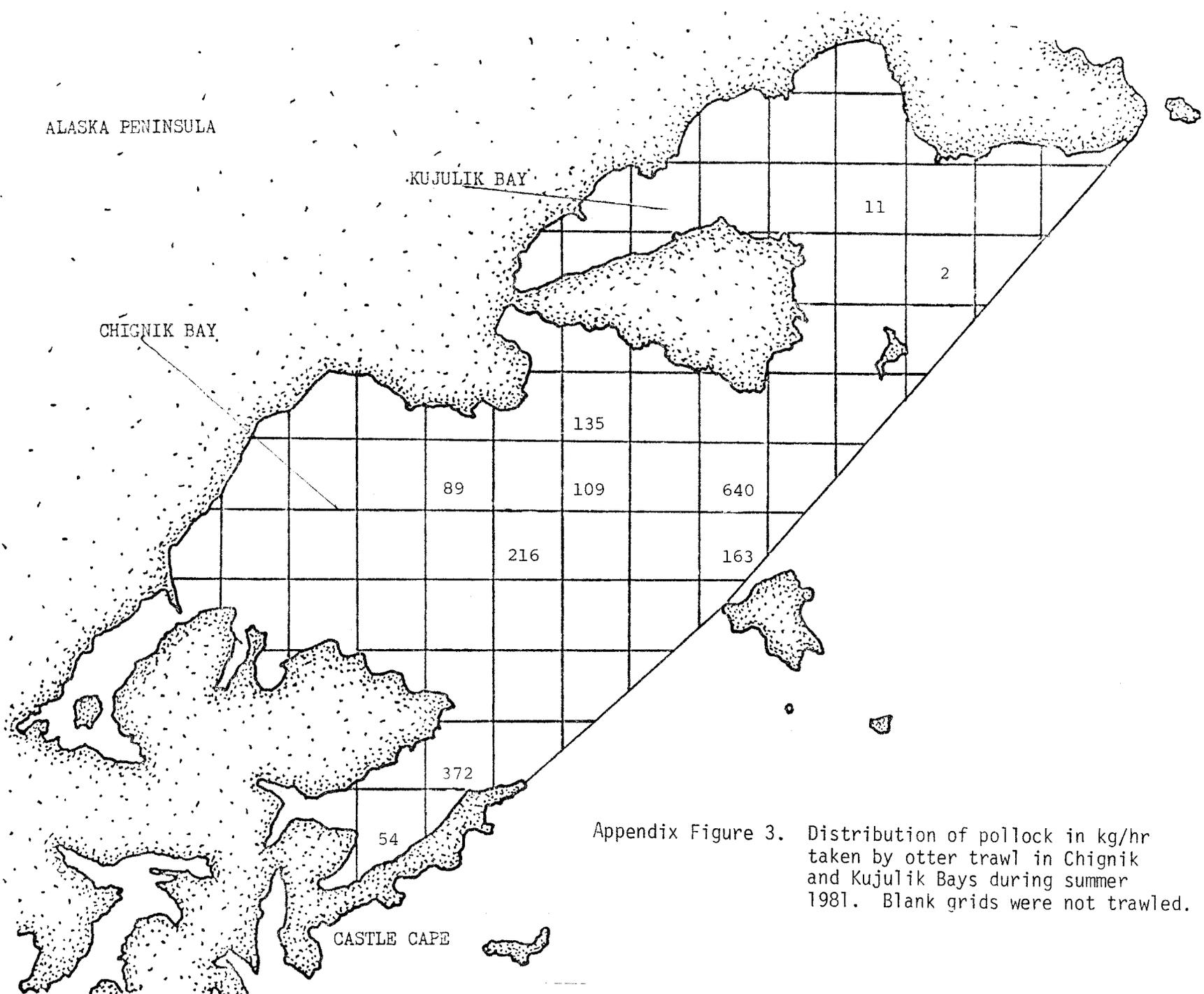
APPENDICES



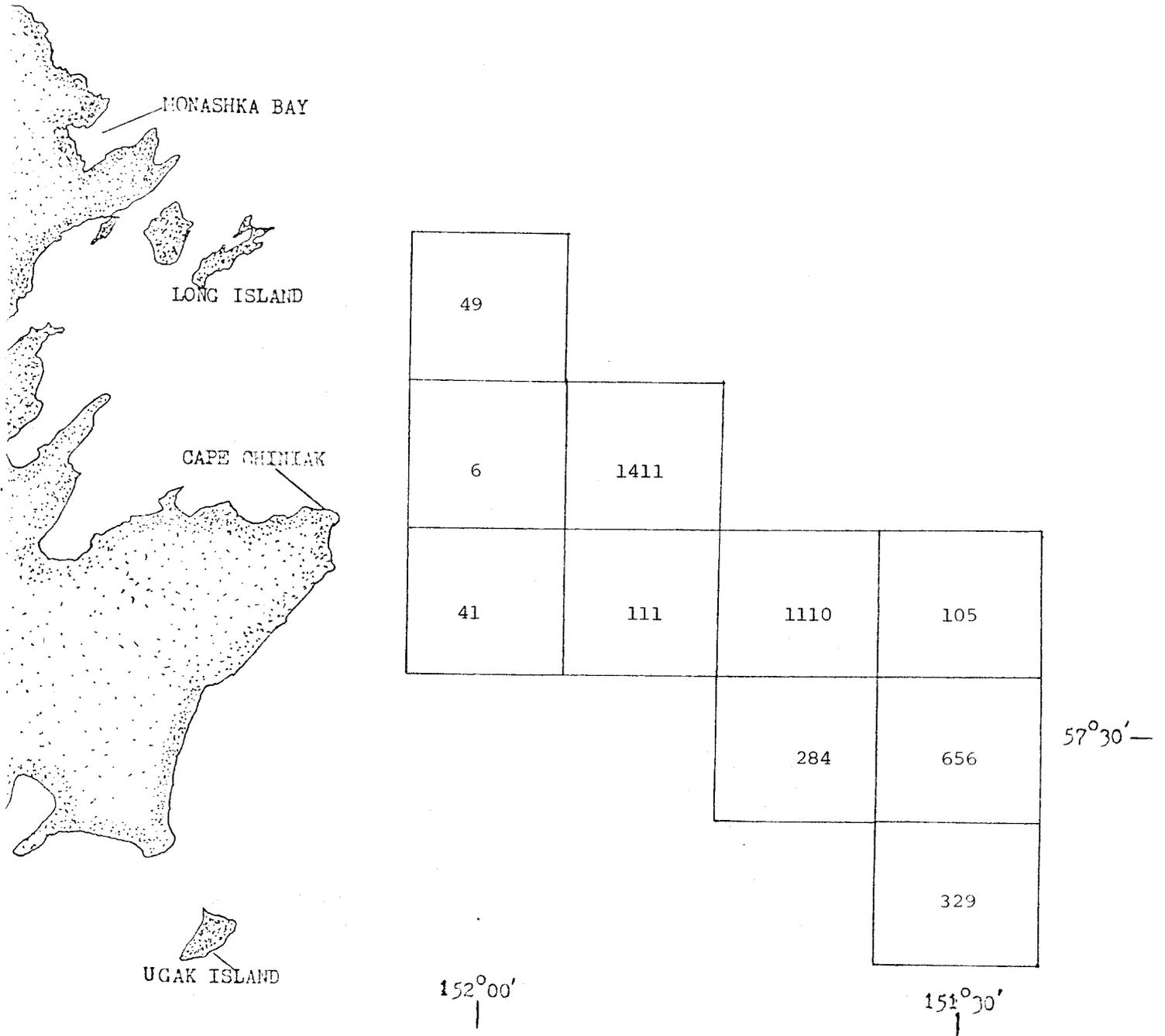
Appendix Figure 1. Distribution of pollock in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



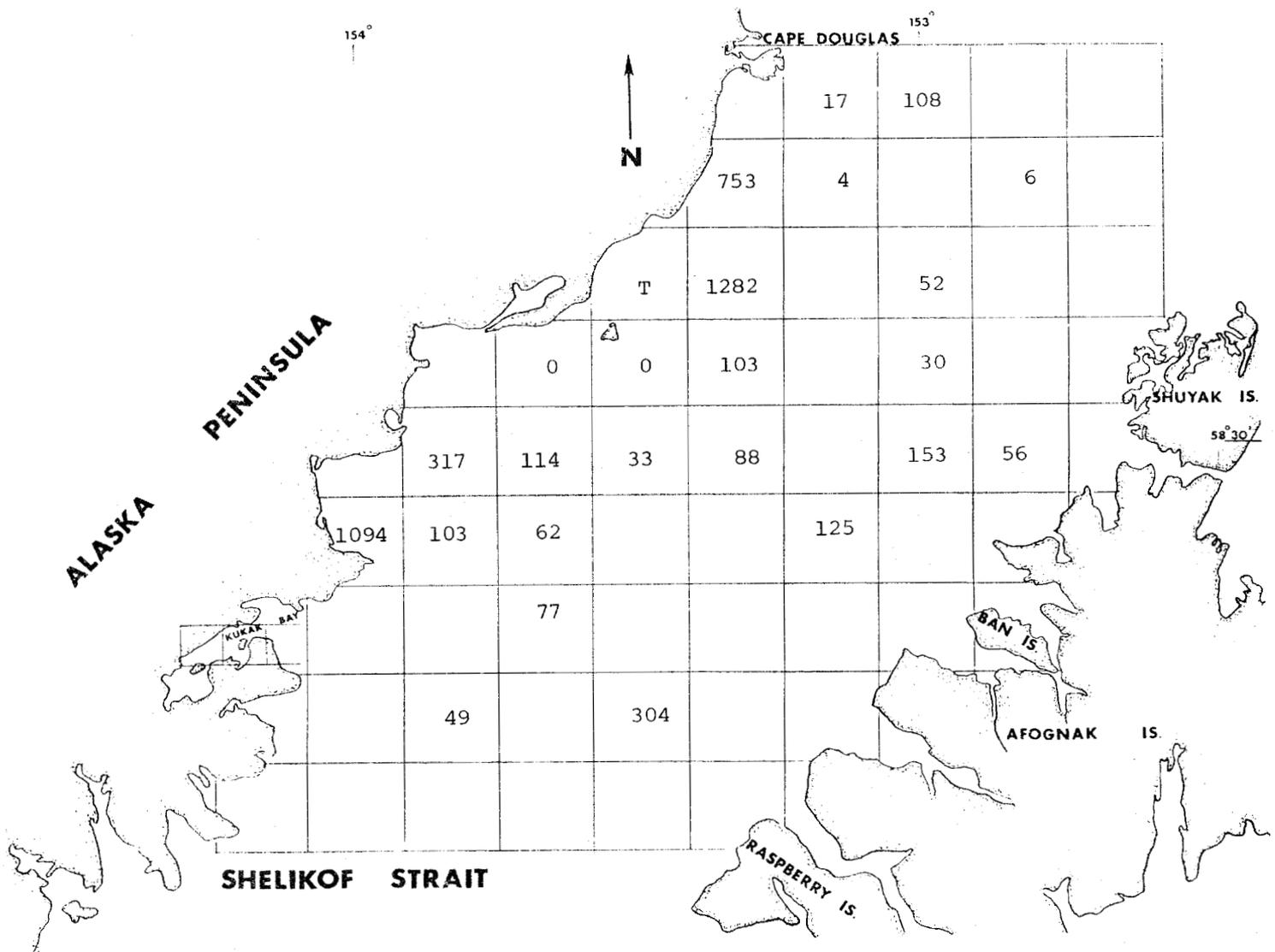
Appendix Figure 2. Distribution of pollock in kg/hr taken by otter trawl offshore of the Alaska Peninsula during summer of 1981. Blank grids were not trawled.



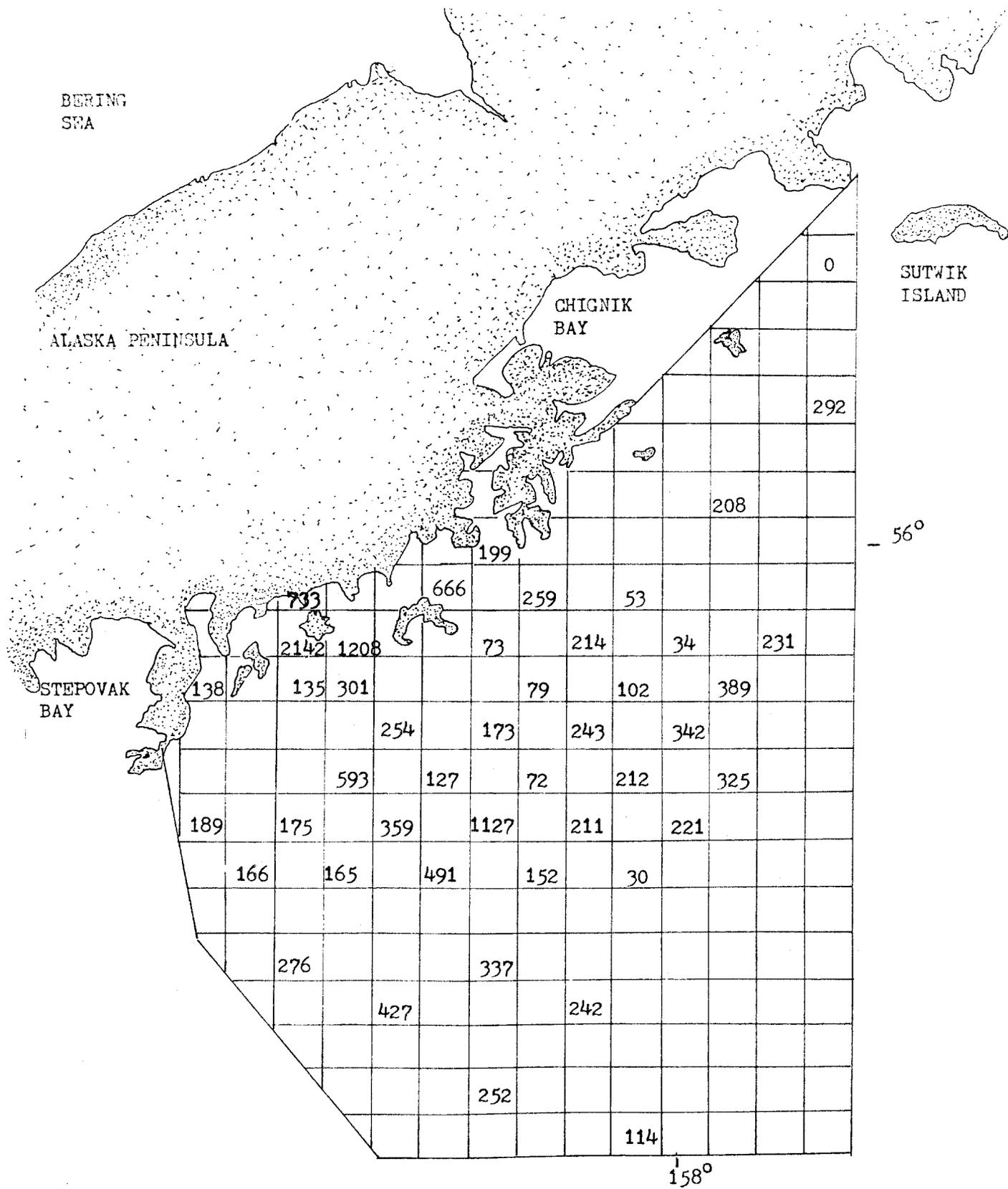
Appendix Figure 3. Distribution of pollock in kg/hr taken by otter trawl in Chignik and Kujulik Bays during summer 1981. Blank grids were not trawled.



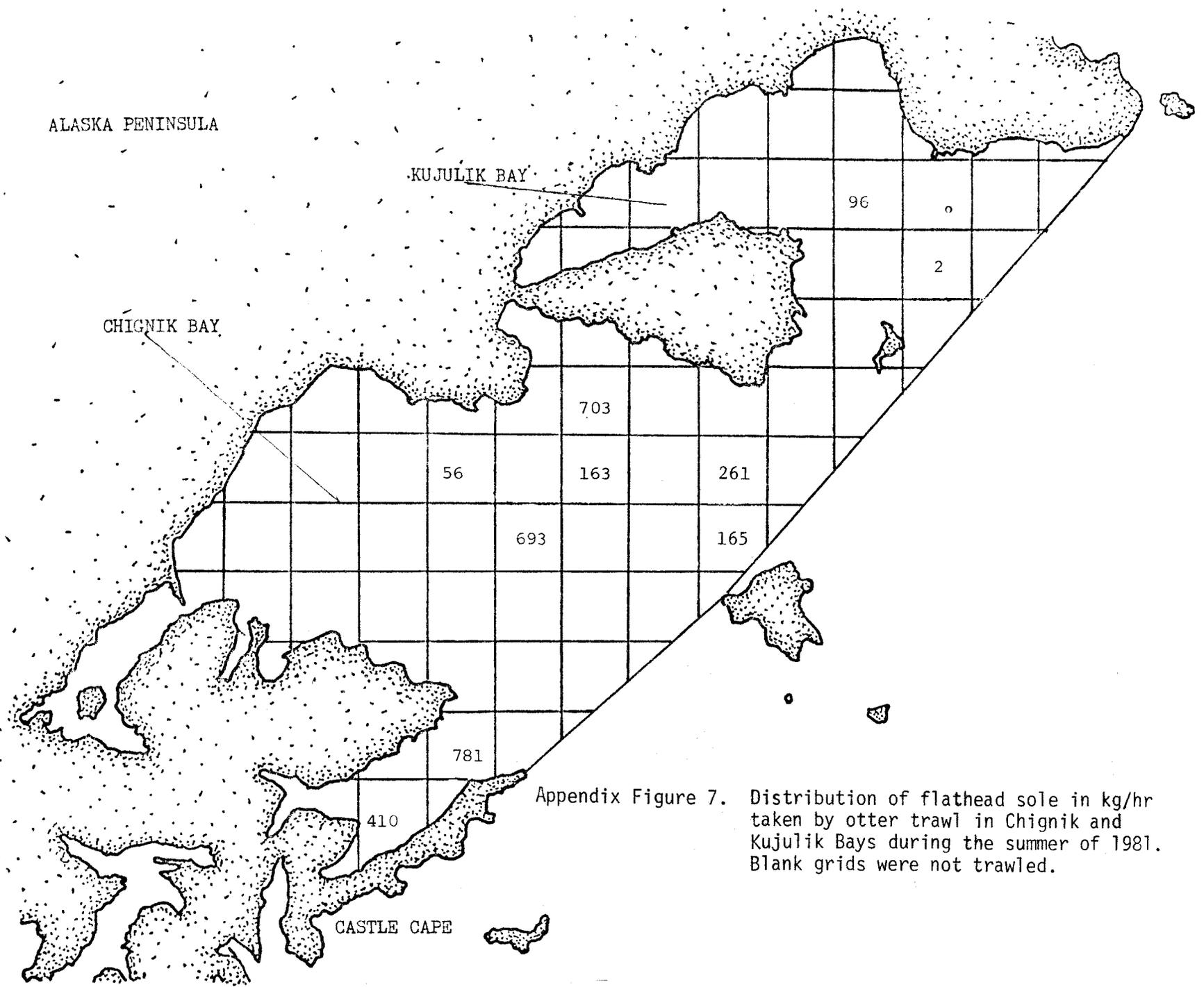
Appendix Figure 4. Distribution of pollock in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.



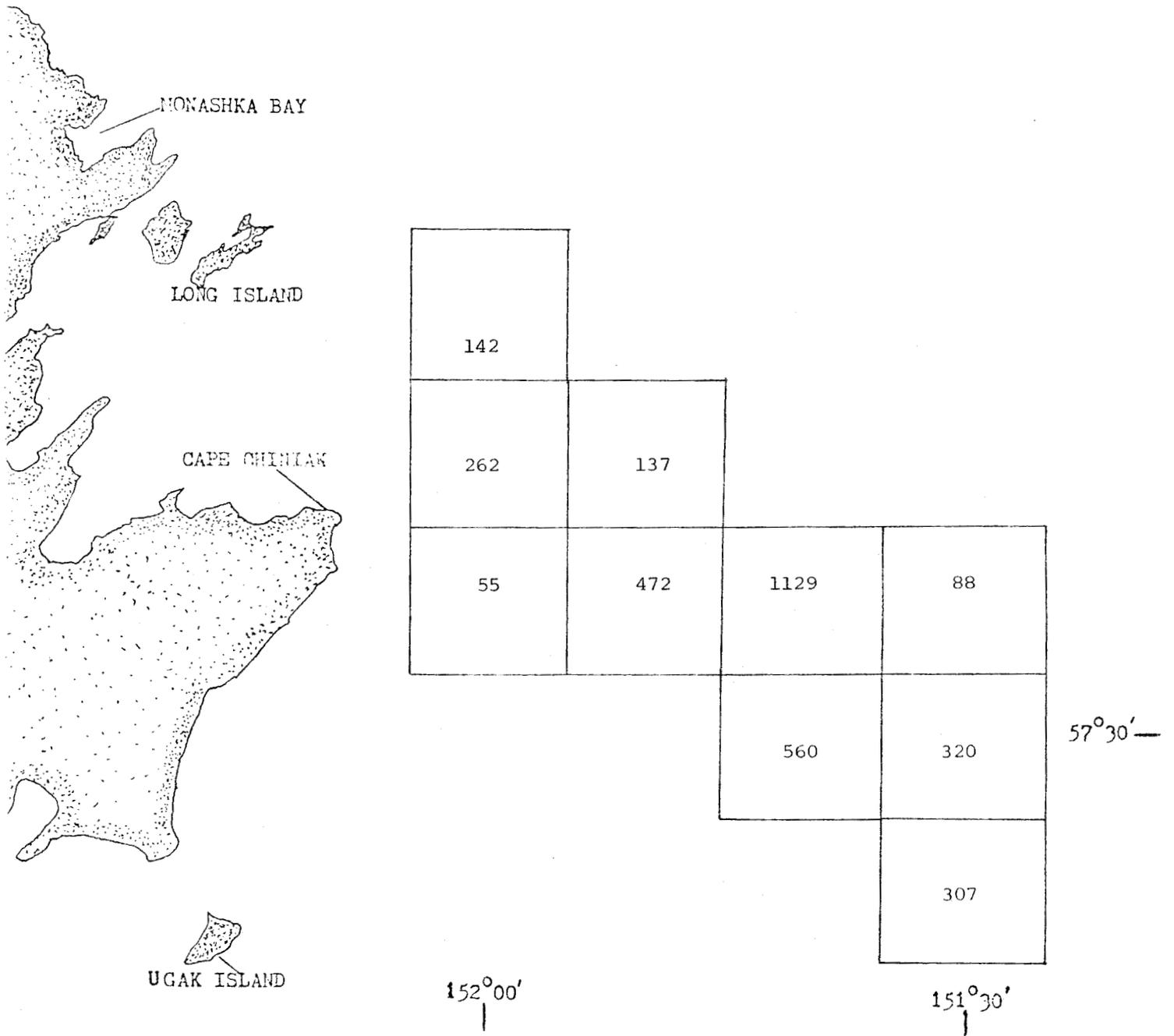
Appendix Figure 5. Distribution of flathead sole in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



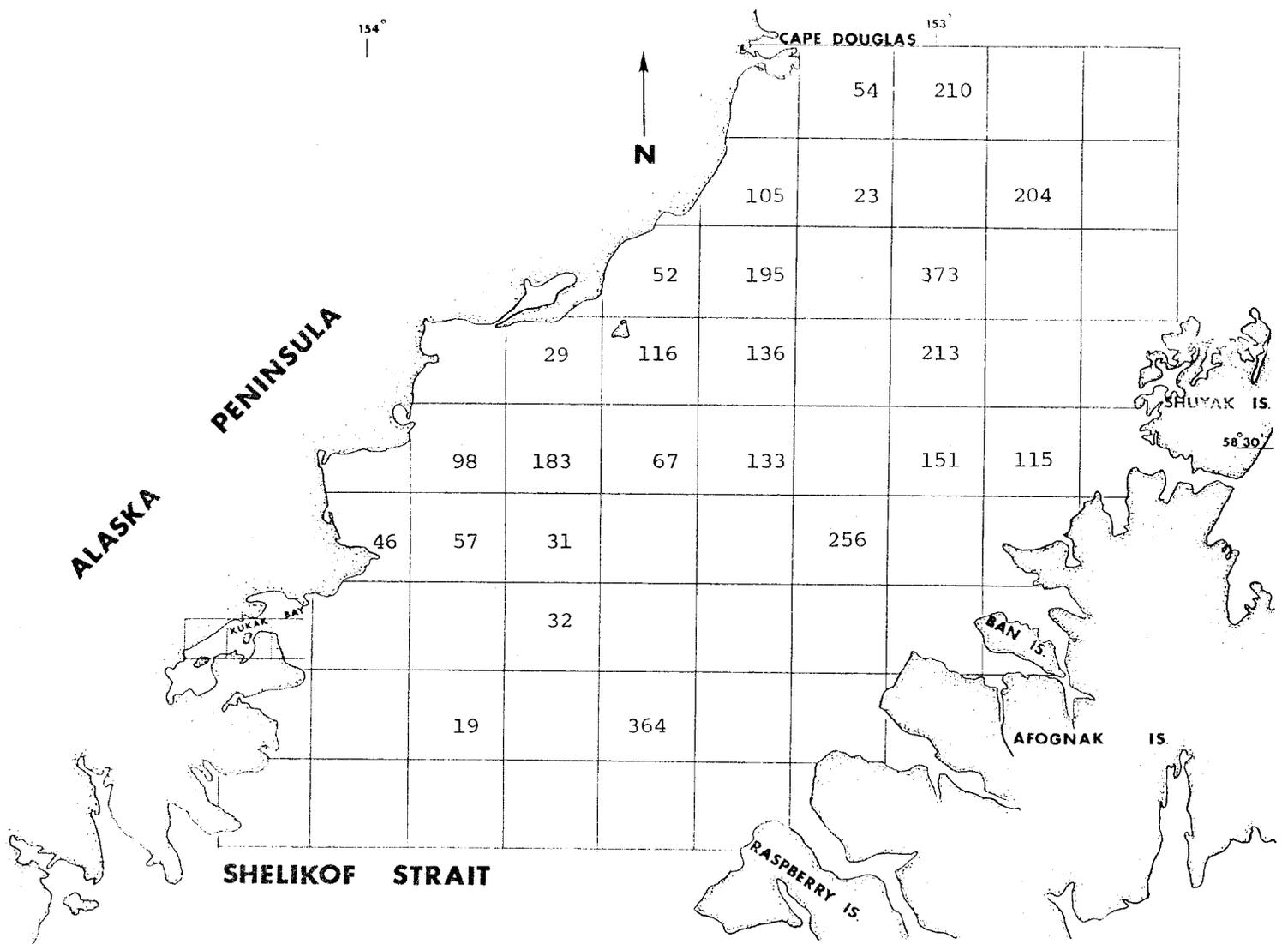
Appendix Figure 6. Distribution of flathead sole in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.



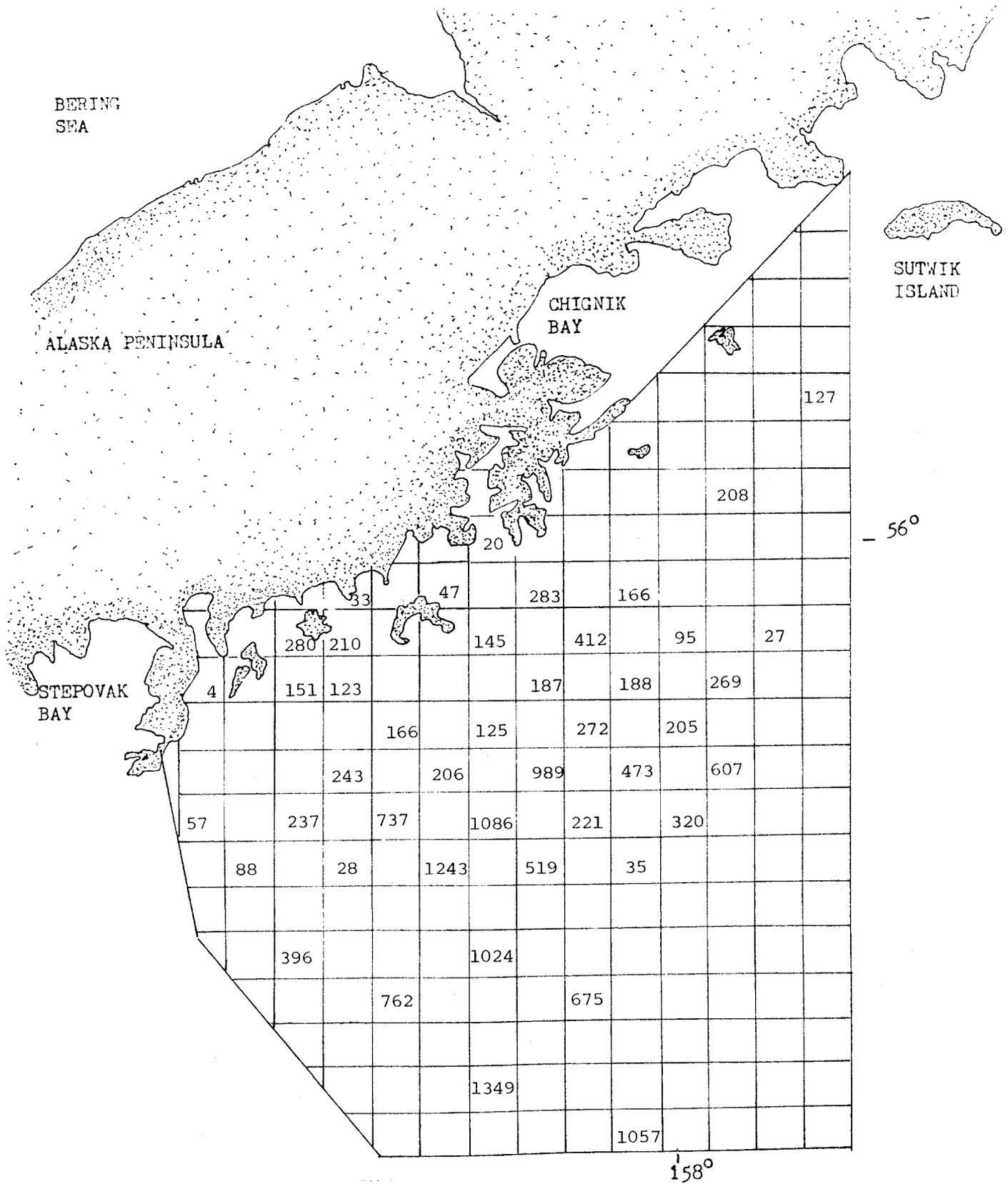
Appendix Figure 7. Distribution of flathead sole in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.



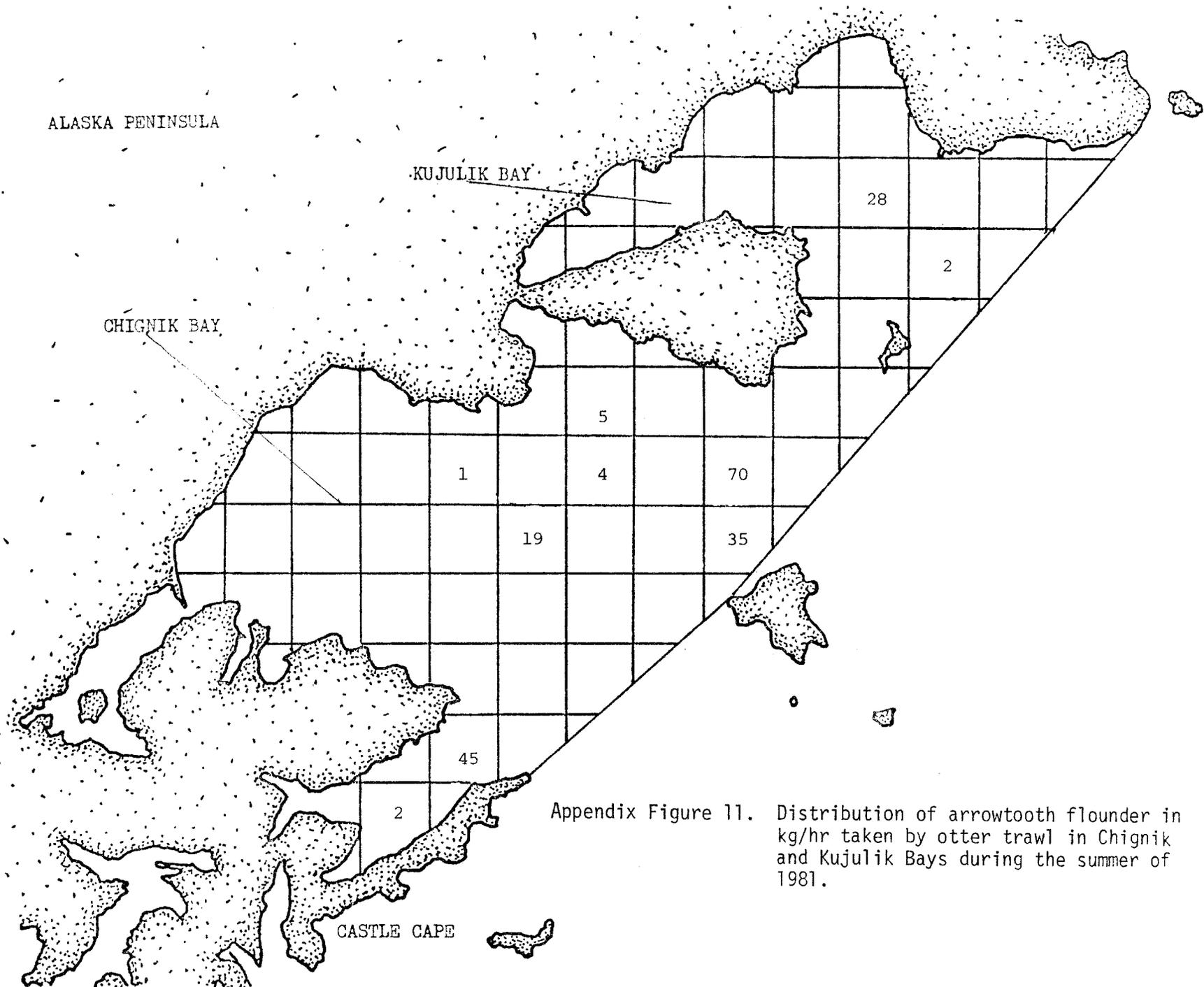
Appendix Figure 8. Distribution of flathead sole in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.



Appendix Figure 9. Distribution of arrowtooth flounder in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.

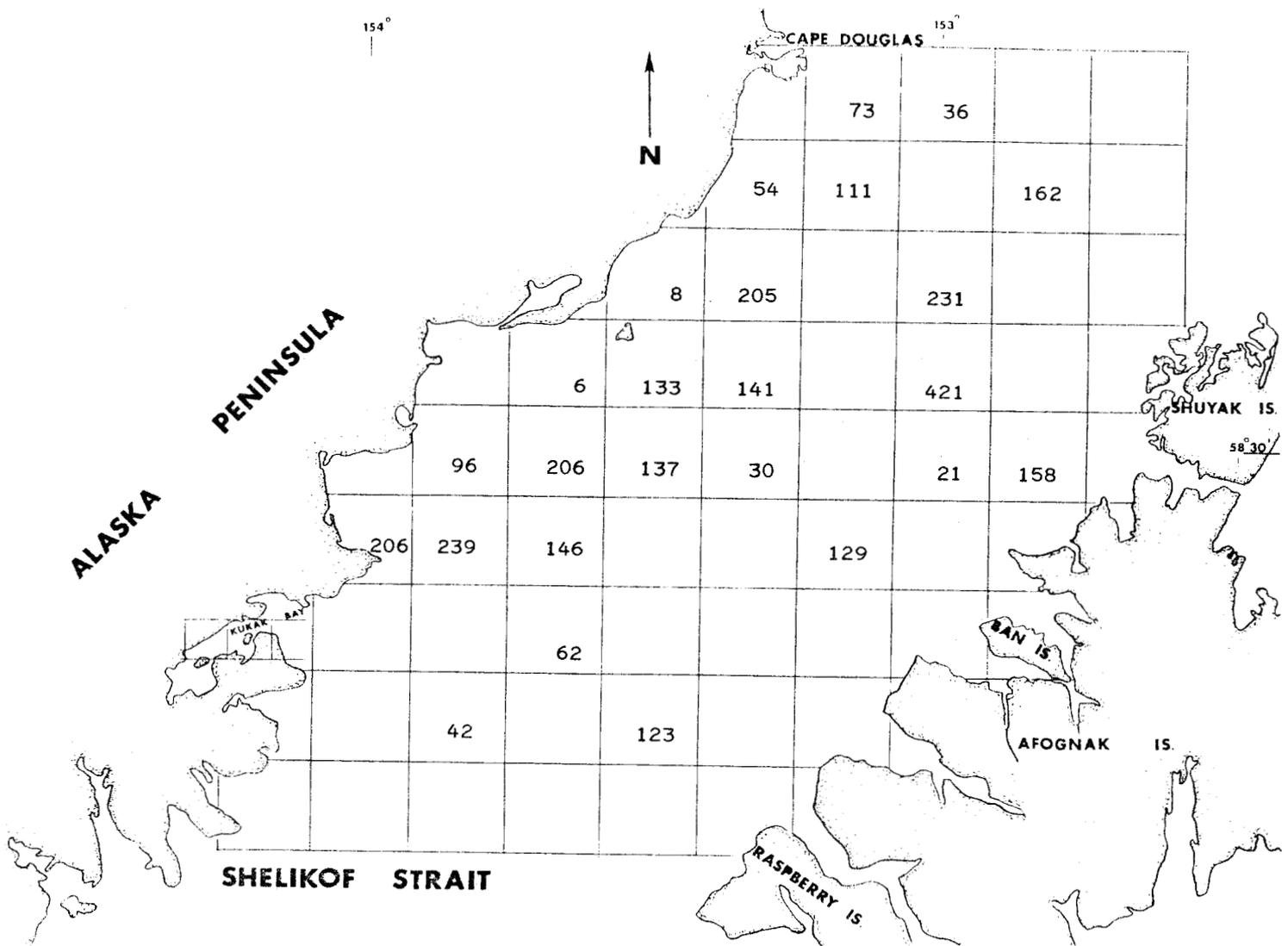


Appendix Figure 10. Distribution of arrowtooth flounder in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.

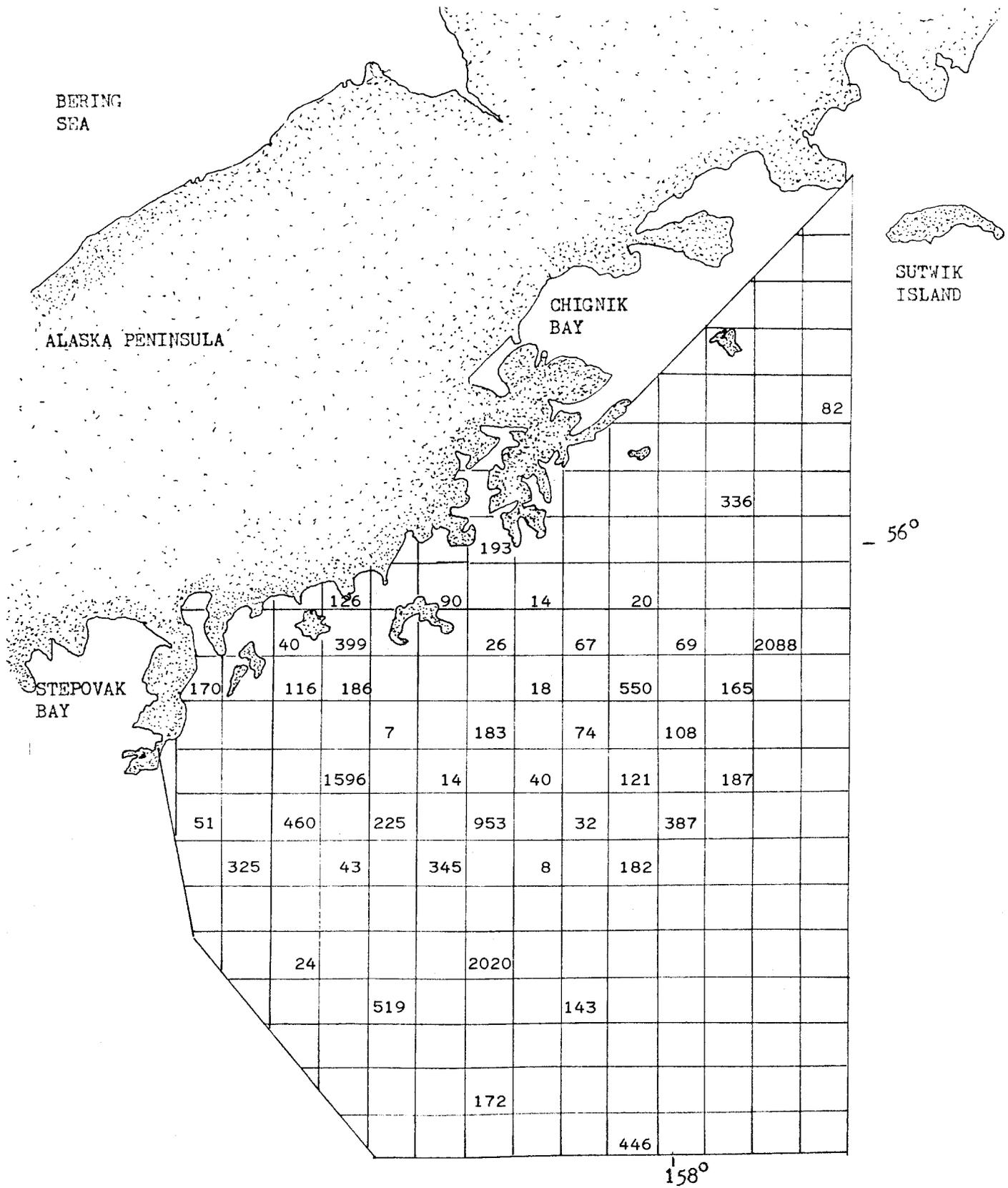


Appendix Figure 11. Distribution of arrowtooth flounder in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981.

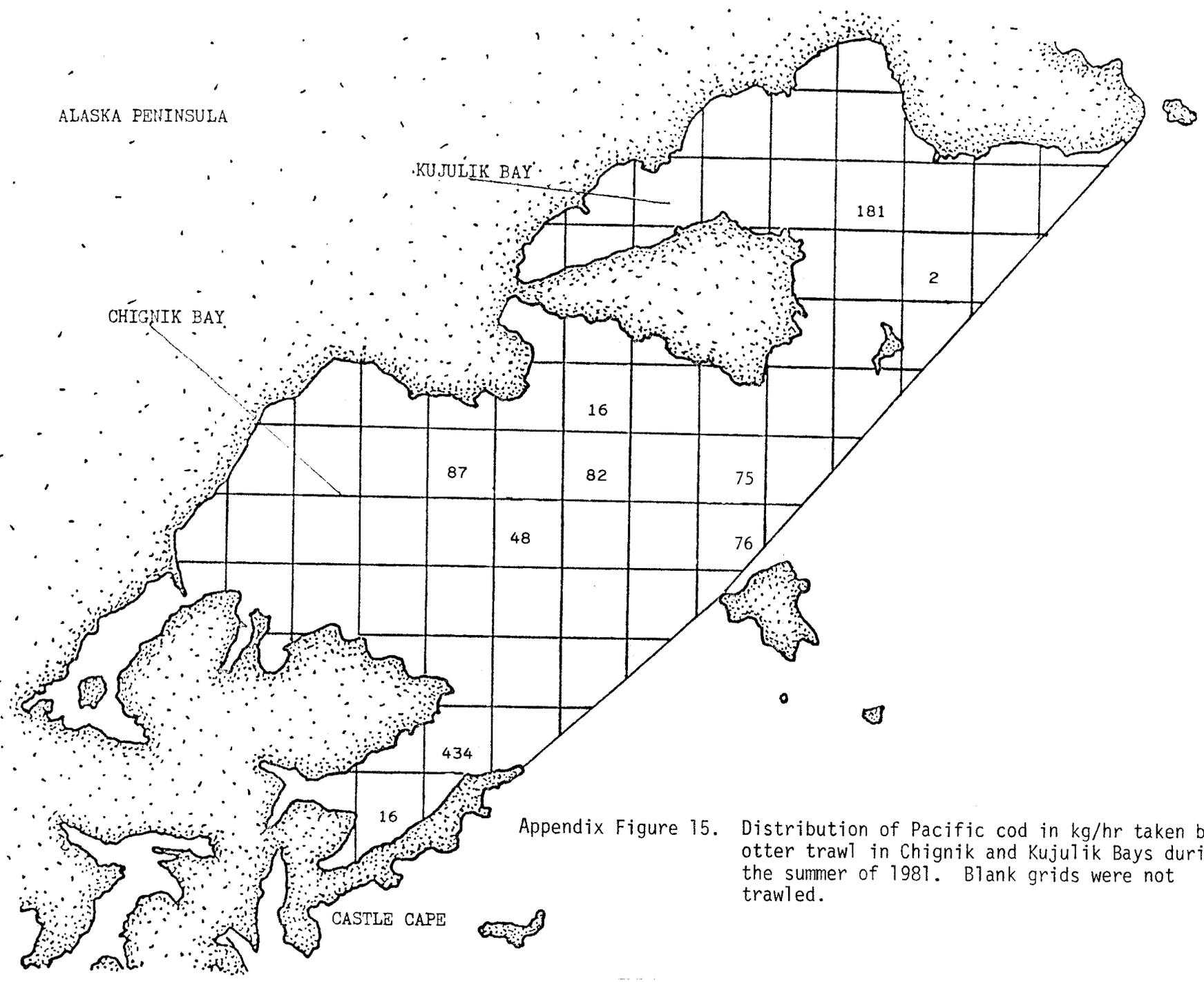




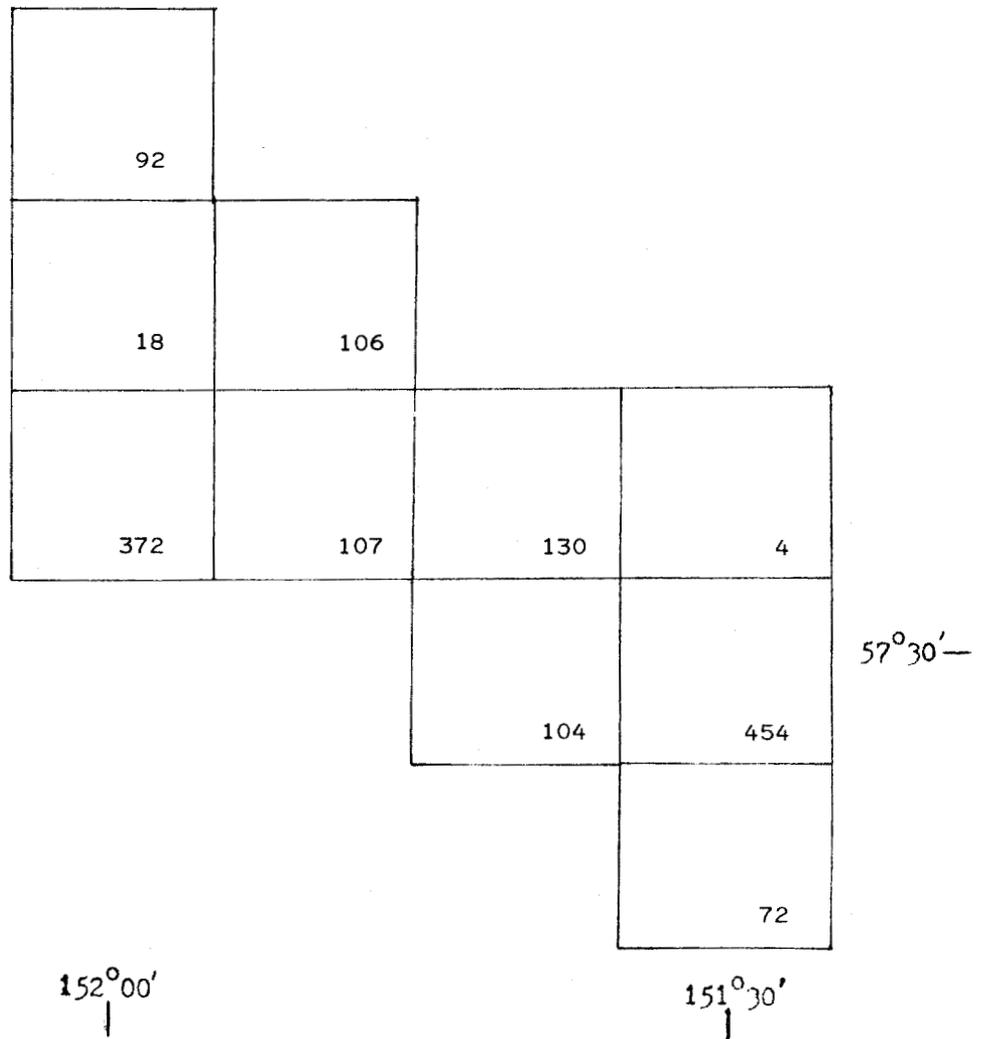
Appendix Figure 13. Distribution of Pacific cod in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



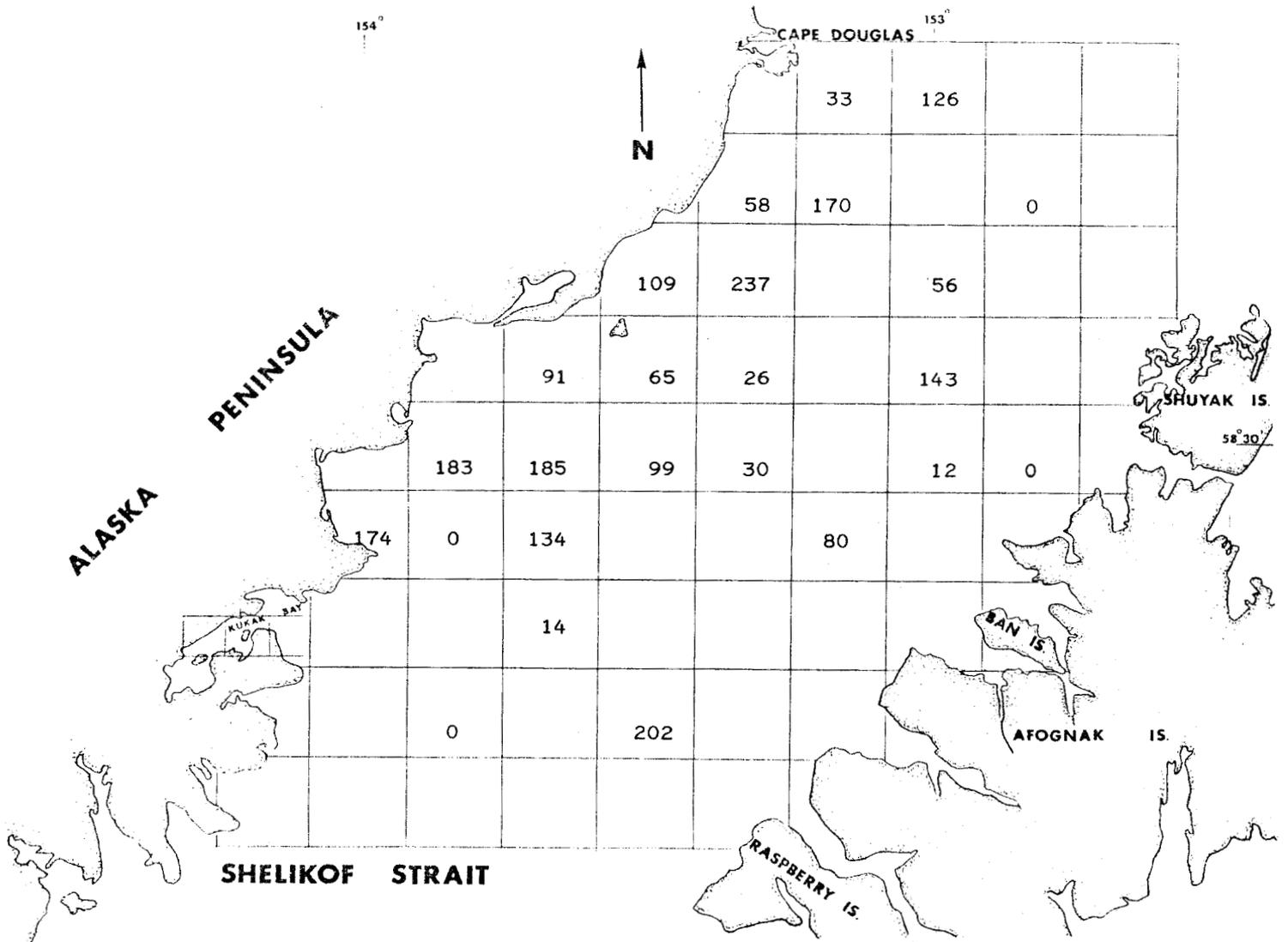
Appendix Figure 14. Distribution of Pacific cod in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.



Appendix Figure 15. Distribution of Pacific cod in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

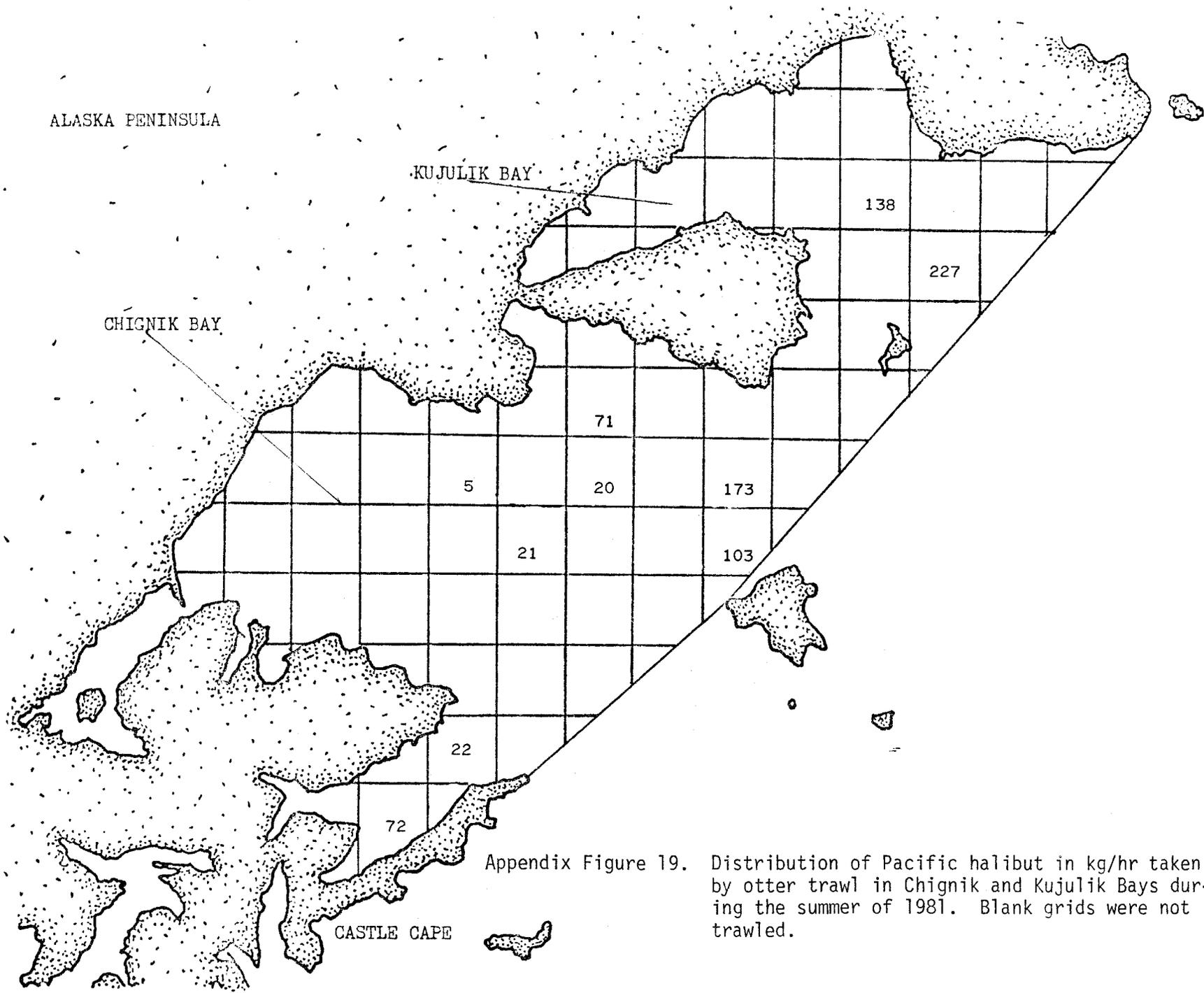


Appendix Figure 16. Distribution of Pacific cod in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.



Appendix Figure 17. Distribution of Pacific halibut in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.





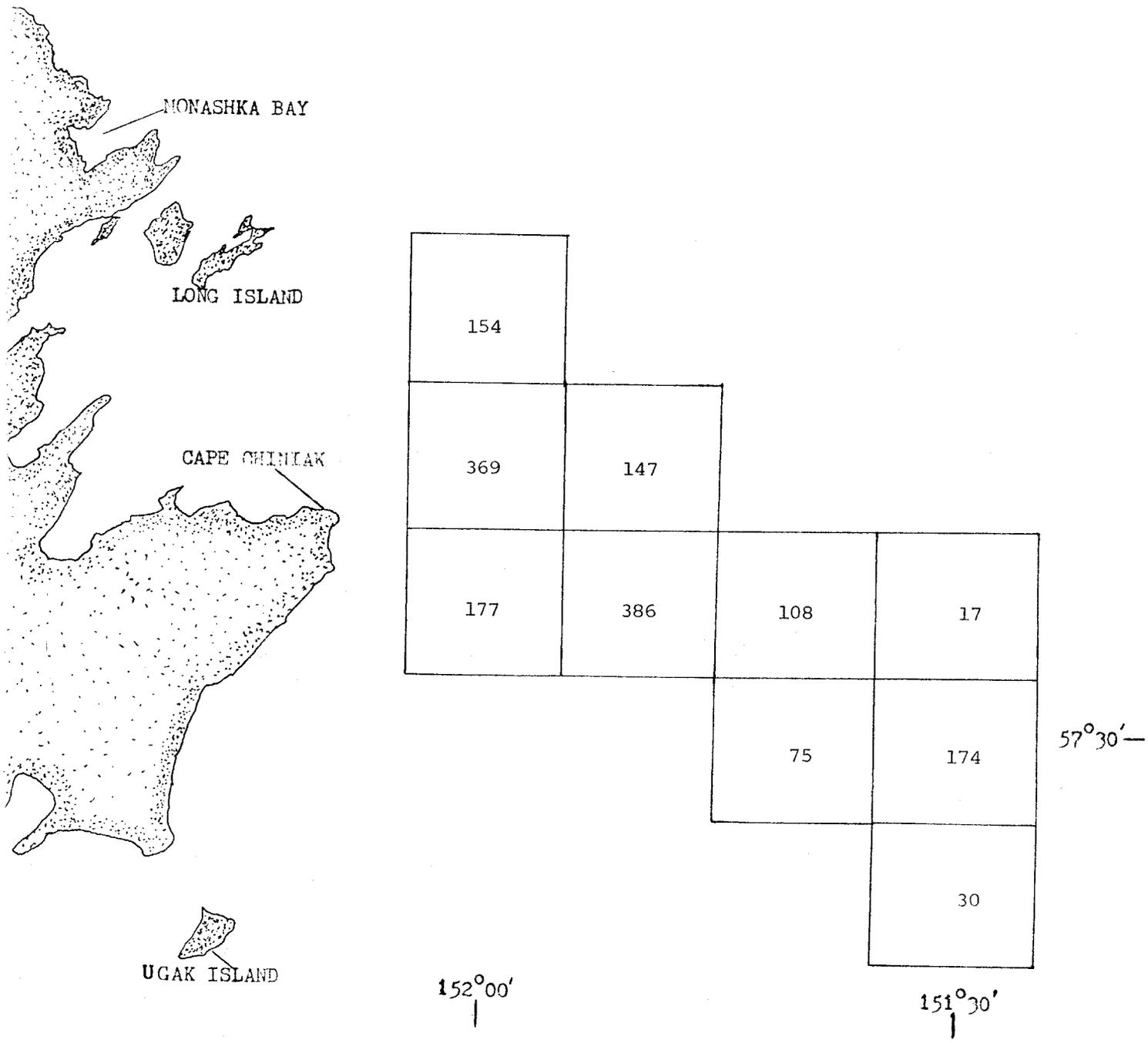
Appendix Figure 19. Distribution of Pacific halibut in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

ALASKA PENINSULA

KUJULIK BAY

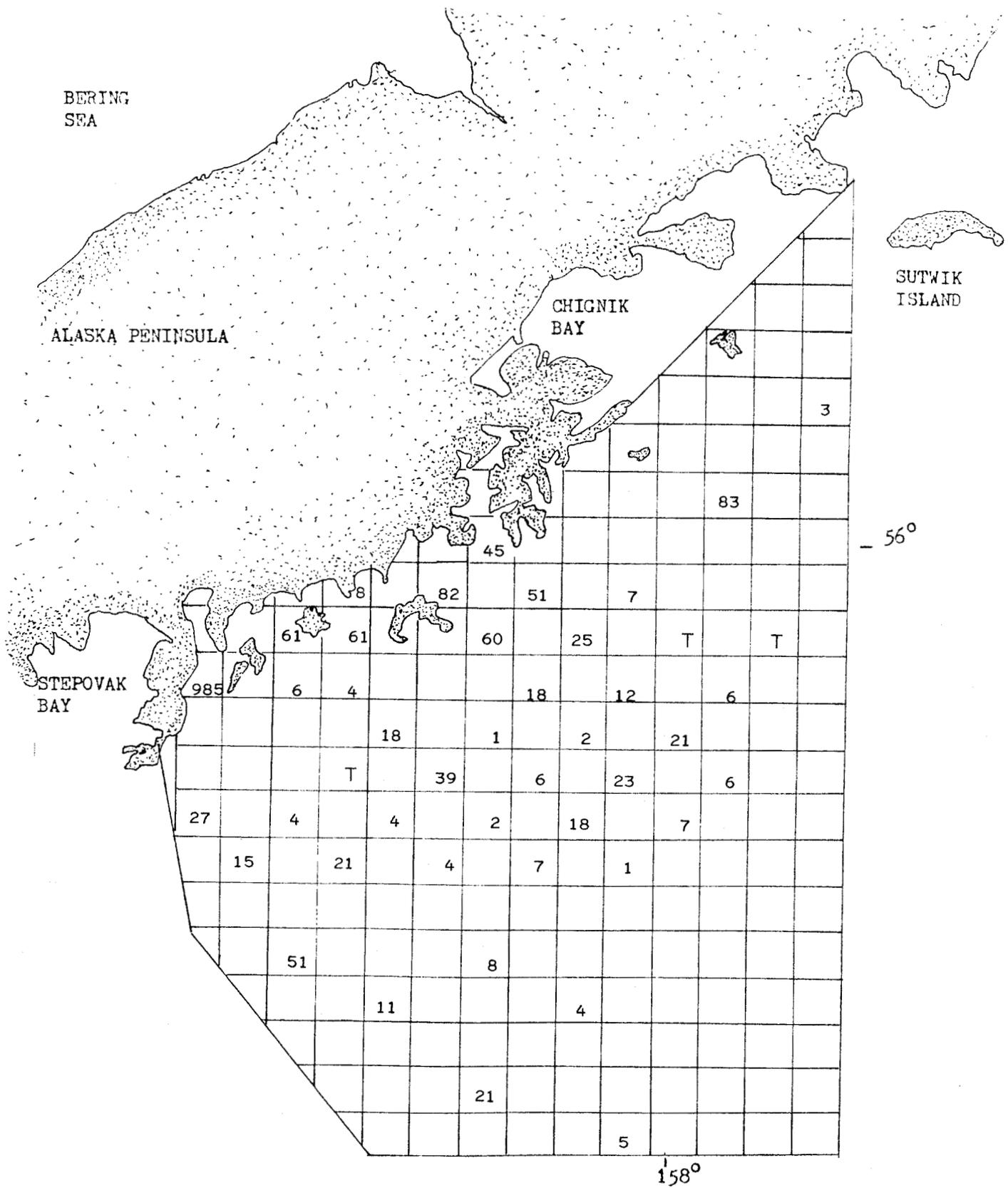
CHIGNIK BAY

CASTLE CAPE

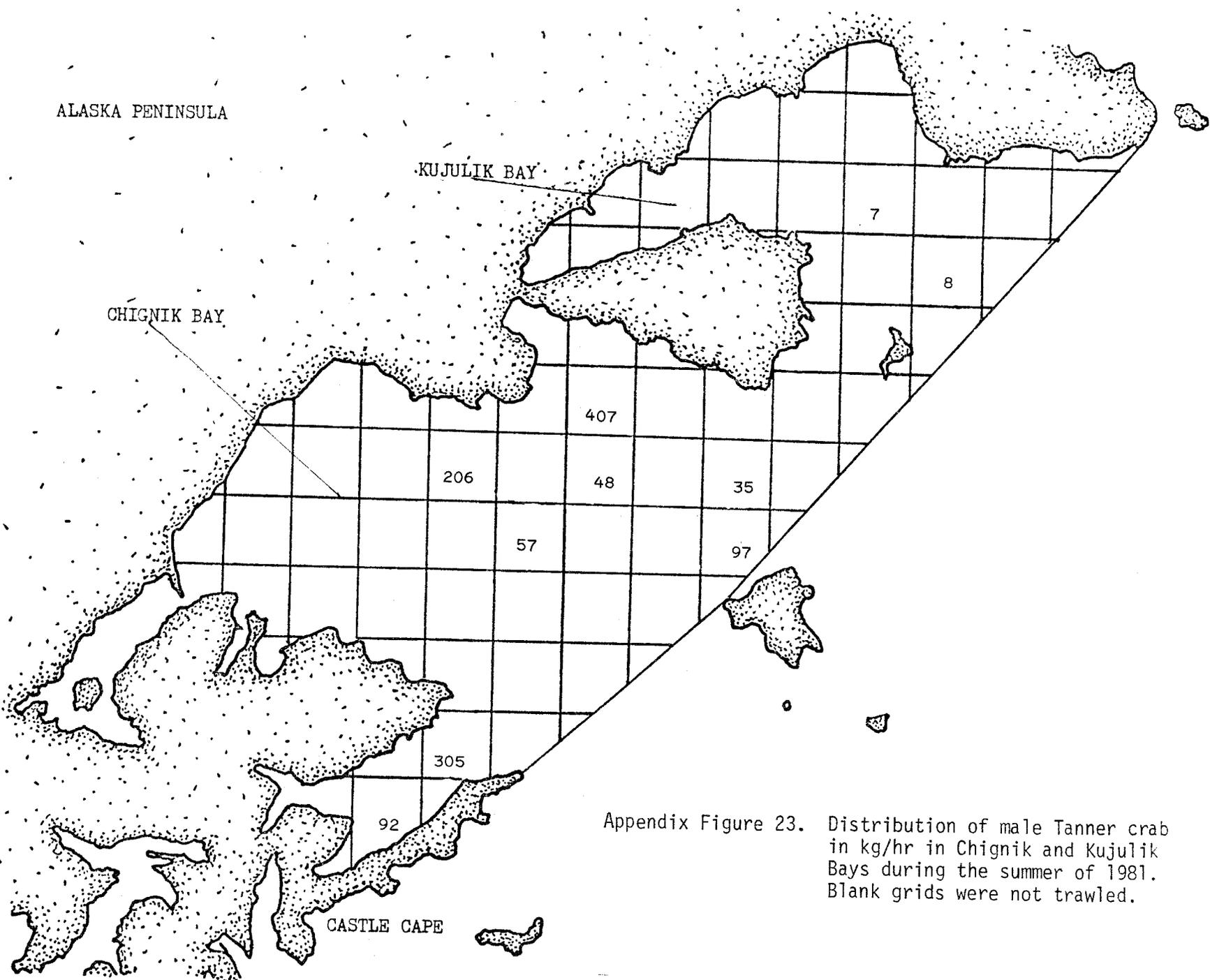


Appendix Figure 20. Distribution of Pacific halibut in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.

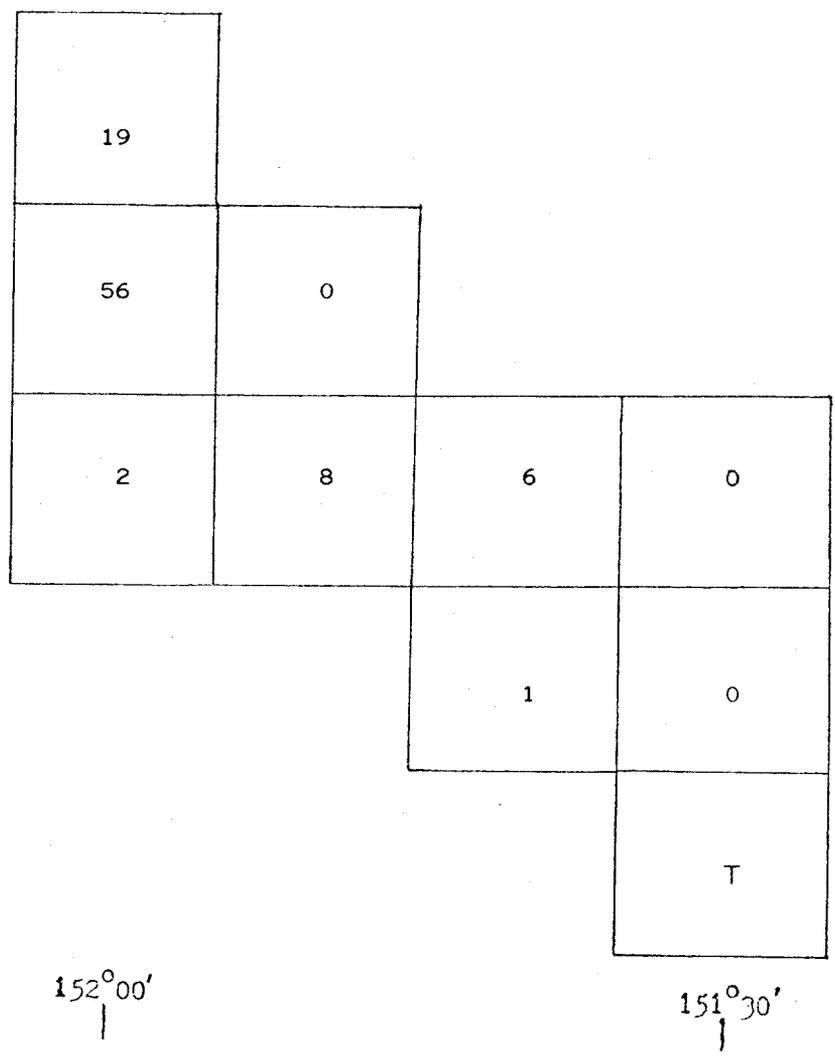
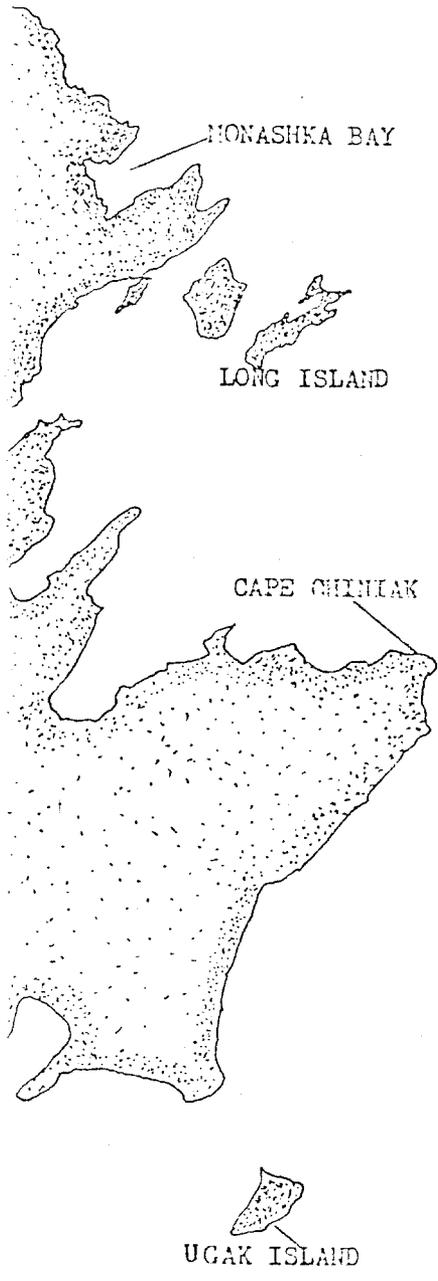




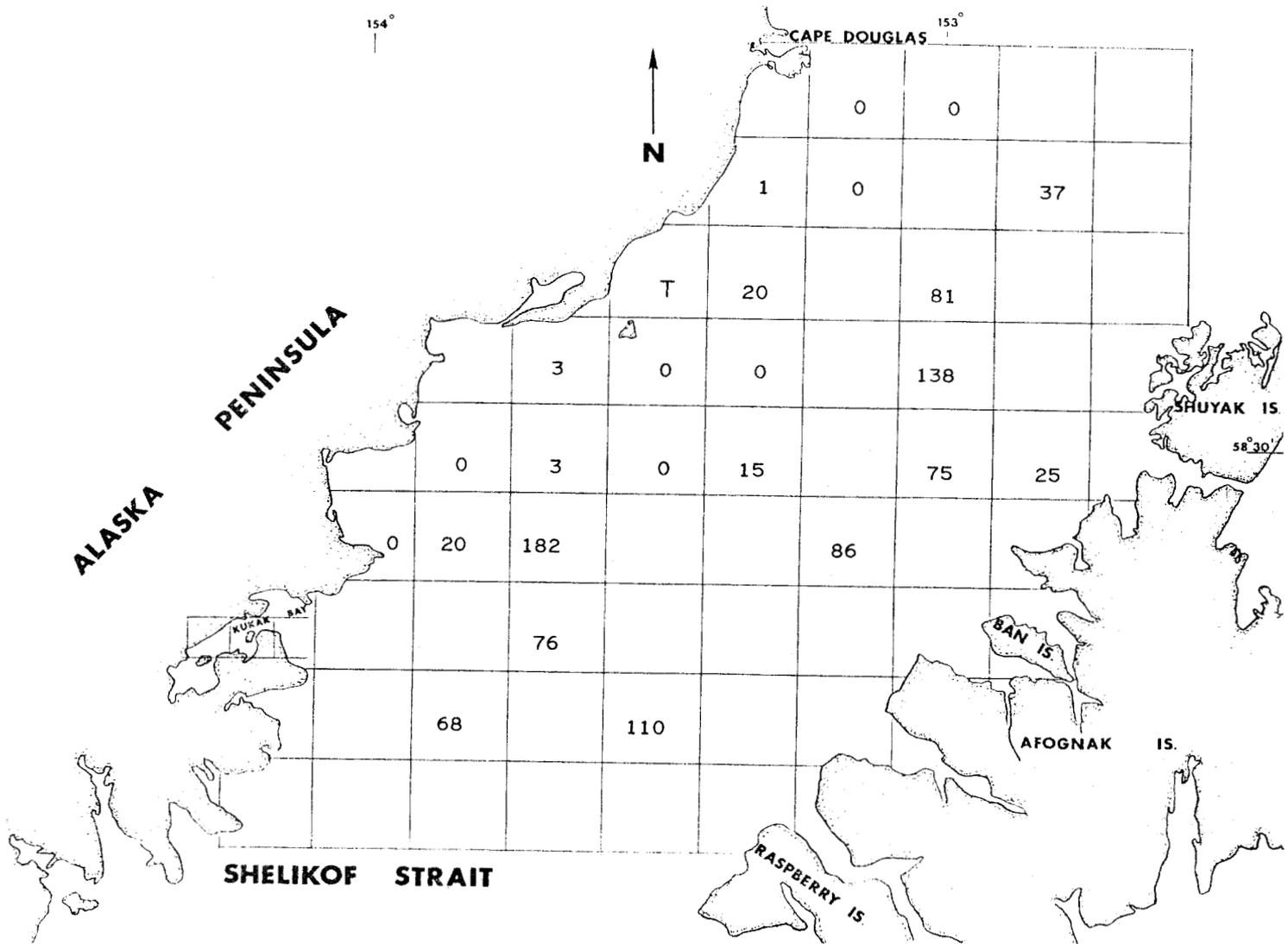
Appendix Figure 22. Distribution of male Tanner crab in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.



Appendix Figure 23. Distribution of male Tanner crab in kg/hr in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

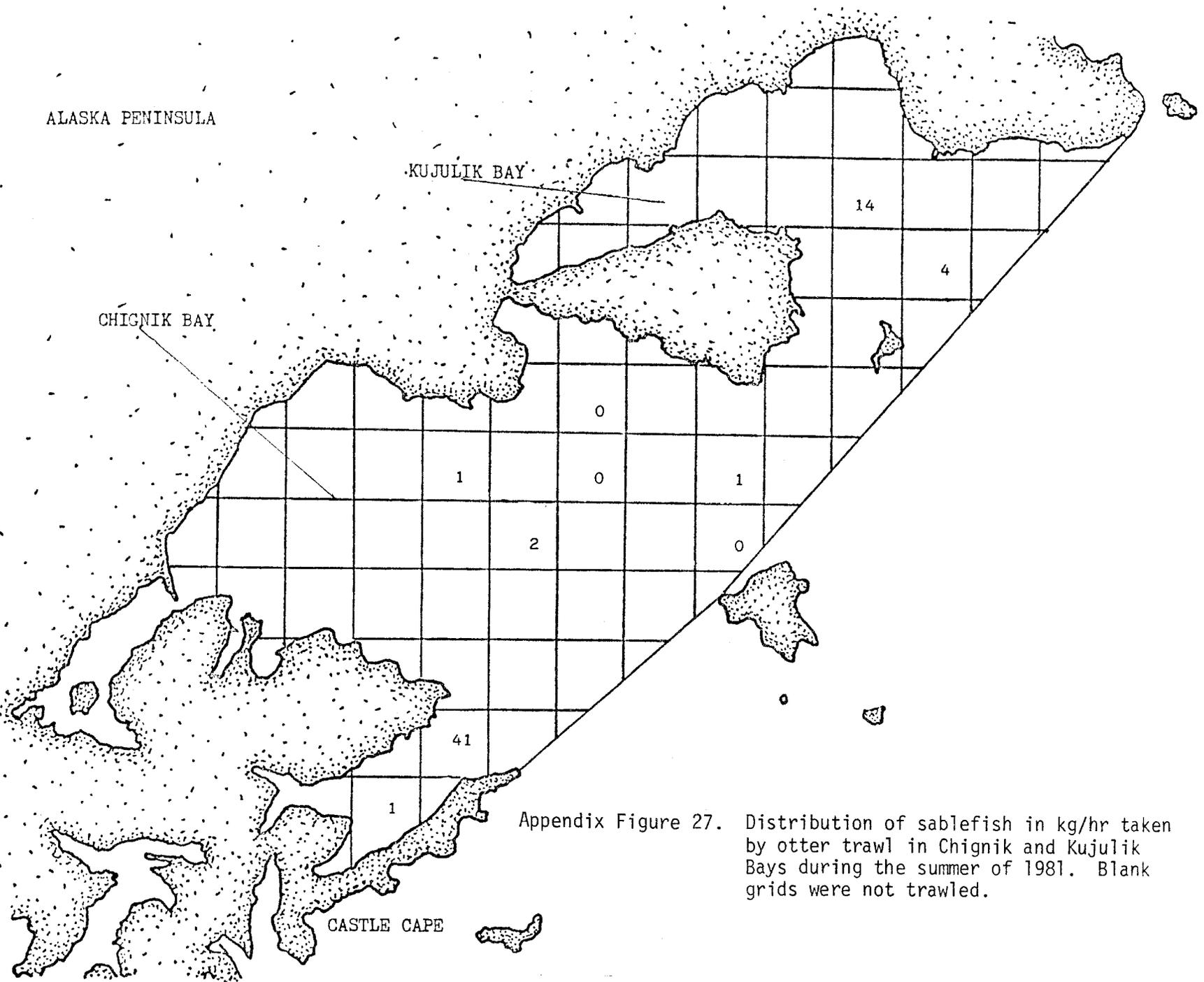


Appendix Figure 24. Distribution of male Tanner crab in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.

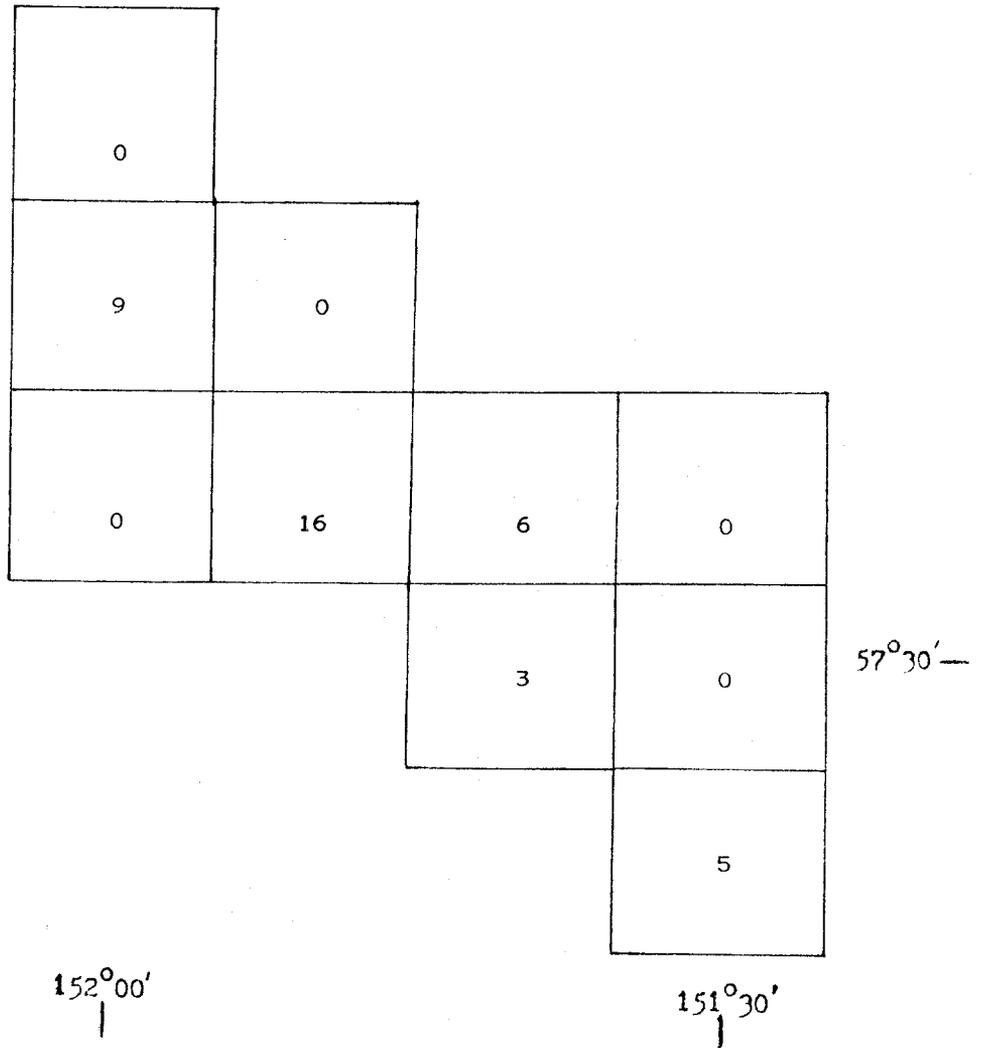
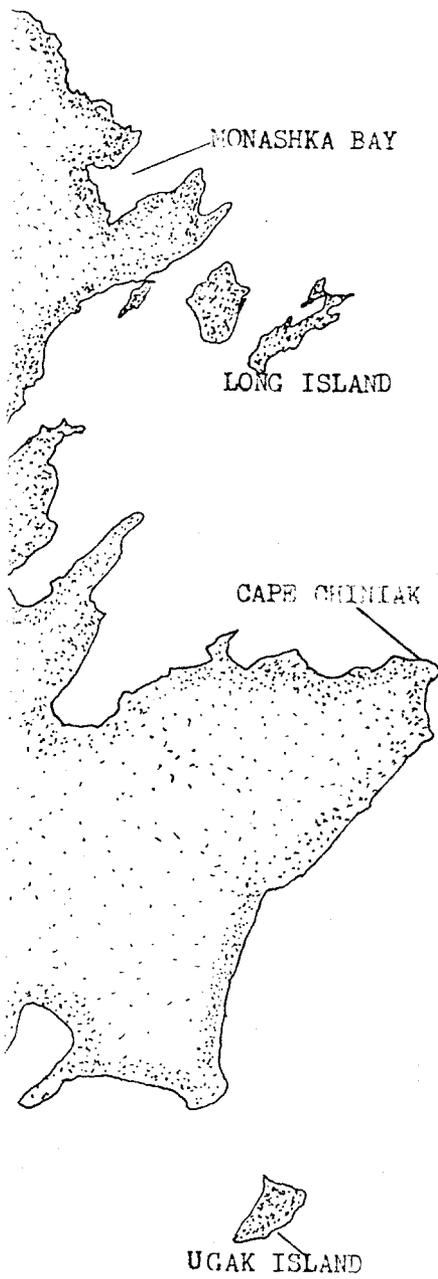


Appendix Figure 25. Distribution of sablefish in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.

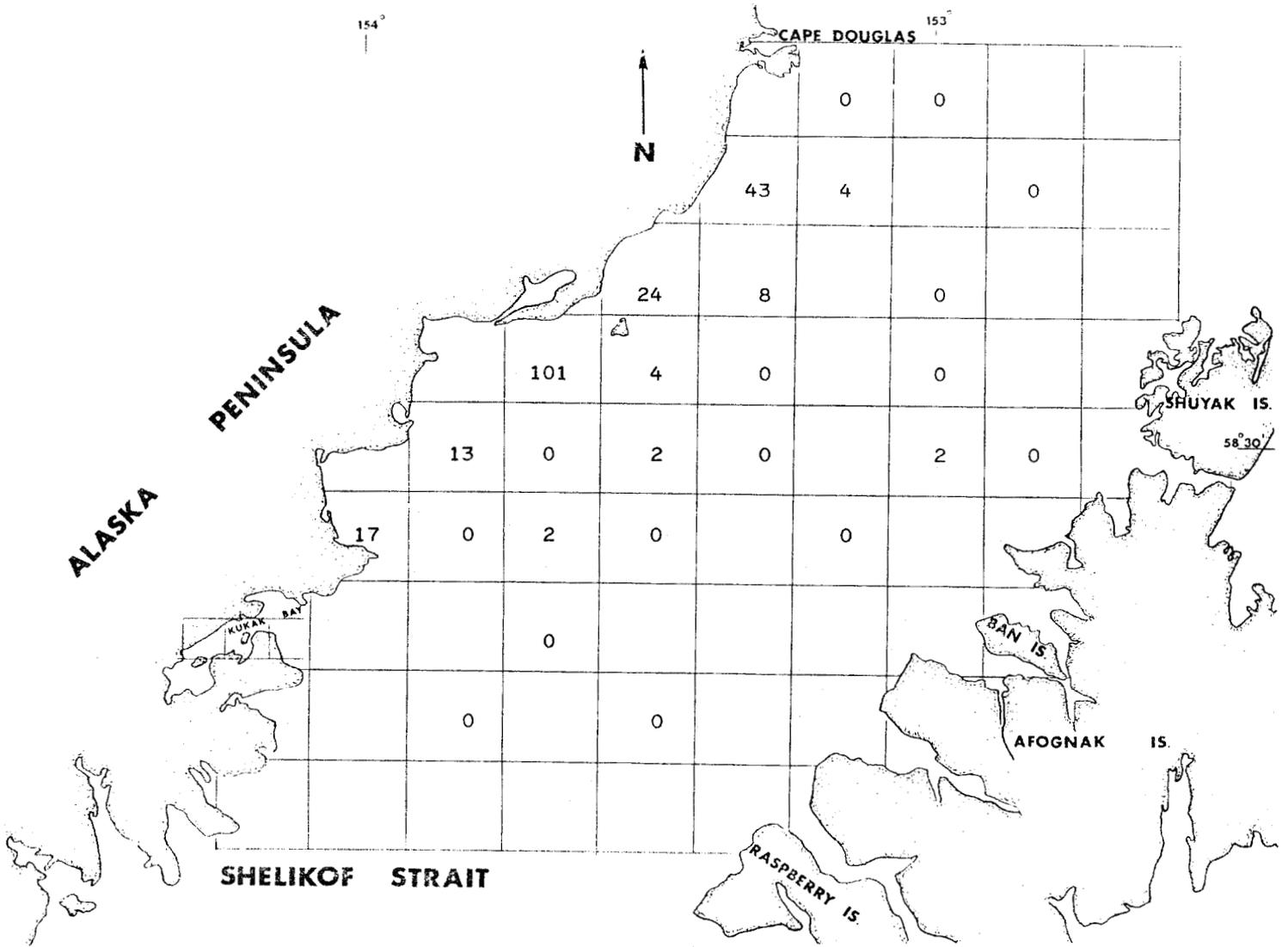




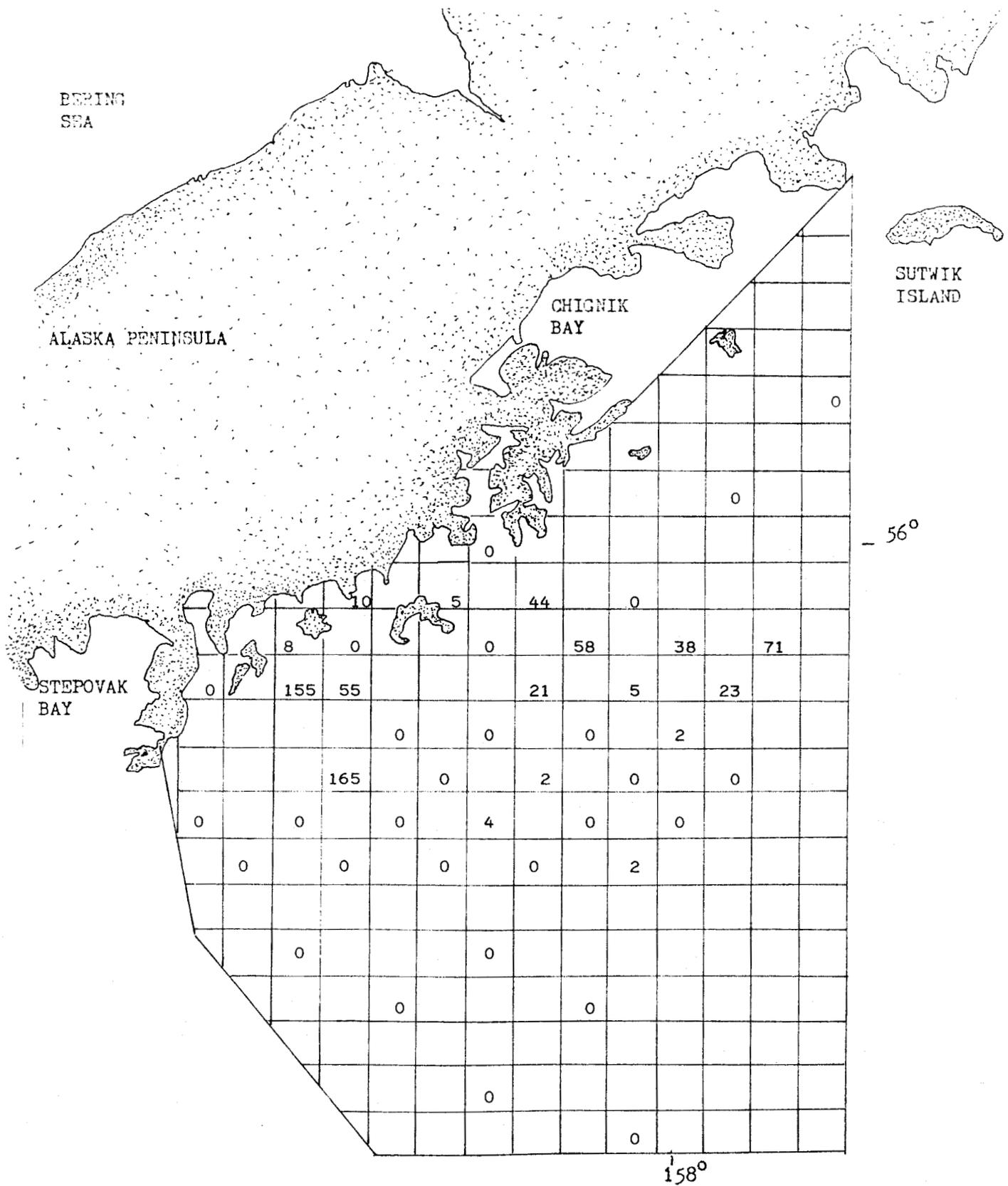
Appendix Figure 27. Distribution of sablefish in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.



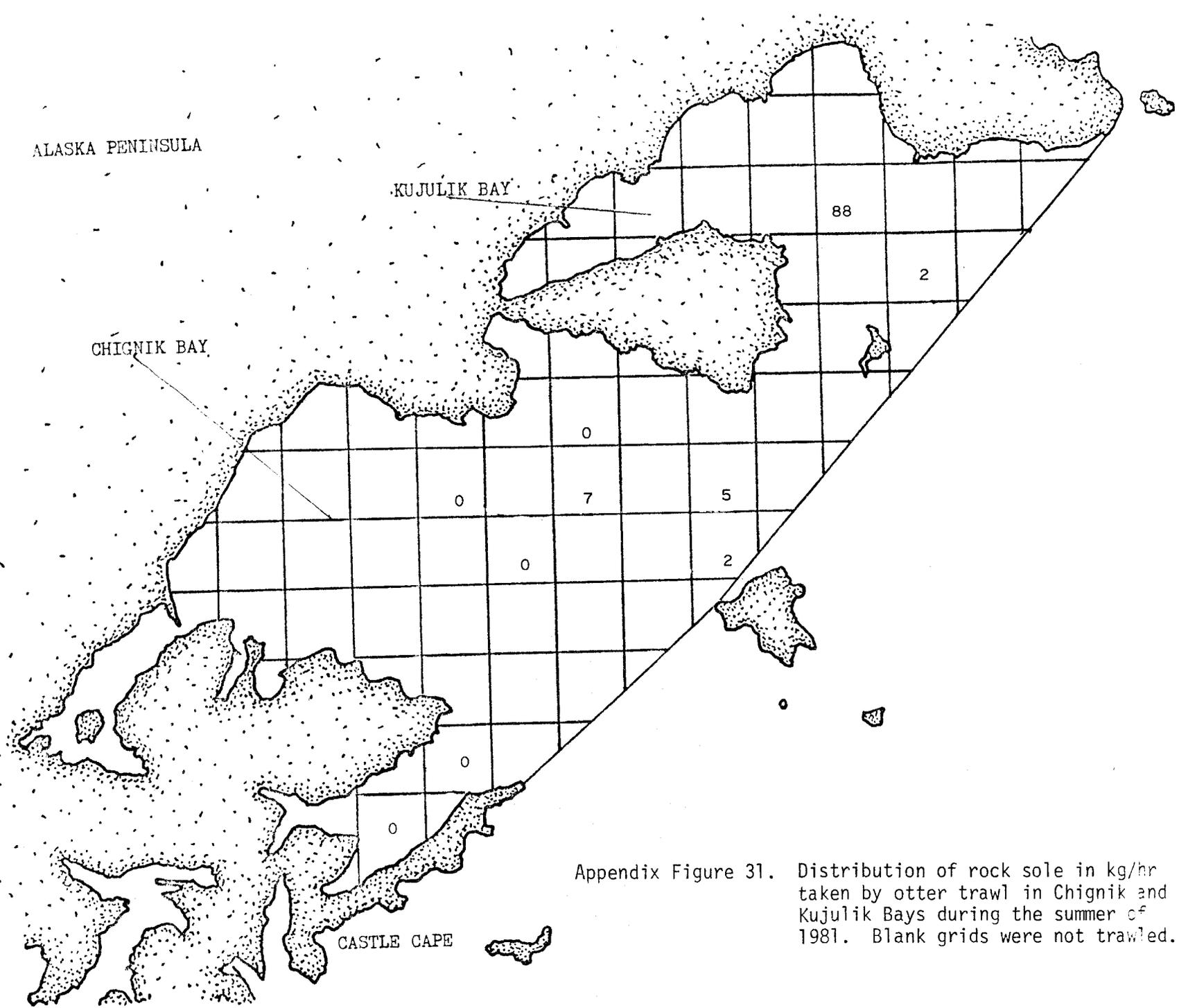
Appendix Figure 28. Distribution of sablefish in kg/hr taken by otter trawl in Chiniak gully during the summer of 1981.



Appendix Figure 29. Distribution of rock sole in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.

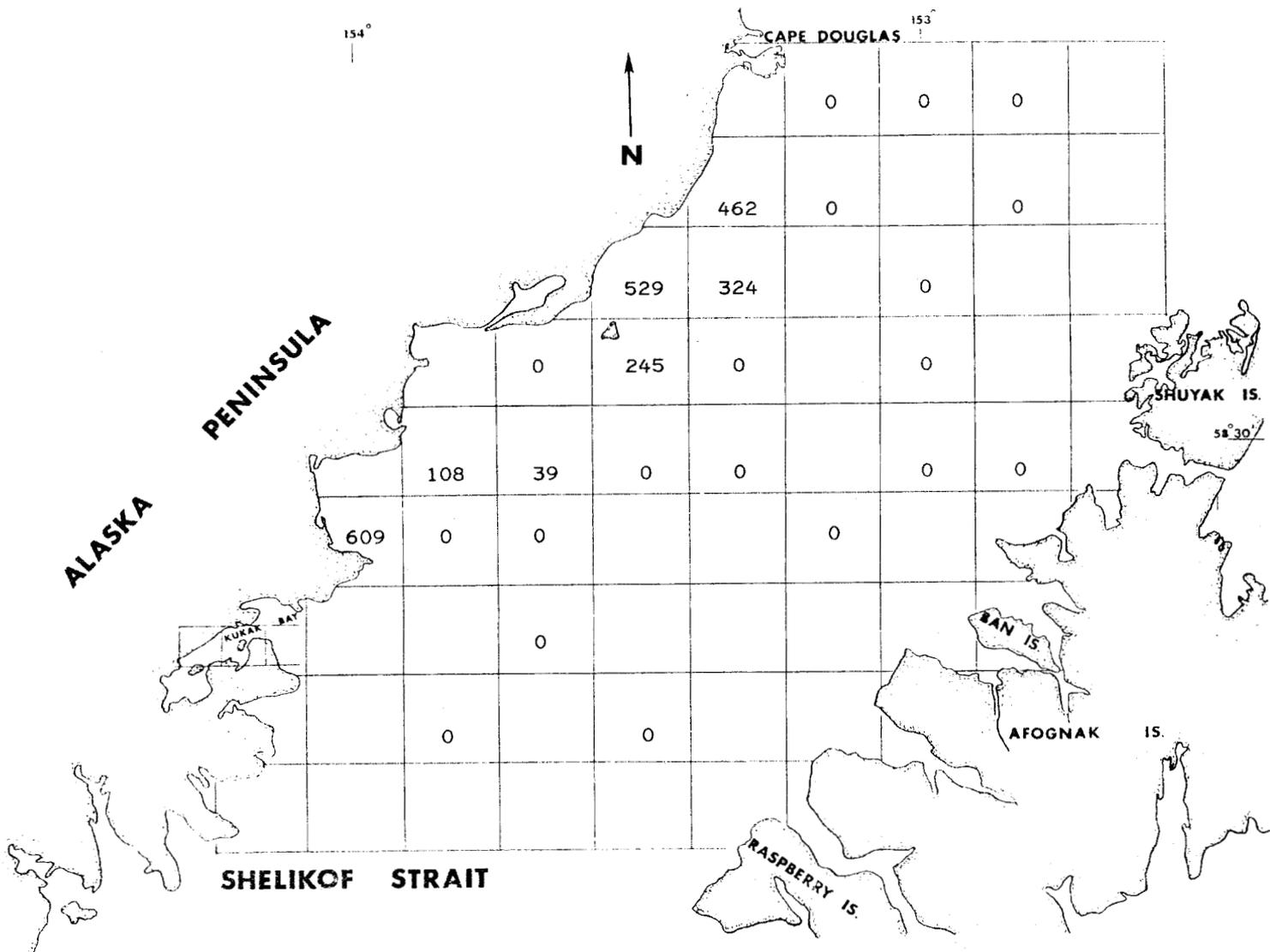


Appendix Figure 30. Distribution of rock sole in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.

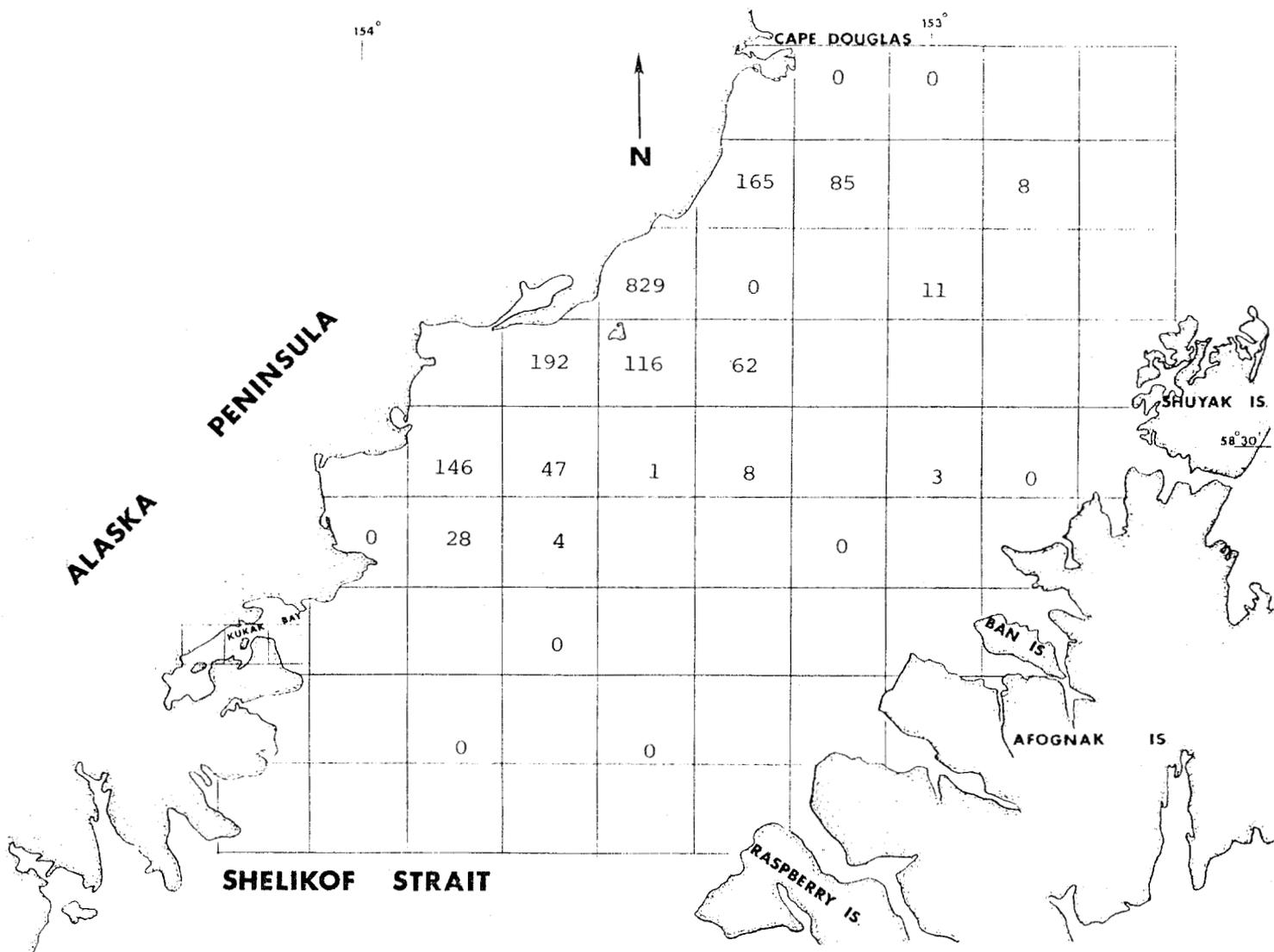


Appendix Figure 31. Distribution of rock sole in kg/hr taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981. Blank grids were not trawled.

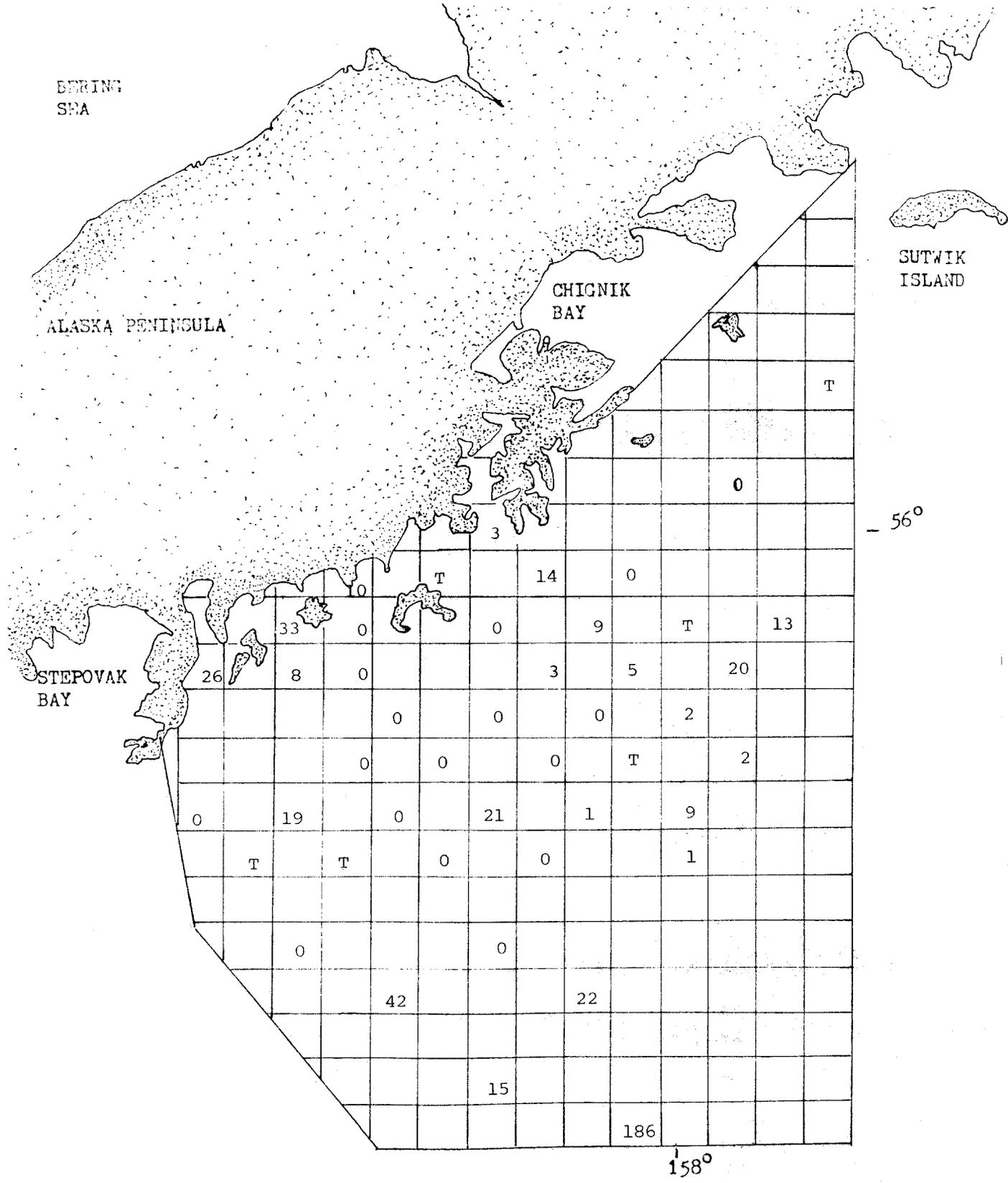




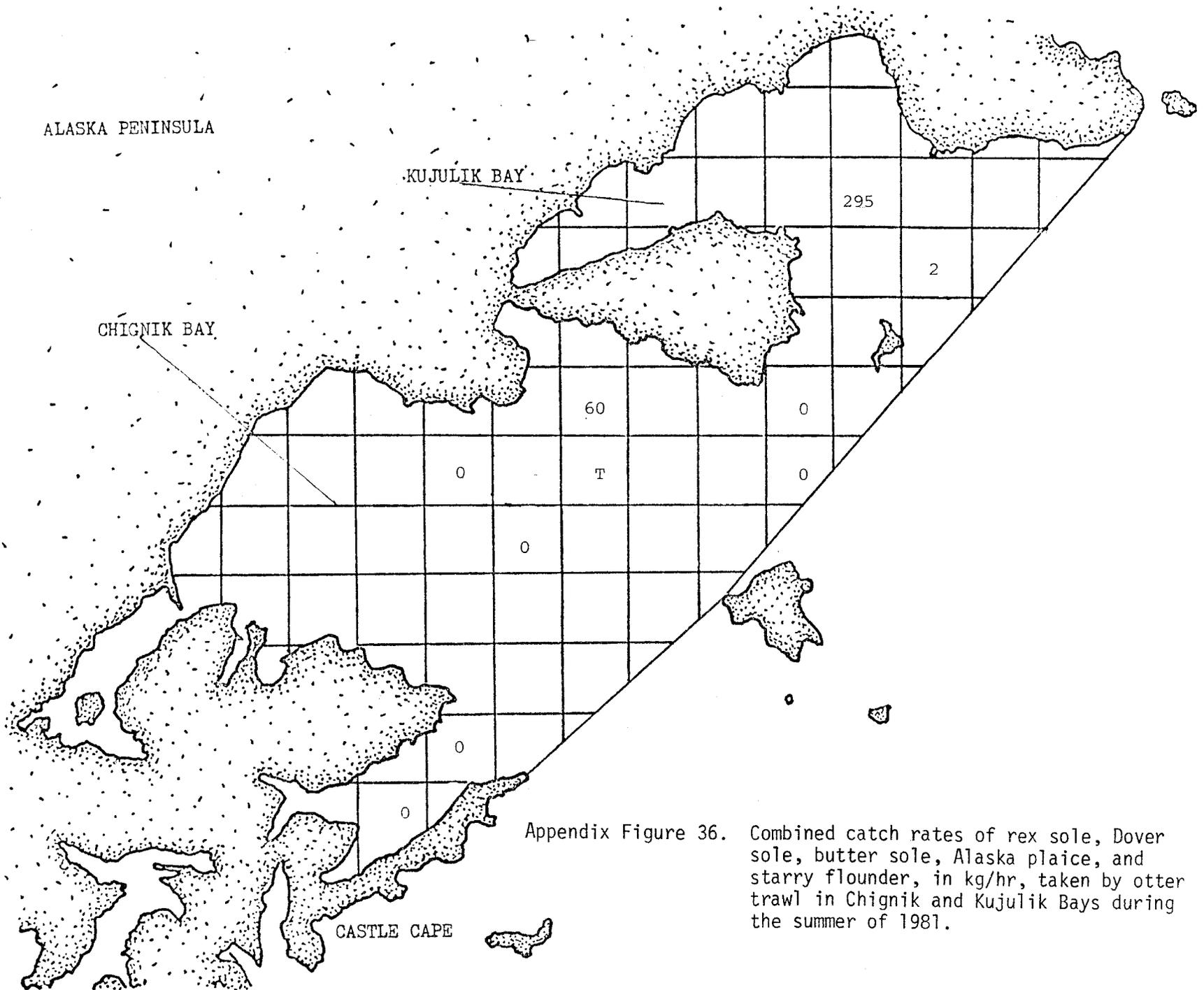
Appendix Figure 33. Distribution of big skate in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



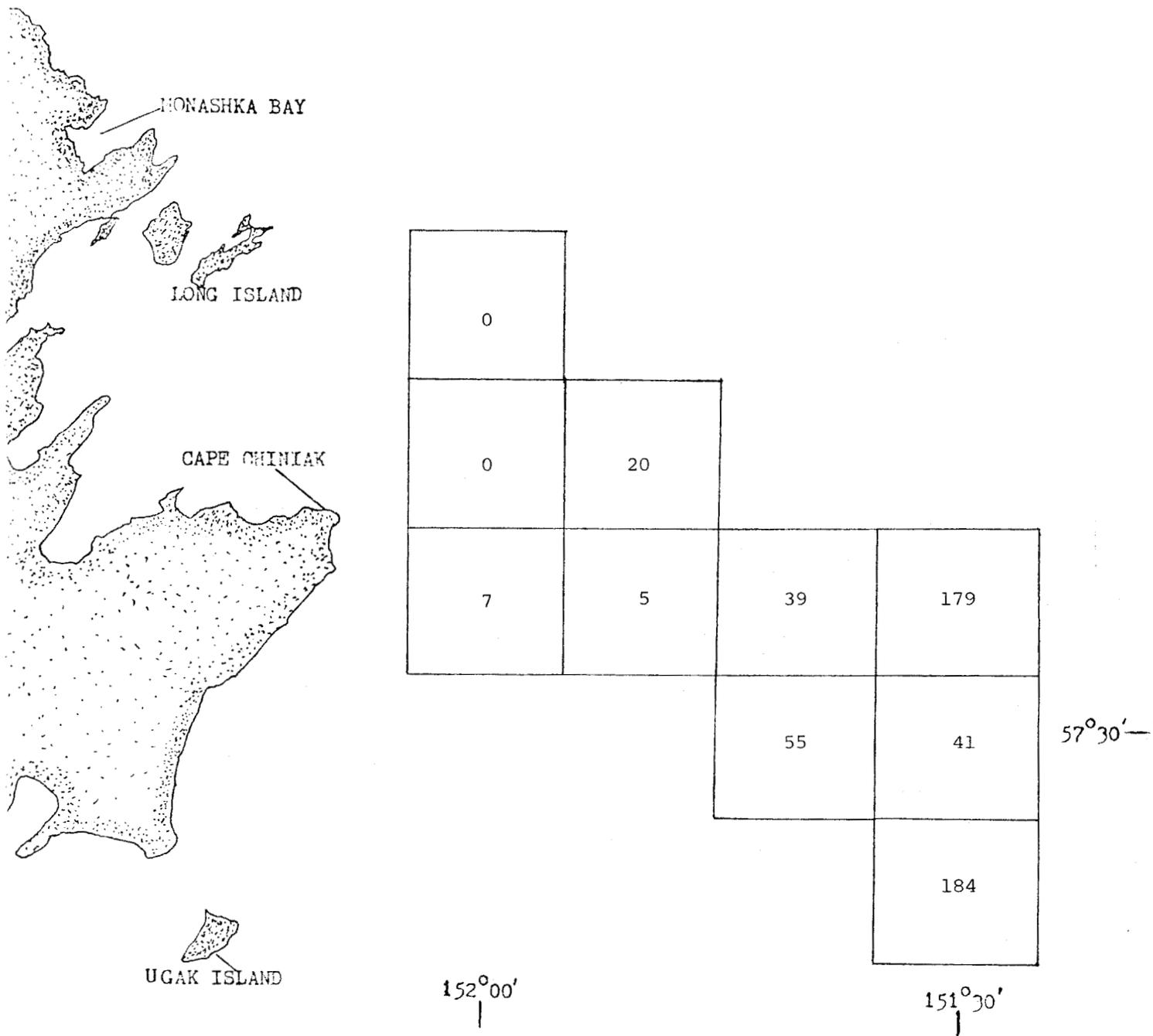
Appendix Figure 34. Combined catch rates of rex sole, Dover sole, butter sole, Alaska plaice, and starry flounder, in kg/hr, taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



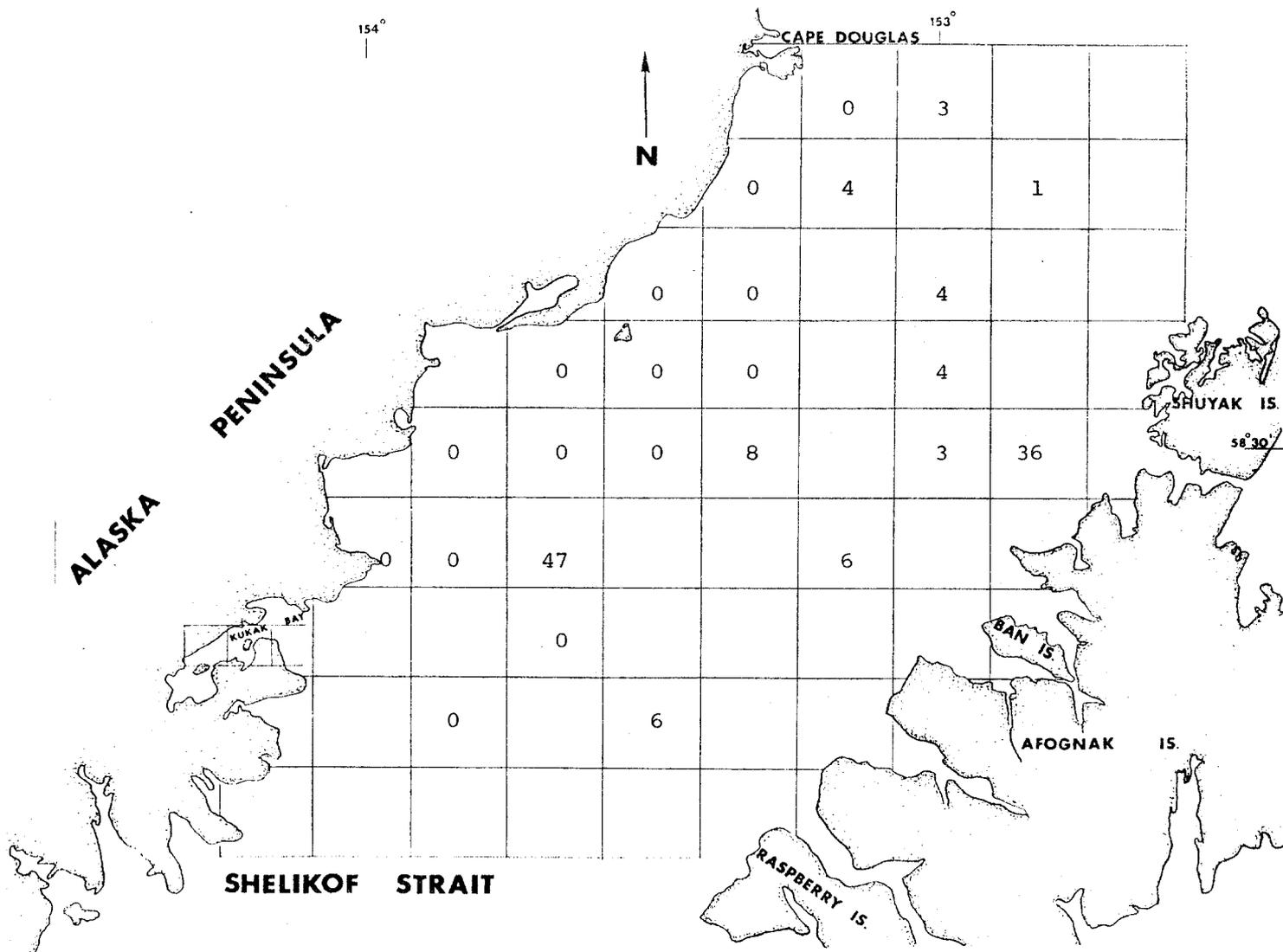
Appendix Figure 35. Combined catch rates of rex sole, Dover sole, butter sole, Alaska plaice, and starry flounder, in kg/hr, taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.



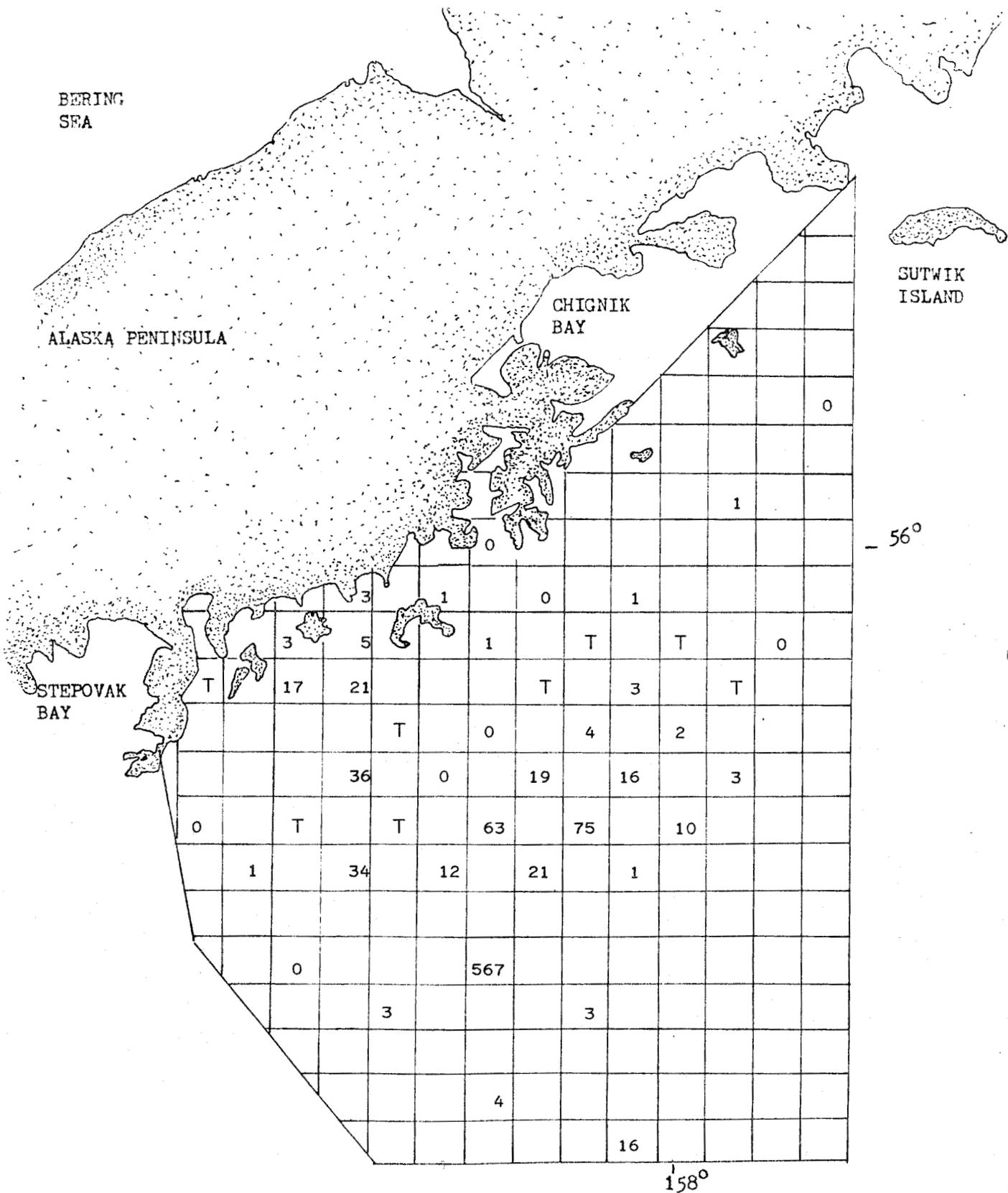
Appendix Figure 36. Combined catch rates of rex sole, Dover sole, butter sole, Alaska plaice, and starry flounder, in kg/hr, taken by otter trawl in Chignik and Kujulik Bays during the summer of 1981.



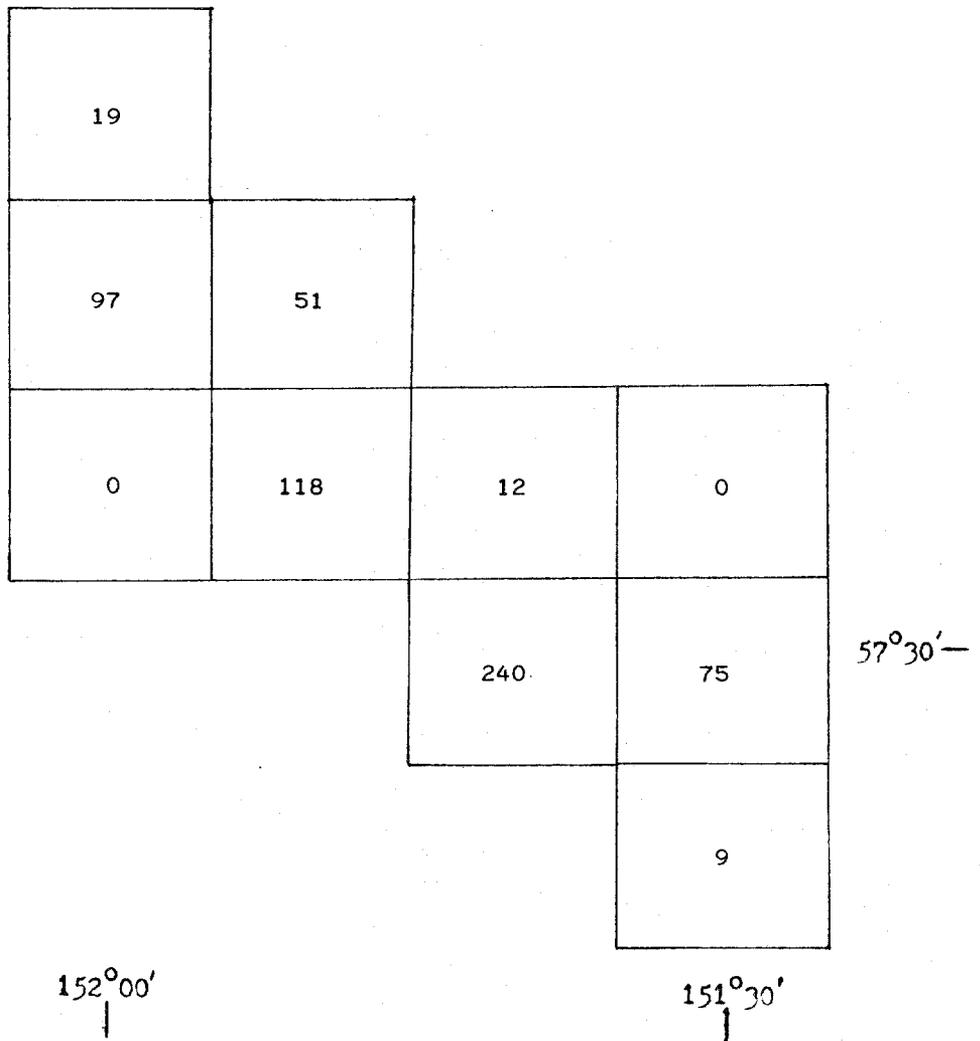
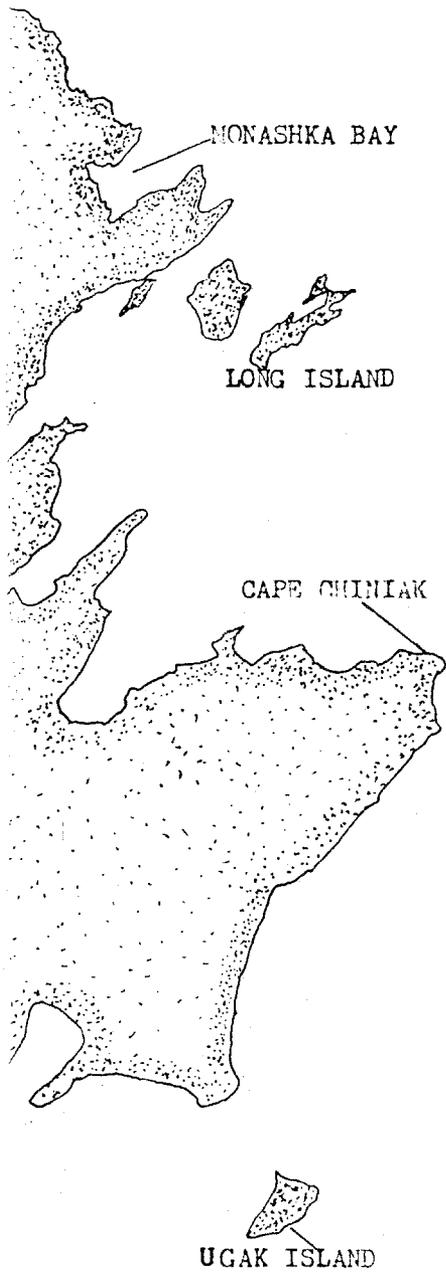
Appendix Figure 37. Combined catch rates of rex sole, Dover sole, butter sole, Alaska plaice, and starry flounder, in kg/hr, taken by otter trawl in Chiniak gully during the summer of 1981.



Appendix Figure 38. Distribution of rockfish spp. in kg/hr taken by otter trawl in Shelikof Strait during the summer of 1981. Blank grids were not trawled.



Appendix Figure 39. Distribution of rockfish spp. in kg/hr taken by otter trawl offshore of the Alaska Peninsula during the summer of 1981. Blank grids were not trawled.



Appendix Figure 40. Distribution of male king crab in kg/hr in Chiniak gully during the summer of 1981.

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