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Recreational Halibut Fishery Statistics for Southcentral Alaska (Area 3A), 1994

A Report to the International Pacific Halibut Commission

by

Scott C. Meyer

March 1996

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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RECREATIONAL HALIBUT FISHERY STATISTICS FOR SOUTHCENTRAL ALASKA (AREA 3A), 1994

A REPORT TO THE INTERNATIONAL PACIFIC HALIBUT COMMISSION

by

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ABSTRACT

Age, length, and sex composition, mean length and weight, and other fishery statistics were estimated for the recreational harvest of Pacific halibut *Hippoglossus stenolepis* in International Pacific Halibut Commission Regulatory Area 3A in 1994. Data were collected from 4,856 halibut landed at Kodiak, Deep Creek, Anchor Point, Homer, Seward, and Valdez. Ages of harvested fish ranged from 3 to 20 years, and the 1987 and 1988 year classes appeared relatively strong at most ports. Most harvested fish were between 6 and 11 years old (70-140 cm). Halibut taken by charter anglers were generally older and larger than fish taken by private anglers. Females made up 60% to 87% of the harvest in each subarea. Mean length and net weight (eviscerated, head-off) of the sport harvest ranged from 81.9 cm (13.3 lb) in Central Cook Inlet to 96.2 cm (25 lb) at Kodiak. Charter anglers accounted for a larger portion of the harvest than of the effort. The estimated percentage of the harvest taken by charter anglers ranged from 31% at Kodiak to over 75% at Homer. At all ports, private anglers tended to fish closer to port than charter anglers. Stratification by user group increased the accuracy of most estimates.

Key words: Pacific halibut, *Hippoglossus stenolepis*, Kodiak, Deep Creek, Anchor Point, Homer, Seward, Valdez, Central Cook Inlet, Cook Inlet, North Gulf Coast, Prince William Sound, Chiniak Bay, Kachemak Bay, Resurrection Bay, recreational fishery, charter, sport fishery, harvest, effort, otolith, age, length, sex, mean length, mean weight.

INTRODUCTION

THE FISHERY

The coastal waters of southcentral Alaska support the largest recreational fishery for Pacific halibut *Hippoglossus stenolepis* in the world. The fishery has developed mostly within the last 20 years and has grown steadily. Within International Pacific Halibut Commission (IPHC) Regulatory Area 3A, which extends from Cape Trinity to Cape Spencer (Figure 1), recreational harvest increased from about 18,000 fish in 1977 to 238,000 fish in 1994 (Figure 2, Appendix A1). Area 3A accounted for 72% (in number of fish) of Alaska's statewide recreational halibut harvest in 1994. The 1993 Area 3A harvest accounted for about 60% by weight of the recreational harvest on the entire west coast of North America (Blood 1994). Cook Inlet fisheries account for the vast majority of the Area 3A sport harvest (Figure 2).

The growing recreational halibut fishery is of vital economic importance to the region. Halibut fishing draws vast numbers of tourists and local derbies raise money for community projects and organizations (Denny 1990). In 1986, anglers spent $18.5 million in southcentral Alaska in pursuit of halibut, and indicated a willingness to pay an additional $25 million to ensure the continued availability of halibut fishing opportunity (Jones and Stokes 1987). Charter boats are a primary means of providing access to the fishery for residents and nonresidents, and most coastal communities support charter fleets ranging in size from a half-dozen to over 100 boats. The Homer halibut charter boat industry generated $9.1 million in gross income and the equivalent of 64 full-time year-round jobs in the Homer economy in 1985 (Coughenower 1986). There are no recent economic statistics for this fishery, but the value of the fishery has certainly increased since the mid-1980s concurrent with growth in the recreational harvest.

STOCK STATUS AND MANAGEMENT ISSUES

Pacific halibut are managed by the IPHC in state and federal waters of Alaska for optimum sustained yield under authority of the 1979 Protocol and the North Pacific Halibut Act of 1982 (McCaughran and Hoag 1992). The IPHC estimates abundance annually using a catch-at-age model, and recommends allowable harvest limits based on a constant exploitation rate strategy.

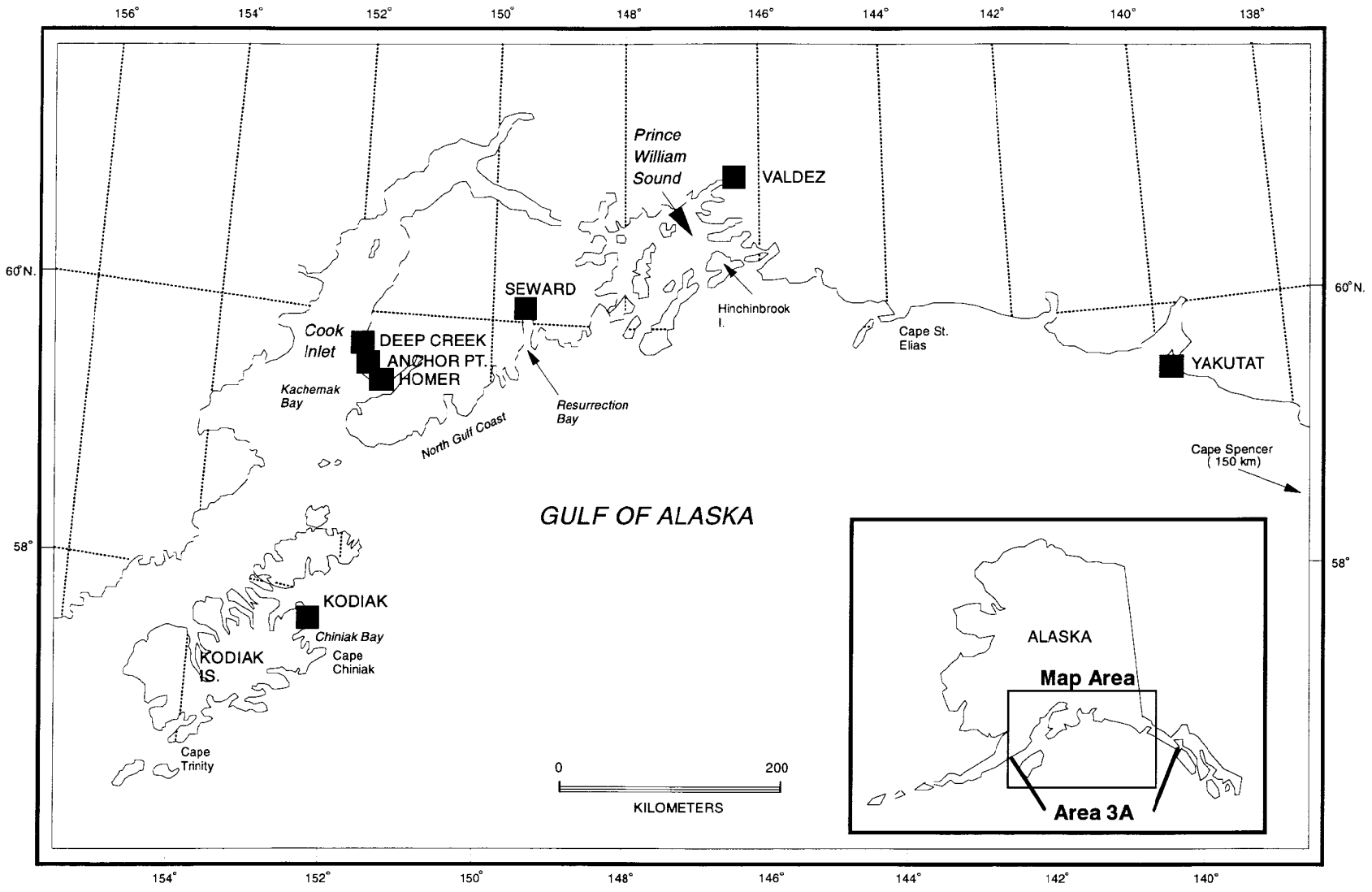

Figure 1.-Coastal waters and ports sampled for estimation of recreational harvest statistics in IPHC Regulatory Area 3A, 1994.

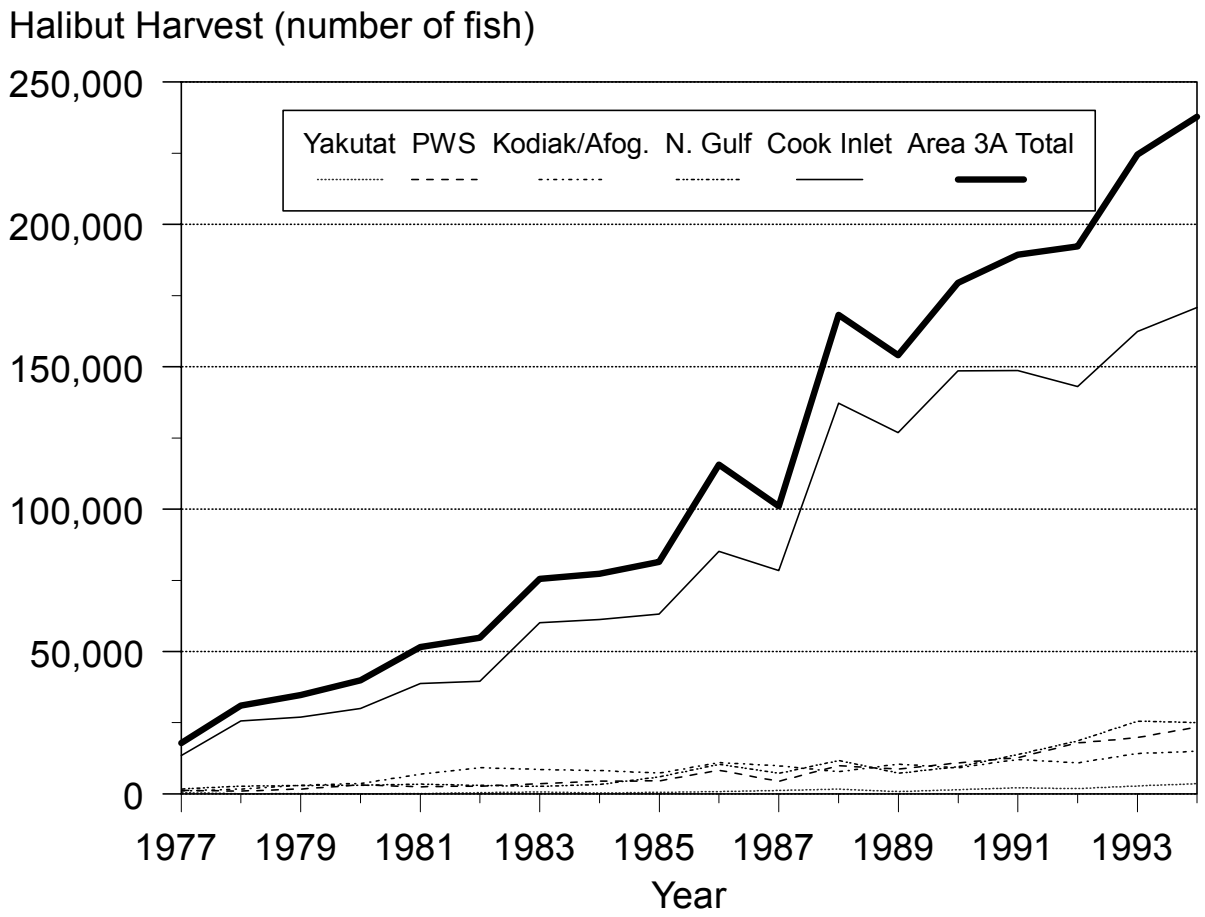

Figure 2.-Estimated recreational halibut harvest, by subarea, in IPHC Regulatory Area 3A, 1977-1994 (Mills 1979-1994, Howe et al. 1995).

Abundance of the halibut stock has risen and fallen twice since the late-1930s, and the stock in Area 3A has generally followed coast-wide trends. Exploitable biomass in Area 3A peaked at about 215 million pounds in 1989 but has since decreased at a rate of 1% to 23% per year (Sullivan and Parma 1995). Recruitment (biomass of 8 year olds) has decreased fairly steadily from a high of 83 million pounds in 1988 to 8 million pounds in 1994. Recent recruitment does not appear to be adequate to reverse the declining trend in biomass in the near future.

The halibut stock is fully utilized. Recent growth in sport harvest has led to allocation conflicts between the commercial setline and recreational fisheries in Alaska. At issue currently is whether the North Pacific Fisheries Management Council (NPFMC) should give the sport fishery, or the charter boat component, an explicit allocation. Under present management, the anticipated sport harvest, personal use harvest, bycatch, and waste are subtracted from the upcoming year's allowable harvest, and the commercial setline fishery is allocated the remainder. Vincent-Lang (1995) provides a summary of this issue.

RECREATIONAL HARVEST ASSESSMENT PROGRAM-GOALS AND OBJECTIVES

Twenty years ago sport harvest in Alaska was not felt to be a critical factor affecting fluctuations in stock abundance (Skud 1975). As the sport harvest has grown, so has the need to incorporate

information on sport removals in the annual stock assessments. As stock biomass declines, harvest by the growing sport fishery makes up an increasing percentage of total removals. Age and size information from the sport harvest is needed for accurate stock assessment. The recreational harvest is generally younger and smaller than the commercial harvest because the sport fishery is not constrained by a minimum size limit.

Although the State of Alaska does not have management authority for halibut stocks, it is interested in the wise use and fair allocation of the halibut resource among users. The state advises the IPHC and NPFMC in management and allocation issues. Through monitoring of marine fisheries for which it does have authority, the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish has collected various harvest data from the sport halibut fishery since the mid-1980s. Some data were obtained opportunistically or in conjunction with other sampling objectives and may not have been representative. A long-term port sampling program was established in 1991 to provide improved estimates of basic sport harvest statistics for halibut and other groundfish for the principal fisheries within Area 3A.

A goal of the program is to provide the IPHC with the recreational harvest data needed for annual stock assessments. Objectives and methods of the sampling program are reviewed periodically by the IPHC to ensure that halibut data meet the requirements of the stock assessment. The objectives for 1994 were to estimate the following statistics for the sport harvest in each major subarea within Area 3A:

1. The age, length, and sex composition;
2. The mean length and weight;
3. The user group composition of effort and harvest; and
4. The spatial distribution of effort and harvest for each user group.

In addition, the proportion of the harvest that was cleaned at sea was estimated for each port. The frequency with which sport-caught halibut are cleaned at sea while returning to port is increasing throughout Area 3A, particularly on charter boats. This trend may pose difficulties for accurate estimation of harvest statistics if fish cleaned and discarded at sea differ from landed fish.

It should be emphasized that the ADF&G sampling program was not established or designed specifically to address issues regarding allocation of the harvest among competing users. Data were not gathered at all ports or from all vessels, and are not indexed to individual vessels or businesses. The study was instead designed to provide the most cost-effective description of the recreational harvest for all of Area 3A.

METHODS

STUDY DESIGN

Area 3A is too large to sample all ports and all landings. Therefore, data were collected at the primary ports within each major subarea. The ports sampled and corresponding subareas were: Kodiak (Kodiak/Afognak), Deep Creek and Anchor Point (Central Cook Inlet), Homer (Lower Cook Inlet), Seward (North Gulf Coast), and Valdez (Prince William Sound). These ports accounted for over 90% of the Area 3A sport halibut harvest in 1993 (Mills 1994). Sampling

was conducted at the primary sites of landings, including harbors, boat ramps, beach launching sites, and military recreation facilities. All data were obtained through the voluntary cooperation of anglers and charter boat captains and owners.

Sampling was conducted 5 days per week at all locations, and generally extended from mid-May through early September. Days sampled were chosen at random such that weekdays and weekends were sampled proportionately. There were two sampling components: (1) biological sampling for age, sex, and size (objectives 1 and 2); and (2) angler interviews to estimate the composition of effort and harvest by user group and geographic area (objectives 3 and 4). Some data from interviews, such as estimates of the temporal distribution of harvest and the proportion of the harvest that was cleaned at sea, were used in the estimation of biological characteristics. At all ports except Kodiak, biological data were collected on 3 randomly selected days per week, and anglers were interviewed on the remaining 2 days. This design allowed technicians to focus on each task and alleviated problems associated with saturation of the sampler. Fish sampling and angler sampling were conducted simultaneously at Kodiak because effort and harvest were relatively low compared to other ports, and both tasks were manageable for the sampler. Work shifts were 7.5 h long and generally fell within the period 1500-2300 hours. Sampling designs varied by port to account for differences in port layout and fishery logistics.

Kodiak

Biological sampling and angler interviews were conducted at St. Paul's Harbor, St. Herman's Harbor (Dog Bay), and the U.S. Coast Guard Base. Starting at approximately 1530 hours, the technician chose the first site at random then "cycled" through the three sites, staying at each site long enough to interview all returning anglers and sample available fish before moving to the next site. Each site was visited two or three times per day under this scheme. Large plastic barrels were placed at each location to collect carcasses that accumulated when the technician was away or busy. About a third of the known charter boat operators cleaned fish and disposed of some or all carcasses at sea in order to expedite shore operations. To avoid bias in estimation of age and length statistics, carcasses from these vessels were included in the sample only when all carcasses from the day's catch were returned to port, or prior arrangements were made for the crew to retain a systematic sample.

Homer

Data were collected at the boat harbor and at cleaning stations on the Homer Spit. Biological sampling shifts started between 1400 and 1500 hours each day. The early portion of each shift was spent sampling at the public fish cleaning station while monitoring the return of charter boats. As charter vessels arrived, they transported fish immediately to cleaning stations near the harbor. After these fish were cleaned, the carcasses were retained in large plastic tubs for several hours before disposal. Once carcasses of charter-caught fish had accumulated, sampling alternated between the boat ramp, public fish cleaning station, and charter facilities. This alternation of sampling sites allowed the technician to monitor incoming harvest and allocate sampling effort proportionately among sites.

Based on the reports of charter operators, it was suspected that a significant portion of the charter halibut harvest was cleaned at sea while returning to port. Carcasses of these fish were discarded at sea and therefore unavailable for sampling on shore. As a result, there was concern over possible bias in estimation due to differences in size between fish that were retained and cleaned

in port and fish that were cleaned at sea. Length, age, and sex data were gathered from charter-caught fish that would otherwise have been discarded at sea through the cooperation of 11 vessel captains that cleaned all or a portion of their catch at sea. Each sample day between June 28 and August 16, one of these 11 vessels was contacted at random and provided with a tub in which to retain carcasses of fish cleaned at sea.

Angler interviews were obtained through a systematic sampling design. The boat harbor at Homer was too large and effort was too great to contact all returning boats. Therefore, the harbor was broken into five areas based on accessibility and relative numbers of recreational boats. Interviews were conducted during the period 1400-2000 hours each day, encompassing the return of the majority of boats. The order in which areas were sampled was determined randomly, with the first area rotated systematically each day, and the second area repeated. Under this design, all five areas were sampled during each 6-hour shift. Over the season, all areas and hours received equal sampling effort, and all user groups returning during the interview period should have been sampled proportionately. All returning boats were contacted for interviews.

Deep Creek and Anchor Point

The primary access areas in the Central Cook Inlet halibut fishery are the beaches near the mouths of Deep Creek and Anchor River. Boats are launched from improved boat ramps or from the beach. Boat ramps can be used by most boats only within a few hours of high tide. Tractor services are provided to launch boats at any tide stage. Data collected in 1993 showed that charter and private (noncharter) boats generally exited at the Deep Creek beach during the 6-hour period following high tide (peak) in 1993 (Larson et al. *Unpublished*). Fish sampling and interviews were therefore scheduled for peak periods, with shifts beginning no earlier than 0800 hours and no later than 1800 hours. Twenty percent of biological sampling effort and angler interview effort was allocated to the Anchor Point exit area, based on the distribution of aerial boat counts in 1993 (Larson et al. *Unpublished*).

It was not possible to achieve biological sample sizes that were proportional to harvest by each user group due to the logistics of boat traffic on the beaches. Halibut caught by private boat anglers were sampled onsite during the first half of each shift. Most charter boats hauled out using tractors, and immediately transported fish to cleaning facilities located up to several miles from the beach. It was impractical to delay tractors and disrupt traffic flow by sampling fish onsite. Therefore, charter-caught halibut were sampled during the latter half of each shift at charter-owned fish cleaning facilities located in the area between Anchor Point and Ninilchik. Each designated fish sampling day, data were obtained from 3-6 companies drawn from a list of 19 cooperating companies. The companies sampled each day were not drawn strictly at random, but the technician selected companies in a systematic fashion to the extent possible. Fish harvested by anglers utilizing these 19 companies were assumed to be representative of the charter angler harvest on the whole.

Interview sampling at Deep Creek was broken into three subareas: (1) the boat ramp and beach north of the tractor launch, (2) the tractor launch area, and (3) the beach south of the tractor launch area. All boats exiting the fishery were contacted in each area for 2 hours each day. The order in which areas were sampled was determined at random prior to the season, with the first area rotated systematically as for Homer. The beach at Anchor Point, however, was effectively sampled by stopping all vehicles as they left the beach through a single point.

Seward

Data were collected in the boat harbor and at both fish cleaning stations at the Seward Military Recreation Camp. Biological sampling typically began between 1500 and 1600 hours. The technician started each shift by sampling charter and private harvest at the boat harbor while visually monitoring the return of military charter boats. Once a significant portion of military boats had returned, fish were sampled at the military cleaning stations for 1-2 h. The technician then spent the remainder of the shift sampling the boat harbor. Large barrels were placed at fish cleaning stations and at selected charter boat slips throughout the harbor to collect carcasses that accumulated while the technician was away or busy. Although some cleaned fish were missed under this design, there was no reason to believe that the biological characteristics of missed fish were systematically different than those of sampled fish. Four charter boats that typically cleaned all of their harvest and discarded the carcasses at sea were provided with logbooks in order to monitor the number of missed fish.

Interviews were obtained only from civilian charter crews and private anglers; military charter operations provided comparable data through a voluntary daily logbook. Interviews were conducted in the harbor during the period 1500-2200 hours. At the start of the season, the harbor was split into two areas and interviews were conducted in each area for one-half of the shift. The order in which areas were sampled each day was determined by the roll of a die. These two areas turned out to be too large to effectively intercept returning boats. As a result, the harbor was divided into three areas on July 1. With the opening of a new boat ramp in the northeast corner of the harbor, a fourth area was added on August 14. With each new division of the harbor, the proportion of returning boats that were contacted for interviews in each area was adjusted to maintain a constant sampling rate.

Valdez

All sampling at Valdez occurred in the harbor as this was virtually the only access point. Biological sampling was conducted primarily during the period 1600-2300 hours, with limited sampling in mid-morning to check for carcasses deposited late the previous night. Samples were obtained by simply roving among the fish cleaning stations. A high proportion of available fish were felt to have been sampled under this design, and frequent contact with anglers enhanced compliance with carcass collection. Interviews were conducted throughout the harbor during the hours 1600-2300 only. All returning boats were contacted for interviews.

DATA COLLECTION

Ideally, sample sizes would have been proportional to the total number of fish harvested in each period for which an estimate of composition was desired. Unstable marine weather and trends in tourism, however, caused high daily and monthly variation in groundfish harvest and effort. In order to prevent saturation of the samplers, fish were sampled systematically (e.g. every third fish), with the sampling fraction adjusted inseason in anticipation of harvest levels. Systematic sampling ensured that the sample was drawn from the entire pool of fish available to the sampler during the work shift.

Samplers also attempted to keep track of the number of fish that were landed but were not available for sampling ("missed fish"). Fish were often not available for sampling because (1) the angler or guide cleaned the fish and discarded carcasses at sea or in the harbor, (2) anglers

were unwilling or unable to allow their fish to be sampled, or (3) there were too many fish available to sample at the prescribed sampling rate in the time allowed.

Generally, biological information was taken from carcasses with fillets already removed. Many halibut taken by unguided anglers were sampled in the round at Deep Creek and Anchor Point. Length was recorded to the nearest millimeter along a straight line from the tip of the snout to the center lobe of the caudal fin. Weight was recorded to the nearest 0.1 kg whenever practical. Sex of all fish was determined by examination of gonads. Left-side otoliths (saggitae) were removed, hand cleaned in water, and stored in labeled coin envelopes. The user group (charter, private, military, etc.) and National Marine Fisheries Service (NMFS) groundfish statistical area (stat area hereafter) of capture were recorded whenever possible.

Returning boats were contacted for angler interviews regardless of fishing success. All anglers that targeted bottomfish (including halibut) or harvested halibut were interviewed. The following information was recorded for each boat-trip: hour of the interview; user group; NMFS groundfish stat area(s) fished; number of anglers that fished; target species; number of halibut, lingcod, rockfishes, and chinook salmon caught and kept; and the number of halibut kept that were cleaned at sea. Users were classified as charter or private at all ports. In addition, data were separated for private anglers using U.S. Coast Guard facilities at Kodiak, and military charter anglers at Seward and Valdez. Effort and harvest by charter boat skippers and crew were included in boat totals if they fished. Charter boat skippers were interviewed to minimize inaccurate reporting of stat areas.

All biological and interview data collected in 1994 are archived with ADF&G, Division of Sport Fish, Research and Technical Services in Anchorage. Data are in either ASCII or Excel 5.0 (IBM compatible) format and are available on request (Appendix C1).

DATA ANALYSIS

Age, Length, and Sex Composition

The number of otoliths collected exceeded the number necessary to meet goals for precision and accuracy. Subsamples of otoliths were selected from as close to the middle of each month as possible for age determination. Subsamples of 130-150 otoliths were aged for June, July, and August, the primary months of harvest. All otoliths collected in May and September were aged. Otoliths were cleared by soaking in a 1:1 mixture of glycerin and water. Ages were determined by surface reading, but the break-and-burn method (Chilton and Beamish 1982) was used to check assigned ages of fish originally assigned a surface age of 16 years or more. A subset of 95 otoliths (from Homer) was sent to the IPHC for independent verification of assigned ages.

Age, length and sex composition (objective 1) were expressed as the proportion of the harvest in each age, length, or sex group. Age composition, for example, was initially estimated for each port, month, and user group as:

$$\hat{P}_i = \frac{n_i}{n} \qquad (1)$$

where:

$\hat{P}_i$ = the estimated proportion of fish of age i in the harvest,

n_i = the number of fish of age i in the sample, and

n = the total number of fish sampled.

The variance of each proportion was estimated as:

$$\mathrm{Var}\left(\hat{P}_i\right) = \frac{\hat{P}_i\left(1-\hat{P}_i\right)}{n-1}. \quad (2)$$

The finite population correction to the estimated variance was ignored because sample size was small relative to the number of fish harvested (Cochran 1977, p. 52).

Next, chi-square contingency tables were used to test for differences in age and sex composition (1) among months, (2) between user groups (e.g. charter, private), and (3) between charter-caught fish cleaned at sea and charter-caught fish cleaned in port at Homer. Age groups with few observations were pooled. The k-sample Anderson-Darling test (Scholz and Stephens 1987) was used to test for similar differences in length composition. Month was eliminated as a factor for all ports because either differences were not significant, or stratification did not significantly alter the estimates.

Estimates for each subarea were calculated simply from pooled data when sample sizes were proportional to harvest between cleaning groups or among user groups. When there were significant differences among cleaning or user groups, and sample sizes were not proportional to harvest, subarea estimates were stratified to reduce bias. The "typical" stratified estimator (Cochran 1977; equation 5.4) was inappropriate because the stratum weights were estimated and were not independent. Two forms of the stratified estimator were used. The first case involved two strata: charter and private (noncharter). In this case the stratified proportion in each age class ($\hat{p}_{i_{ST}}$) was estimated as:

$$\hat{p}_{i_{ST}} = \hat{p}_{i(p)} - \hat{p}_{i(p)}h_c + \hat{p}_{i(c)}h_c \quad (3)$$

where:

$\hat{p}_{i(p)}$ = the estimated proportion of private-caught fish in age class i,

$\hat{p}_{i(c)}$ = the estimated proportion of charter-caught fish in age class i, and

h_c = the estimated proportion of the total subarea harvest taken by charter anglers (Appendix A2).

Variances (V) of the estimated proportions were estimated by:

$$V(\hat{p}_{i_{ST}}) = V(\hat{p}_{i(p)}) + V(\hat{p}_{i(p)}h_c) + V(\hat{p}_{i(c)}h_c), \quad (4)$$

where:

$$V(\hat{p}_{i(p)}h_c) = V(h_c)\hat{p}^2_{i(p)} + h_c^2 V(\hat{p}_{i(p)}) - V(h_c)V(\hat{p}_{i(p)}), \text{ and}$$

$$V(\hat{p}_{i(c)}h_c) = V(h_c)\hat{p}^2_{i(c)} + h_c^2 V(\hat{p}_{i(c)}) - V(h_c)V(\hat{p}_{i(c)}).$$

The second case involved splitting the charter stratum into two components at Homer and Seward. At Homer, for example, the charter harvest was divided into fish cleaned in port and fish cleaned at sea. The proportion of the harvest in each sex group was estimated for the Lower Cook Inlet subarea by:

$$\hat{p}_{i_{ST}} = \hat{p}_{i(p)} - h_c\hat{p}_{i(p)} + h_c\hat{p}_{i(port)} - h_c\hat{p}_{i(port)}c_{sea} + h_c\hat{p}_{i(sea)}c_{sea} \quad (5)$$

where:

$\hat{p}_{i(port)}$ = the estimated proportion of charter-caught fish in sex group i cleaned in port,

$\hat{p}_{i(sea)}$ = the estimated proportion of charter-caught fish in sex group i cleaned at sea, and

c_{sea} = the estimated proportion of charter-caught fish that were cleaned at sea.

Variances of the proportions were estimated by:

$$V(\hat{p}_{i_{ST}}) = V(\hat{p}_{i(p)}) + V(h_c\hat{p}_{i(p)}) + V(h_c\hat{p}_{i(p)}) + V(h_c\hat{p}_{i(p)}c_{sea}) + V(h_c\hat{p}_{i(sea)}c_{sea}). \quad (6)$$

Variances of products were calculated as (Goodman 1960):

$$V(h_c\hat{p}_{i(p)}) = V(h_c)\hat{p}^2_{i(p)} + h_c^2V(\hat{p}_{i(p)}) - V(h_c)V(\hat{p}_{i(p)}),$$

$$V(h_c\hat{p}_{i(port)}) = V(h_c)\hat{p}^2_{i(port)} + h_c^2V(\hat{p}_{i(port)}) - V(h_c)V(\hat{p}_{i(port)}),$$

$$\begin{aligned} V(h_c\hat{p}_{i(port)}c_{sea}) = {} & V(h_c)\hat{p}^2_{i(port)}c^2_{sea} + h_c^2V(\hat{p}_{i(port)})c^2_{sea} + h_c^2\hat{p}^2_{i(port)}V(c_{sea}) \\ & - V(h_c)V(\hat{p}_{i(port)})c^2_{sea} - h_c^2V(\hat{p}_{i(port)})V(c_{sea}) - V(h_c)\hat{p}^2_{i(port)}V(c_{sea}) \\ & + V(h_c)V(\hat{p}_{i(port)})V(c_{sea}), \text{ and} \end{aligned}$$

$$\begin{aligned} V(h_c\hat{p}_{i(sea)}c_{sea}) = {} & V(h_c)\hat{p}^2_{i(sea)}c^2_{sea} + h_c^2V(\hat{p}_{i(sea)})c^2_{sea} + h_c^2\hat{p}^2_{i(sea)}V(c_{sea}) \\ & - V(h_c)V(\hat{p}_{i(sea)})c^2_{sea} - h_c^2V(\hat{p}_{i(sea)})V(c_{sea}) - V(h_c)\hat{p}^2_{i(sea)}V(c_{sea}) \\ & + V(h_c)V(\hat{p}_{i(sea)})V(c_{sea}). \end{aligned}$$

The stratum weight c_{sea} was estimated for Lower Cook Inlet using Homer interview data. Similarly, the Seward charter harvest was split into civilian and military components and age composition was estimated for the North Gulf Coast subarea using equations 5 and 6, substituting age for sex, the subscripts "civilian" for "port," and "military" for "sea." The stratum weight c_{sea} was therefore replaced with c_{mil}, which was determined for the North Gulf from a logbook provided by the Seward Military Recreation Camp.

The estimation procedure for age, length, and sex composition differed markedly from previous years in that many estimates were stratified by user group. The stratum weights h_c were based on the 1994 statewide postal survey data for each subarea (Appendix A2), rather than on interview or sampling data from each port. This approach incorporated harvest data from locations and periods not sampled by this study. A major assumption inherent in this new method was that the biological characteristics of fish harvested by each user group were uniform throughout each subarea. While this was probably not strictly true, large differences would have been required to

cause appreciable bias in subarea estimates because sampled ports encompassed over 90% of the Area 3A harvest.

Mean Length and Weight

Most sampled fish were filleted or gutted. Since most fish could not be weighed, the IPHC length-weight relationship was employed to estimate the mean net weight and round weight of all measured halibut. Mean net and round weight were estimated for each user group component of the harvest as the mean of the predicted weights of all n sampled fish (Nielsen and Schoch 1980):

$$\bar{x} = \frac{\sum_{i=1}^{n} aL_i^b}{n}, \tag{7}$$

where L_i = the observed length of the ith fish in centimeters, a = 6.921 X 10^{-6} for net weight in pounds and 9.205 X 10^{-6} for round weight in pounds, and b = 3.24 (Clark 1992). These parameters were validated by comparing the predicted and measured weights of over 5,000 fish collected on IPHC research cruises in 1989. Variances of the mean predicted weights were estimated using standard normal procedures (Cochran 1977; equation 2.6), but should be considered minimum estimates because variation inherent in the length-weight relationship was not incorporated.

The estimates of overall mean length and weight for each subarea (objective 2) were also stratified by user group using equations 3-6. Means were substituted for proportions and the i subscript (age, length, or sex group) was dropped. Again, user group strata were weighted using postal survey data to incorporate locations and periods not sampled. Estimates are presented in pounds because that is the standard unit used by all halibut management agencies.

Effort and Harvest by User Group

The proportions of fishing effort and halibut harvest by each user group (objective 3) were estimated from interview data using equations 1 and 2, substituting user group for age group. Anglers often targeted halibut in conjunction with other species. Effort estimates were therefore based on angler-days spent targeting halibut for any portion of a day. Harvest estimates were based on the number of fish taken while targeting any species.

Estimates of effort and harvest by user group are presented by port, rather than by subarea, because they were felt to be accurate only for the specific dates, locations, and times of day sampled. Estimates based on statewide postal survey data are considered more accurate for each subarea because they include the entire year, all locations, and all times of day.

Spatial Distribution of Effort and Harvest

Spatial distribution (objective 4) was expressed as the proportion of effort and harvest by each user group in each NMFS stat area. Proportions were estimated using equations 1 and 2, substituting stat area for age. Estimates were computed separately for each user group to avoid bias due to nonrepresentative sampling. Effort was measured as angler-days targeting halibut for any portion of the day, and harvest included halibut taken while targeting any species. Effort and harvest were recorded separately for each stat area whenever possible. An angler-day was tallied for each area in which an angler spent any portion of the day fishing. Harvest from multiple stat

areas that was not separable was apportioned to stat areas based on the portion of harvest that was separable.

RESULTS

SAMPLING SUMMARY

Sampling extended from late May through early September at most ports, and from June 20 through August 26 at Deep Creek and Anchor Point (Table 1). Fish cleaned at sea were sampled only at Homer during the period June 28-August 16. Biological data were obtained for 4,856 fish. Of the 835 halibut sampled in the Central Cook Inlet harvest, 666 (80%) were from Deep Creek and 169 (20%) were from Anchor Point. The sample was drawn from a total of at least 21,000 halibut observed by technicians at all ports. The manner in which missed fish were accounted for varied by port. The number of missed fish is therefore useful only as a relative measure over time for each port, and is not comparable between ports. The number of missed fish was highest at Seward primarily because four charter operators kept logs of the number of fish cleaned and discarded at sea.

A total of 2,163 boat-trip interviews was obtained in 1994. The number of interviews at any one sampling location ranged from 340 in Central Cook Inlet to 511 at Homer. Two hundred sixty-eight (79%) of the Central Cook Inlet interviews were obtained at Deep Creek, with the remainder from Anchor Point. The Seward Military Recreation Camp also reported effort and harvest statistics for 805 Army boat-trips and 119 Air Force boat-trips.

The fraction of the harvest that was cleaned at sea ranged from 0% to 13% for private boats and from 0% to 33% for charter boats (Table 2). The practice was not apparent in the Central Cook Inlet fishery. Among all ports, the percentage of the harvest that was cleaned at sea was highest at Homer (29%). Private anglers and charter operators both tended to clean either all or none of their harvest at sea (Table 3). Charters, however, were more likely than private anglers to clean only a portion of the harvest at sea, and generally cleaned the larger fish in port.

AGE, LENGTH, AND SEX COMPOSITION

Age composition was estimated from 2,853 otoliths. Harvested fish from all ports ranged from 3 to 20 years in age. Age groups 6-11 made up the bulk of the harvest at most ports (Figure 3, Appendix B1). The 1987 and 1988 year classes (ages 7 and 6, respectively) made up 39% of the Kodiak/Afognak harvest, 53% of the Central Cook Inlet harvest, 33% of the North Gulf harvest, and 29% of the Prince William Sound (PWS) harvest. Contribution of these age groups to the Lower Cook Inlet harvest was not unusually large.

Tests for differences in age composition produced varied results. Differences among months were significant only for Central Cook Inlet and Valdez (Table 4). Stratification by month did not functionally alter estimates for either port, so data from all months were pooled. Significantly fewer old fish were landed at Anchor Point than at Deep Creek ($\chi^2 = 26.6$, df = 7, $P < 0.01$). Age composition was significantly different among user groups at all ports except Kodiak (Table 4). Specifically, halibut taken by private anglers were younger than charter-caught fish. Only the age composition estimates for Lower Cook Inlet, the North Gulf, and PWS were stratified by user group because samples for other subareas were self-weighting. There was no significant difference in the age composition of fish cleaned at sea or fish cleaned in port at

Table 1.-Summary of recreational halibut harvest sampling in Area 3A, 1994.

Port	Period	No. of Days Sampled	Sampling Rate	Sample Size	No. of Fish Observed	No. of Fish Missed
Kodiak	May 26-31	6	1:1	89	89	0
	Jun 1-14	10	1:1	241	241	12
	Jun 15-30	11	1:2	133	266	65
	Jul 1-31	21	1:2	341	682	102
	Aug 1-31	19	1:2	376	752	72
	Sep 1-12	10	1:1	210	210	11
	Total	77		1,390	2,240	262
Deep Creek/Anchor Point	Jun 20-30	9	N/A	268	N/A	N/A
	Jul 1-31	21	N/A	348	N/A	N/A
	Aug 1-26	19	N/A	219	N/A	N/A
	Total	49		835		
Homer (fish cleaned in port)	May 26-31	3	1:10	44	440	99
	Jun 1-30	14	1:10	322	3,220	136
	Jul 1-31	12	1:15	306	4,590	338
	Aug 1-31	13	1:10	270	2,700	216
	Sep 1-13	7	1:10	102	1,020	28
	Total	49		1,044	11,970	817
Homer (fish cleaned at sea)	Jun 28-30	2	N/A	16	N/A	N/A
	Jul 1-31	10	N/A	137	N/A	N/A
	Aug 1-16	3	N/A	50	N/A	N/A
	Total	15		203		
Seward	May 26-31	4	1:4	76	304	154
	Jun 1-13	4	1:4	143	572	55
	Jun 14-30	8	1:8	136	1,088	294
	Jul 1-21	7	1:10	74	740	116
	Jul 22-31	4	1:1	153	153	395
	Aug 1-31	11	1:10	140	1,400	226
	Sep 1-10	5	1:5	43	215	79
	Total	43		765	4,472	1,319
Valdez	May 28-31	2	1:1	79	79	0
	Jun 1-30	12	1:3	159	477	0
	Jul 1-31	12	1:3	191	573	104
	Aug 1-31	11	1:2	145	290	13
	Sep 1-5	3	1:1	45	45	0
	Total	40		619	1,464	117

Table 2.-Number and percent of halibut cleaned at sea by private and charter anglers interviewed at selected Area 3A ports, 1994.

Port and User	No. Halibut Kept	No. Cleaned at Sea	Percent Cleaned at Sea
Kodiak			
Private	987	26	3
Charter	631	102	16
Total	1,618	128	8
Deep Cr./Anchor Pt.			
Private	898	0	0
Charter	863	0	0
Total	1,761	0	0
Homer			
Private	818	103	13
Charter	4,173	1,363	33
Total	4,991	1,466	29
Seward			
Private	569	36	6
Charter	1,155	161	14
Total	1,724	197	11
Valdez			
Private	523	55	11
Charter	1,756	357	20
Total	2,279	412	18

Table 3.-Percentage of boat trips in which few, some, or nearly all harvested halibut were cleaned at sea, 1994. For example, fewer than 5% of the halibut kept were cleaned at sea on 97% of the private angler boat trips at Kodiak.

	Sample Size	Fraction of Boat Trip Harvest Cleaned at Sea		
Port and User	(Boat Trips)	Less Than 5%	5%-95%	Greater than 95%
Kodiak				
Private	298	97	0	3
Charter	99	91	1	8
Homer				
Private	161	89	1	10
Charter	282	73	7	20
Deep Cr./Anchor Pt.				
Private	188	100	0	0
Charter	100	100	0	0
Seward				
Private	171	93	0	7
Charter	105	86	2	12
Valdez				
Private	138	96	1	4
Charter	184	88	4	8

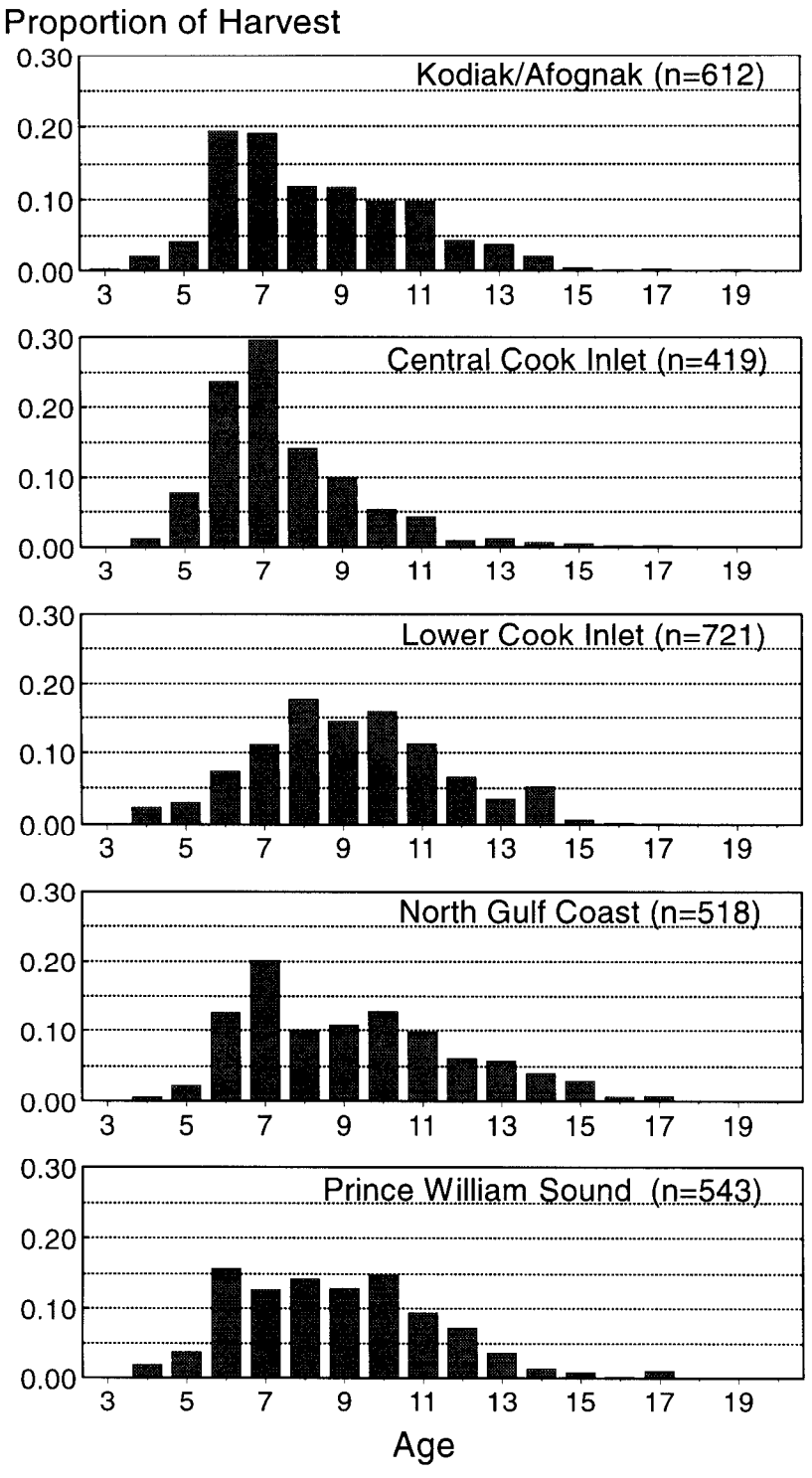

Figure 3.-Estimated age composition, by subarea, of the 1994 recreational halibut harvest.

Table 4.-Results of chi-square contingency tests for differences in age composition among components of the 1994 Area 3A recreational halibut harvest.

Test and Port	Groups Tested	Test Statistic χ^2	df	P
Tests among Months:				
Kodiak	May-Sep	40.6	32	0.15
Deep Cr./Anchor Pt.	Jun-Aug	26.7	12	0.01
Homer (private and charter cleaned in port)	May-Sep	41.6	28	0.05
Homer (charter cleaned at sea)	Jul-Aug	6.4	6	0.38
Seward	May-Sep	41.5	36	0.25
Valdez	May-Sep	62.2	28	<0.01
Tests among User Groups:				
Kodiak	Private, Charter	8.6	7	0.28
Deep Cr./Anchor Pt.	Private, Charter	32.5	6	<0.01
Homer	Private, Charter (cleaned in port), Charter (cleaned at sea)	38.7	16	<0.01
Seward	Private, Charter (civilian), Charter (military)	127.9	16	<0.01
Valdez	Private, Charter	52.4	8	<0.01

Homer ($\chi^2 = 14.0$, df = 9, P = 0.12), but both components of the charter harvest were older than the private harvest (Figure 4). In addition, a relatively greater percentage of halibut cleaned at sea were males. Age composition of the military charter harvest at Seward was more similar to the private harvest than the civilian charter harvest (Figure 5).

Length composition was estimated from a total of 4,672 measurements. The largest fish measured 230 cm and was landed at Kodiak. Most harvested halibut, however, were between 70 and 140 cm in length (Figure 6). The Central Cook Inlet harvest had the smallest proportion of large halibut, and the Lower Cook Inlet harvest had the smallest proportion of small halibut. An estimated 48% of the Area 3A recreational harvest was shorter than the 81 cm (32 in) minimum size limit for commercial retention.

Length composition of the Kodiak, Central Cook Inlet, and Valdez harvests differed significantly among months (Table 5). Stratification by month did not significantly alter these estimates, however. Charter-caught fish cleaned at sea were significantly shorter than charter-caught fish landed at Homer ($T_{akn} = 37.7$, $P < 0.01$). Fish landed at Anchor Point were significantly smaller than fish landed at Deep Creek ($T_{akn} = 2.9$, $P = 0.02$). Differences among user groups were significant for all ports (Table 5). With the exception of Kodiak, charter-caught halibut were generally longer, but the private harvest usually contained similar proportions of fish over 120 cm in length (Figure 7). Only the Lower Cook Inlet and Prince William Sound estimates of length composition were stratified by user group. All other estimates were unstratified.

Sex composition was estimated from a sample of 4,571 halibut. The proportion of females in the harvest ranged from 60% in the North Gulf Coast subarea to 87% in Central Cook Inlet and

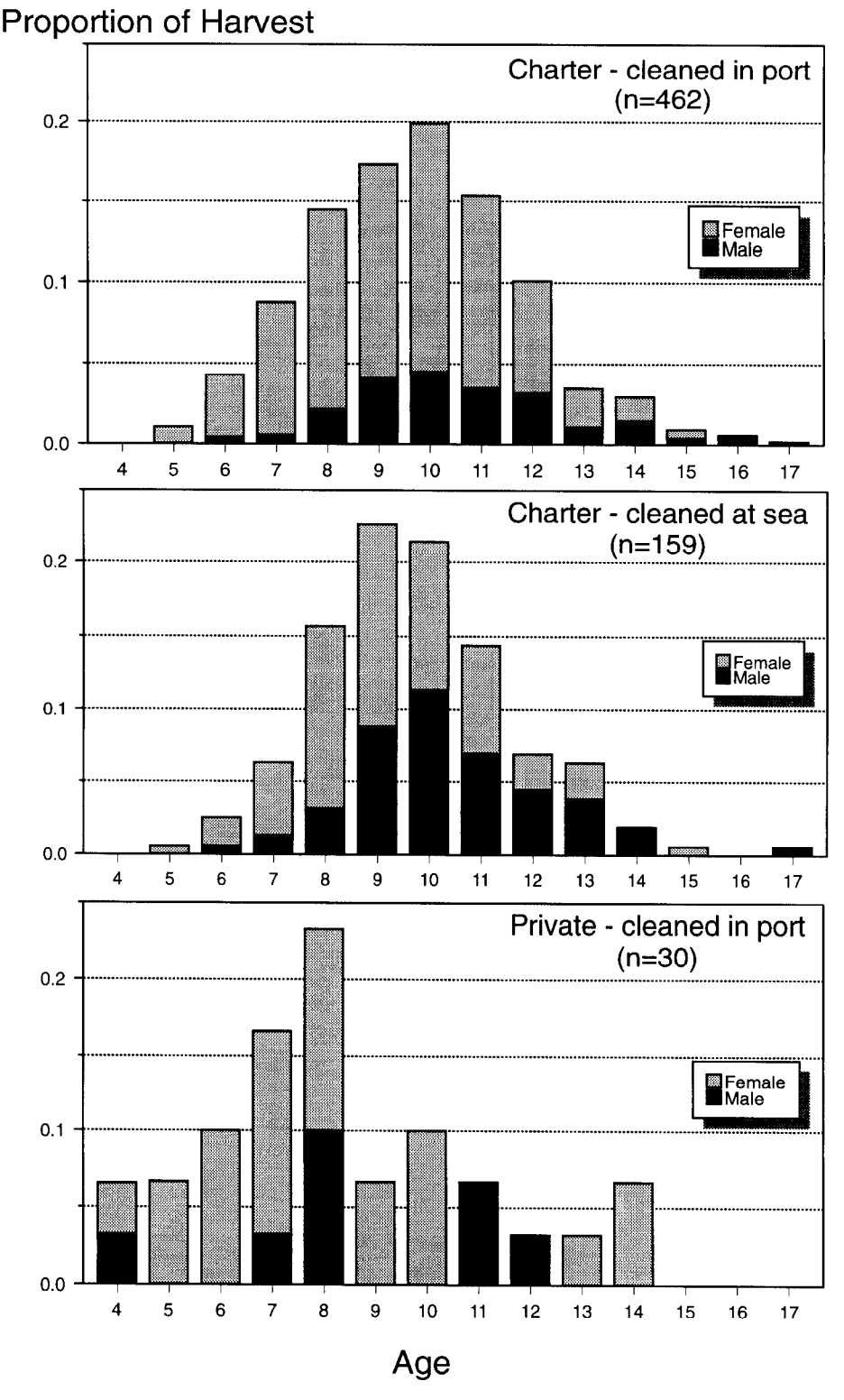

Figure 4.-Age composition of charter-caught halibut landed and cleaned in port, charter-caught halibut cleaned at sea, and private-caught halibut sampled in the Homer fishery, 1994.

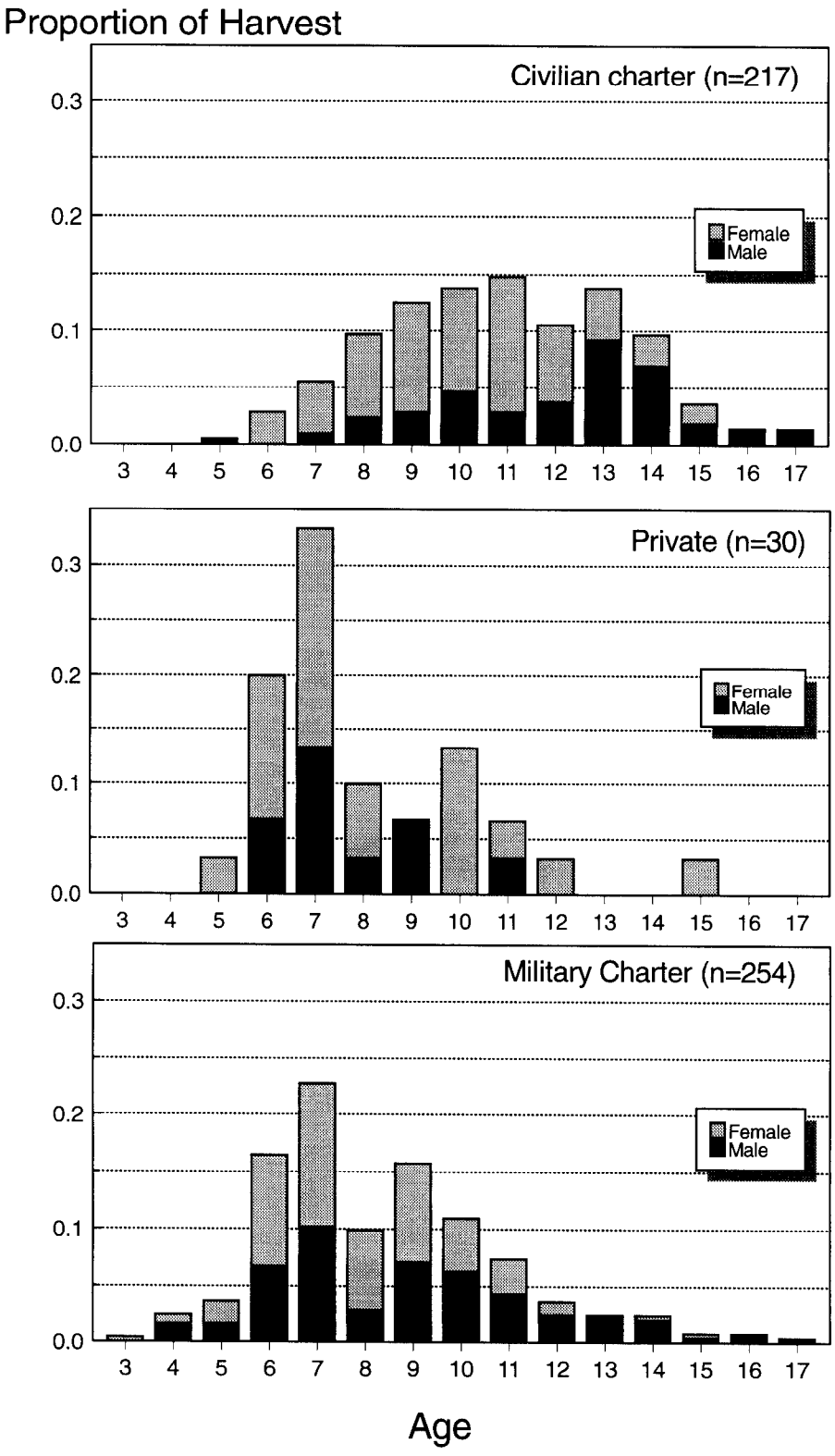

Figure 5.-Age composition of halibut harvested by civilian charter, private, and military charter anglers in the Seward fishery, 1994.

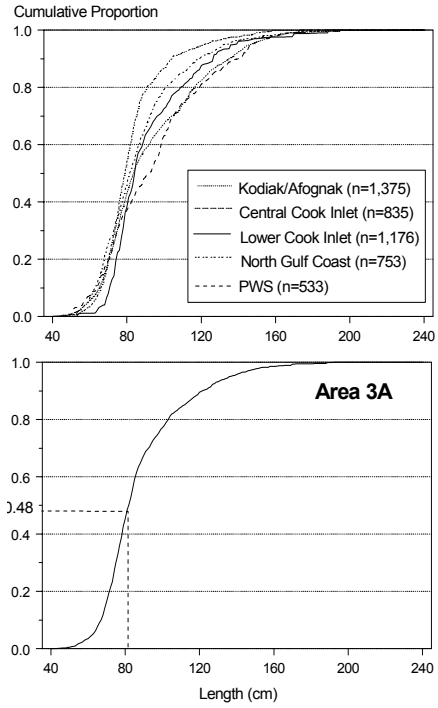

Figure 6.-Estimated length composition (cumulative distributions) of the 1994 recreational halibut harvest in each subarea (upper graph) and all of Area 3A (lower graph). The Yakutat subarea harvest was included in the Area 3A estimate and length composition was assumed to be identical to that of Prince William Sound. Lines in the lower graph indicate that 48% of the recreational harvest was under the 81 cm minimum size limit for the commercial fishery.

Table 5.-Results of Anderson-Darling tests for differences in length composition among components of the 1994 Area 3A recreational halibut harvest.

		Test Statistic		
Test and Port	Groups Tested	T_{akn}	No. Groups	P
Tests among Months:				
Kodiak	May-Sep	8.4	5	<0.01
Deep Cr./Anchor Pt.	Jun-Aug	3.9	3	0.01
Homer (private and charter cleaned in port)	May-Sep	0.4	5	0.57
Homer (charter cleaned at sea)	Jul-Aug	0.1	3	0.37
Seward	May-Sep	0.5	5	0.26
Valdez	May-Sep	7.3	5	<0.01
Tests among User Groups:				
Kodiak	Private, USCG, Charter	6.2	3	<0.01
Deep Cr./Anchor Pt.	Private, Charter	57.2	2	<0.01
Homer	Private and charter (cleaned in port), Charter (cleaned at sea)	37.7	2	<0.01
Seward	Private, Charter (civilian), Charter (military)	118.6	3	<0.01
Valdez	Private, Charter	16.7	2	<0.01

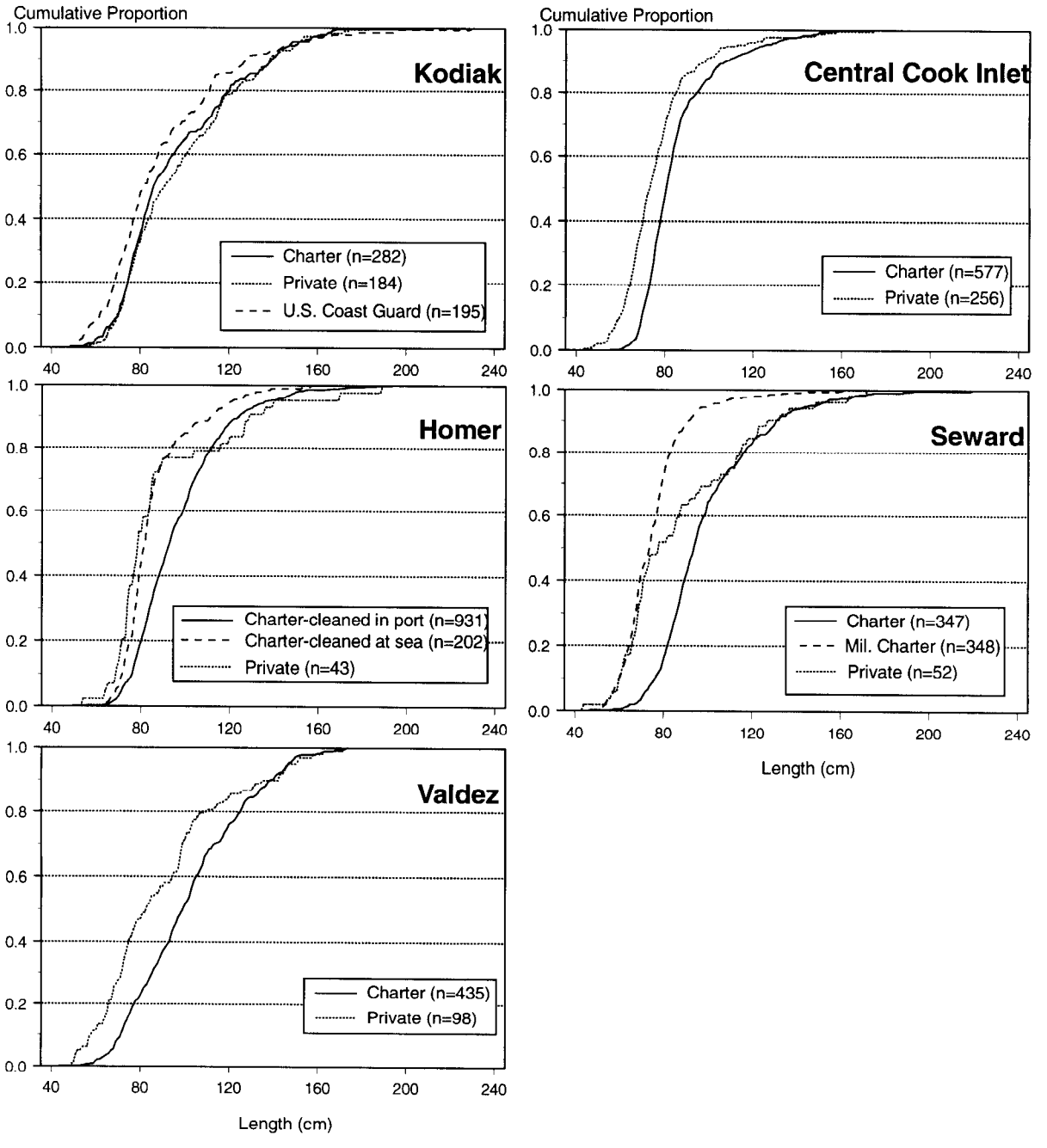

Figure 7.-Estimated length composition (cumulative distributions) of the 1994 recreational halibut harvest, by user group and port.

Prince William Sound (Figure 8, Appendix B2). There were no significant differences among months at any port, and there was no difference between Anchor Point and Deep Creek ($\chi^2 = 0.1$, df = 2, P = 0.71). Differences among user groups were significant only for Homer and Seward (Table 6). At Homer, 79% of halibut landed and cleaned on shore were female, compared with only 57% of halibut cleaned at sea. At Seward, 65% of the civilian (private and charter) harvest was female, compared with 54% of the military charter harvest.

MEAN LENGTH AND WEIGHT

Mean length and weight were estimated from measurements of 3,950 fish for which the user group was known. Estimates of mean length ranged from 81.9 cm in the Central Cook Inlet subarea to 96.2 cm in the Kodiak/Afognak subarea (Table 7). Likewise, mean net weight ranged from 13.3 lb to 25 lb. Charter-caught fish were larger than private-caught fish, with the exception of fish cleaned at sea at Homer and the military charter harvest at Seward (Table 8). Mean weight estimates for each subarea and user group were incorporated in the 1994 sport harvest biomass estimate of 4.5 million pounds for all of Area 3A (Appendix A3).

EFFORT AND HARVEST BY USER GROUP

Interviewed anglers at all ports reported 9,664 angler-days of effort targeting halibut, and a total harvest of 12,819 halibut taken while targeting all species. The estimated percentage of the harvest taken by charter anglers varied widely by port, ranging from 39% at Kodiak to over 83% at Homer (Table 9). Estimates for Seward were computed separately for the civilian and military fleets.

Anglers on charter boats were more effective at catching halibut than private anglers. Charters accounted for a larger percentage of the harvest than of the effort at all ports. For example, Kodiak charter anglers made up 31% of the effort targeted on halibut, but 39% of the harvest. The discrepancies were not due to large numbers of halibut taken while targeting other species; halibut was by far the primary species targeted by interviewed anglers at all ports, and relatively few halibut were taken while targeting other species.

Seward Military Recreation Camp charter anglers fished 8,169 angler-days and harvested 6,129 halibut. There was no difference in the effectiveness of Army and Air Force charter boats, however. Assuming that the North Gulf Coast subarea harvest was 25,009 halibut, and the overall charter portion was 15,501 fish (Appendix A2), the military camp accounted for about 25% of the total North Gulf Coast subarea harvest and 40% of the charter harvest.

SPATIAL DISTRIBUTION OF EFFORT AND HARVEST

Recreational effort and harvest of halibut were spread over large geographic areas. Charter effort and harvest were generally distributed farther from the port of origin than private effort and harvest. As a general rule, areas farther from port accounted for a greater percentage of the harvest than of the effort. The ratio of the proportions of effort to harvest are an indication of the relative catch rates in each stat area. Estimates and standard errors are presented for all stat areas in Appendices B3-B8.

Chiniak Bay (stat area 525733) was the primary area fished by private anglers from the port of Kodiak, and accounted for 76% of the effort and 75% of the harvest by the private fleet (Figure 9). Popular spots within this stat area included Buoy 4, and waters near Woody Island, Long

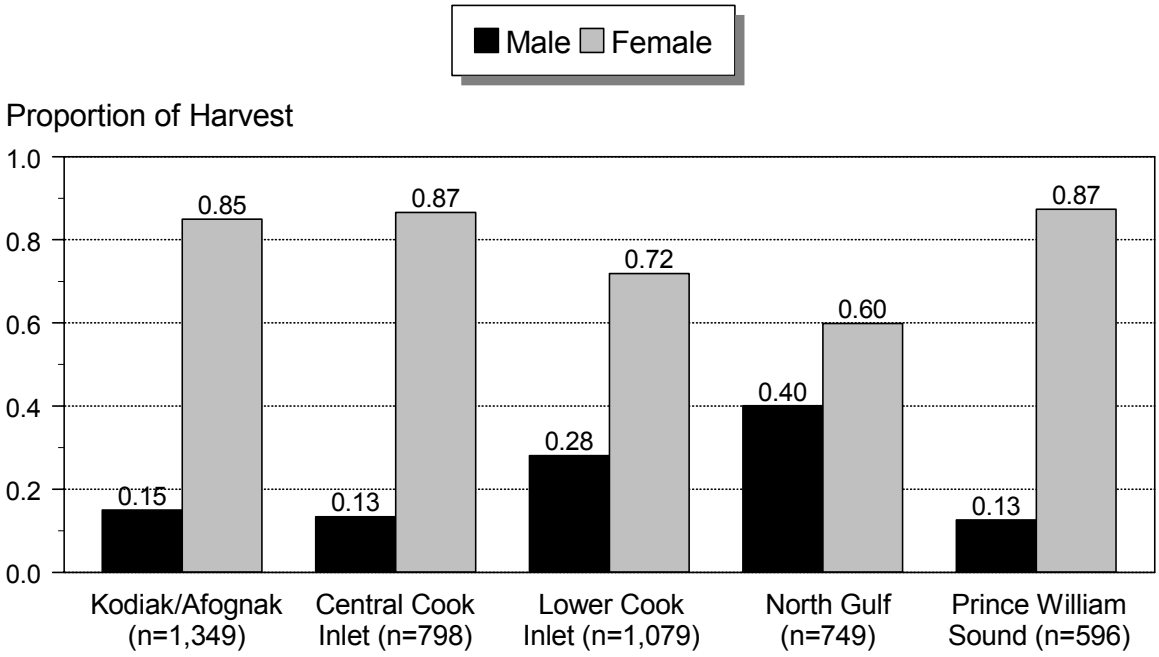

Figure 8.-Estimated sex composition, by subarea, of the 1994 Area 3A recreational halibut harvest.

Table 6.-Results of chi-square contingency tests for differences in sex composition among components of the 1994 Area 3A recreational halibut harvest.

Test and Port	Groups Tested	Test Statistic		
		χ^2	df	P
Tests among Months:				
Kodiak	May-Sep	4.7	4	0.33
Deep Cr./Anchor Pt.	Jun-Aug	1.9	2	0.40
Homer (private and charter cleaned in port)	May-Sep	2.8	4	0.59
Homer (charter cleaned at sea)	Jun-Aug	0.4	2	0.83
Seward	May-Sep	6.6	4	0.16
Valdez	May-Sep	4.0	4	0.40
Tests among User Groups:				
Kodiak	Private, USCG, Charter	0.2	2	0.92
Deep Cr./Anchor Pt.	Private, Charter	0.4	1	0.54
Homer	Private, Charter (cleaned in port	1.7	1	0.20
Homer	Private and charter (cleaned in port), Charter (cleaned at sea)	37.5	1	<0.01
Seward	Private, Charter (civilian), Charter (military)	8.7	2	0.01
Valdez	Private, Charter	1.8	1	0.18

Table 7.-Estimated mean length (cm), net weight (lb), and round weight (lb), by subarea, for the 1994 Area 3A recreational halibut harvest.

Measurement	Subarea	Mean	SE
Length	Kodiak/Afognak	96.2	1.9
	Central Cook Inlet	81.9	1.9
	Lower Cook Inlet	92.9	5.2
	North Gulf Coast	89.4	5.1
	Prince William Sound	95.4	3.2
Net Weight	Kodiak/Afognak	25.0	1.9
	Central Cook Inlet	13.3	1.0
	Lower Cook Inlet	21.1	5.5
	North Gulf Coast	20.3	4.1
	Prince William Sound	24.0	2.7
Round Weight	Kodiak/Afognak	33.3	2.5
	Central Cook Inlet	17.7	1.4
	Lower Cook Inlet	28.1	7.4
	North Gulf Coast	27.0	5.5
	Prince William Sound	31.9	3.6

Table 8.-Mean length and weight, by user group, of the recreational harvest landed at selected Area 3A ports, 1994.

	Sample	Length (cm)		Net Weight(lb)		Round Weight (lb)	
Port and Component	Size	Mean	SE	Mean	SE	Mean	SE
Kodiak							
Private	379	95.3	1.5	24.7	1.6	32.9	2.1
Charter	282	97.4	1.6	25.4	1.6	33.8	2.1
Deep Cr./Anchor Pt.							
Private	256	77.6	1.2	11.5	0.9	15.3	1.2
Charter	577	86.1	0.7	15.1	0.6	20.0	0.7
Homer							
Private	43	90.8	4.4	22.0	4.7	29.3	6.3
Charter-cleaned at sea	202	86.9	1.1	15.2	0.9	20.2	1.1
Charter-cleaned in port	931	98.0	0.7	23.1	0.7	30.7	0.9
Seward							
Private	52	88.4	4.1	20.2	3.4	26.9	4.5
Charter-civilian	347	99.6	1.3	25.5	1.4	33.9	1.9
Charter-military	348	75.3	0.8	9.8	0.5	13.0	0.7
Valdez							
Private	98	90.4	2.9	21.3	2.4	28.3	3.2
Charter	435	102.4	1.2	27.8	1.1	37.0	1.4

Table 9.-User group composition of the recreational effort for halibut (angler-days) and halibut harvest (number of fish) at selected Area 3A ports, 1994.

Port and User Group	No. of Interviews	Effort			Harvest		
		Angler-Days	Percent	SE(%)	No. of Halibut	Percent	SE(%)
Kodiak							
Private	380	1,106	68.6	1.3	987	61.0	1.5
Charter	116	507	31.4	1.3	631	39.0	1.5
Total	496	1,613			1,618		
Deep Cr./Anchor Pt.							
Private	236	724	58.1	1.4	863	49.0	1.2
Charter	103	523	41.9	1.4	898	51.0	1.2
Total	339	1,247			1,761		
Homer							
Private	220	741	24.8	0.8	818	16.4	0.5
Charter	291	2,249	75.2	0.8	4,173	83.6	0.5
Total	511	2,990			4,991		
Seward (civilian)							
Private	288	844	45.6	1.2	950	33.0	1.1
Charter	121	1,008	54.4	1.2	1,220	67.0	1.1
Total	409	1,852			2,170		
Seward (military)							
Army	805[a]	6,247	76.5	0.5	4,671	76.2	0.5
Air Force	119[a]	1,922	23.5	0.5	1,458	23.8	0.5
Total	924[a]	8,169			6,129		
Valdez							
Private	198	647	33.0	1.1	523	22.9	0.9
Charter	210	1,315	67.0	1.1	1,756	77.1	0.9
Total	408	1,962			2,279		

[a] Total number of boat trips reported in Seward Military Recreation Camp logbook.

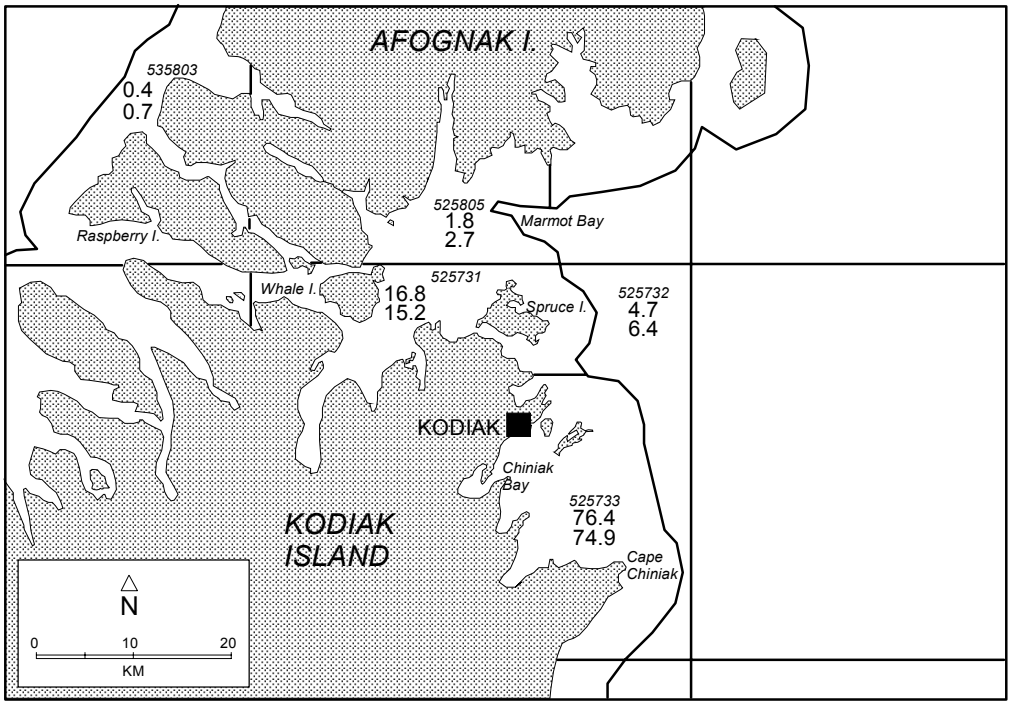

Figure 9.-Spatial distribution of recreational effort and halibut harvest by private anglers interviewed at Kodiak, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

Island, Williams Reef, and Cape Chiniak. Charter effort and harvest were more dispersed. Chiniak Bay only accounted for 66% of the effort and 61% of the charter harvest (Figure 10). Marmot Bay and offshore waters northeast of Kodiak accounted for 22% of the effort and 25% of the charter harvest.

Stat area 525931, in the central portion of Cook Inlet, accounted for 36% of the private effort, and 45% of the private halibut harvest in the Central Cook Inlet fishery (Figure 11). Two stat areas adjacent to Deep Creek and Anchor Point accounted for an additional 47% of the private effort and 41% of the harvest. The charter fleet, in contrast, expended the majority of effort and took the majority of harvest in stat area 525931 (Figure 12). Nearshore waters accounted for a small portion of the charter harvest. With the exception of stat area 525931, very little harvest was taken south of Anchor Point.

Effort and harvest by the Homer private fleet was focused in the outer waters of Kachemak Bay and in the central waters of Cook Inlet (Figure 13). Stat area 525931 accounted for nearly 40% of the Homer harvest. Very little private harvest was recorded south of Point Adam. Charter effort and harvest were concentrated in the central portion of Cook Inlet, with lesser amounts near the Chugach and Barren islands (Figure 14). With the exception of stat area 525931, very little of the harvest by either user group was from waters north of Anchor Point.

Private anglers fishing from Seward spent 93% of their effort and caught 92% of their halibut in the six stat areas stretching from the Chiswell Islands to Cape Puget (Figure 15). Stat area 495938, encompassing the southern portions of Resurrection Bay and Day Harbor, was the most

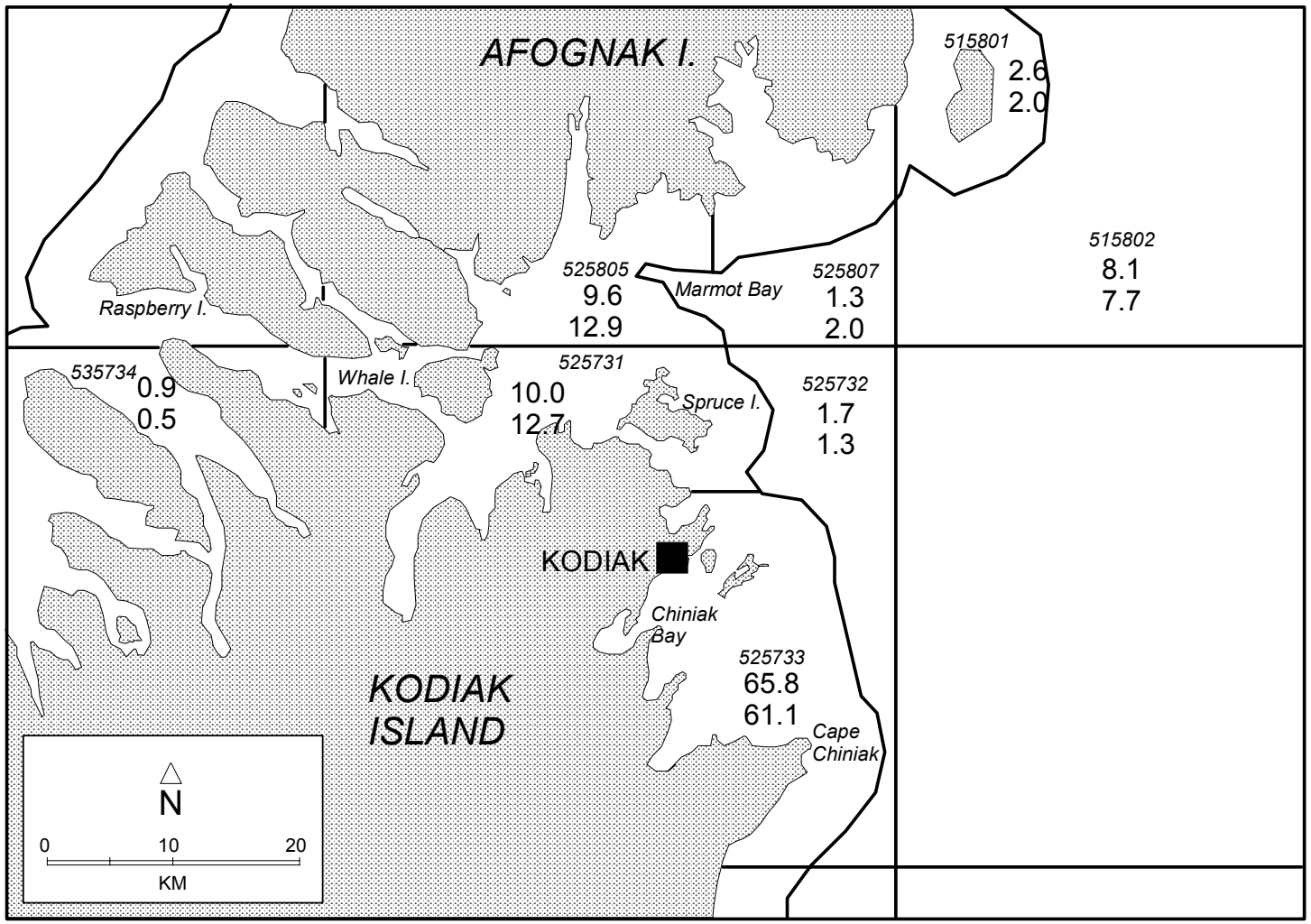

Figure 10.-Spatial distribution of recreational effort and halibut harvest by charter anglers interviewed at Kodiak, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

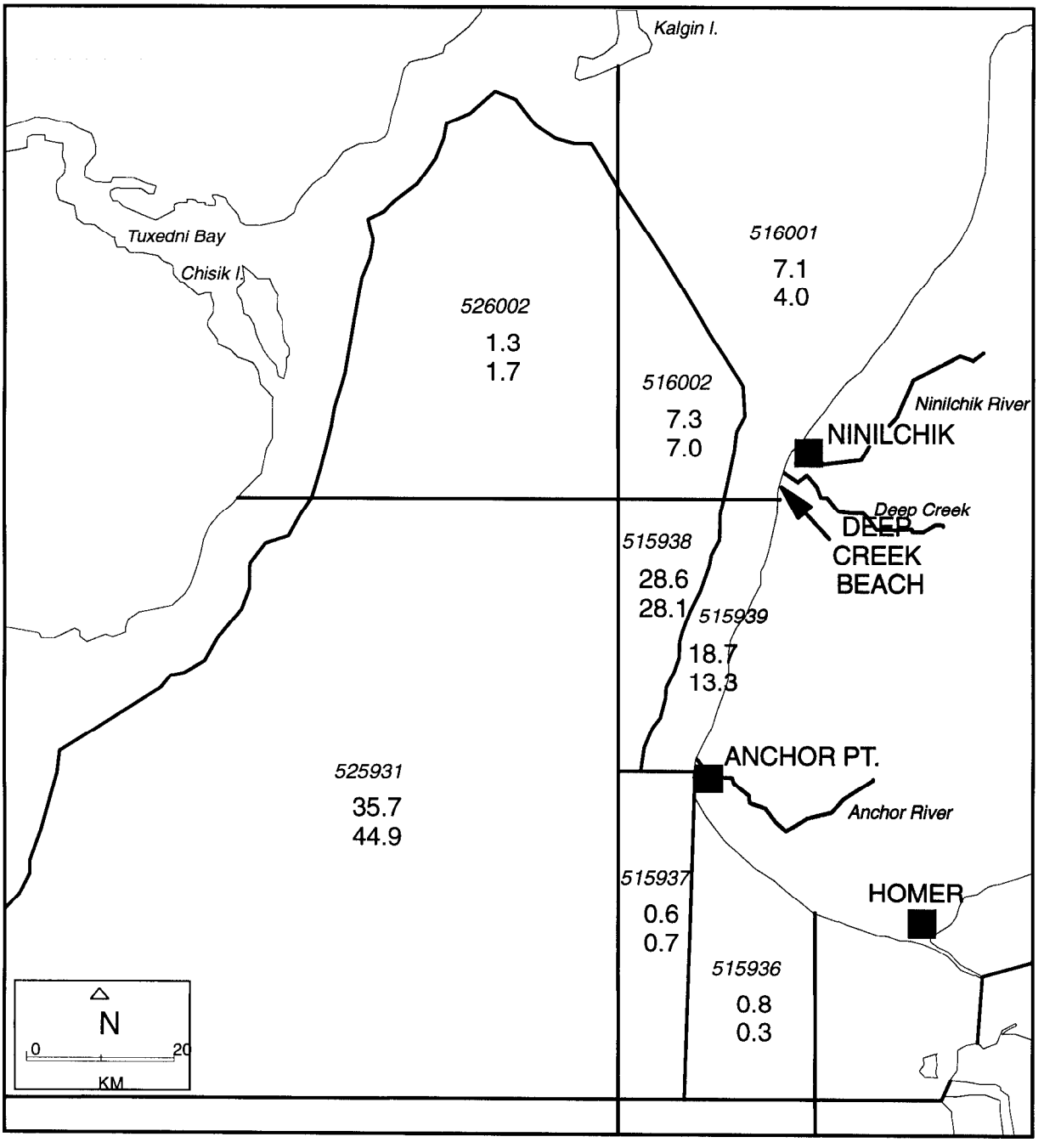

Figure 11.-Spatial distribution of recreational effort and halibut harvest by private anglers interviewed at Deep Creek and Anchor Point, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

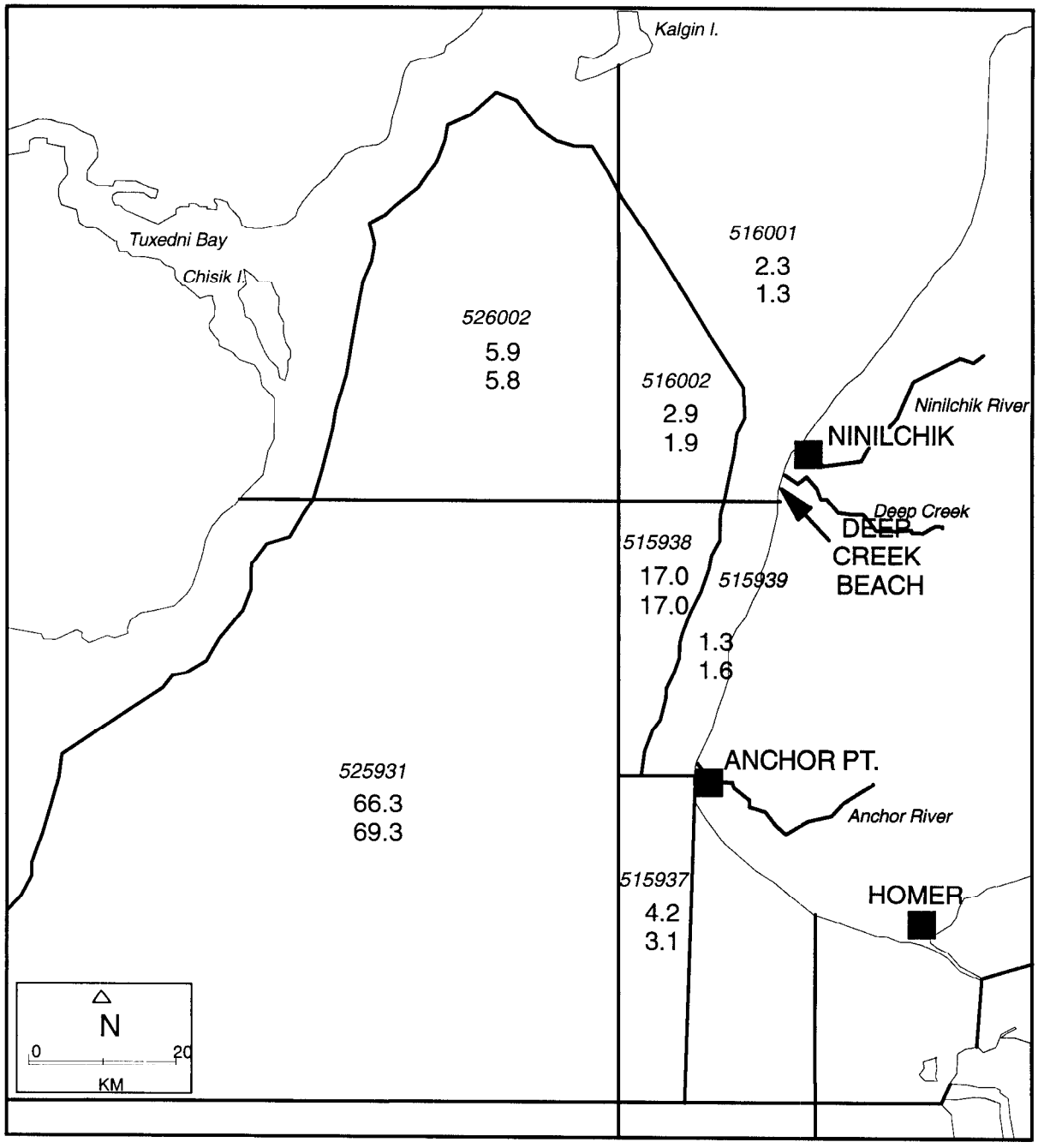

Figure 12.-Spatial distribution of recreational effort and halibut harvest by charter anglers interviewed at Deep Creek and Anchor Point, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

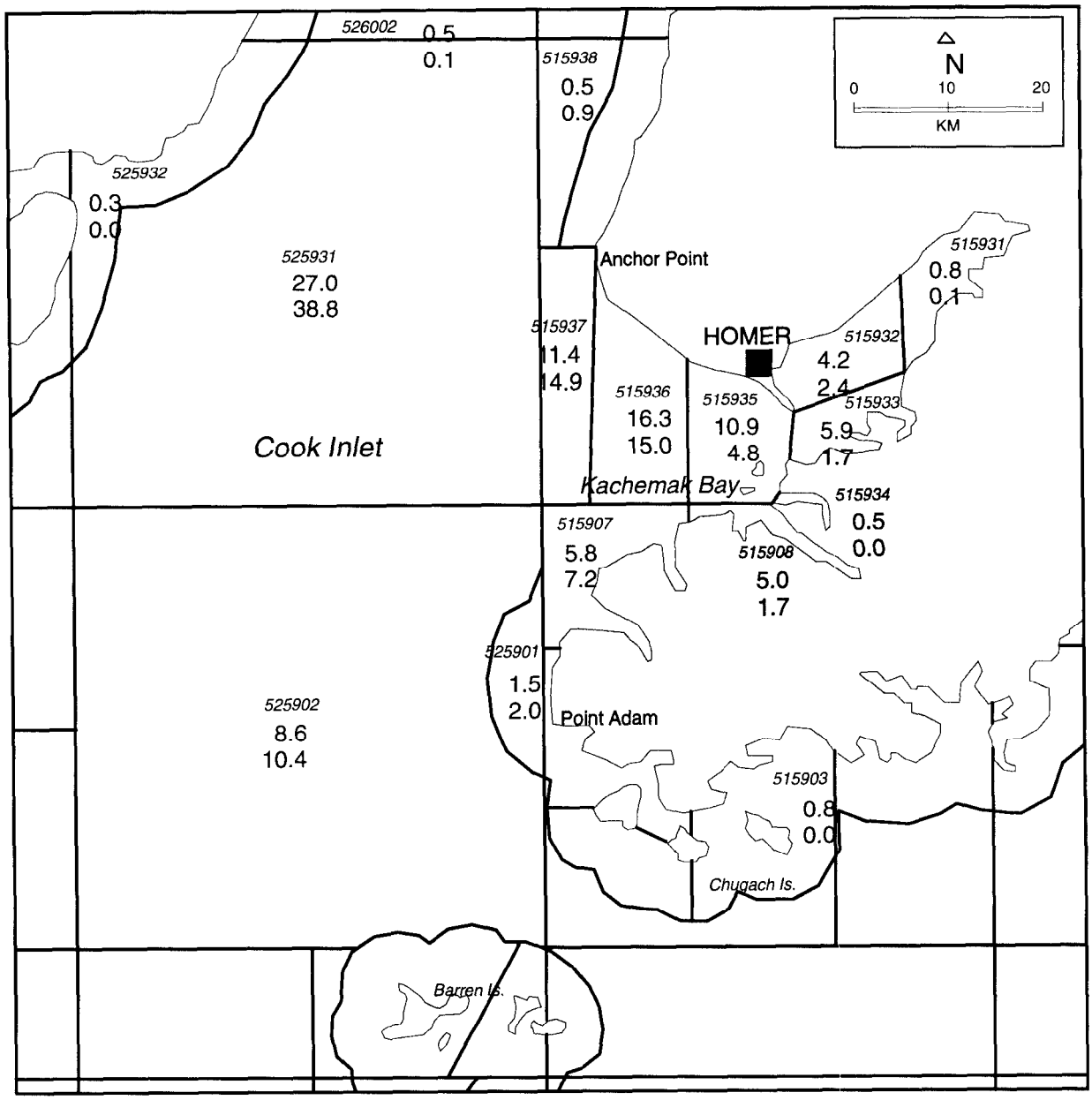

Figure 13.-Spatial distribution of recreational effort and halibut harvest by private anglers interviewed at Homer, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

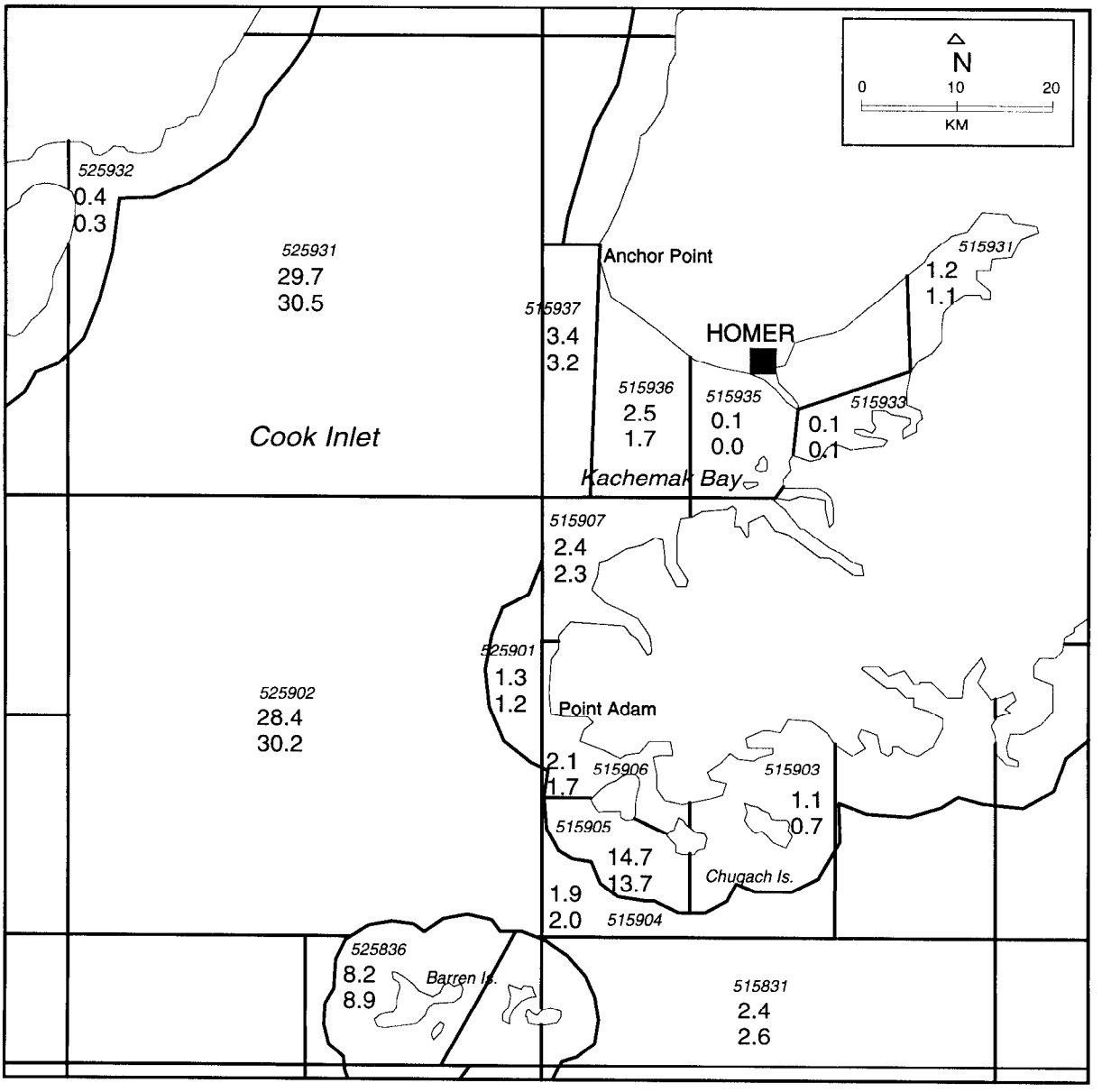

Figure 14.-Spatial distribution of recreational effort and halibut harvest by charter anglers interviewed at Homer, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

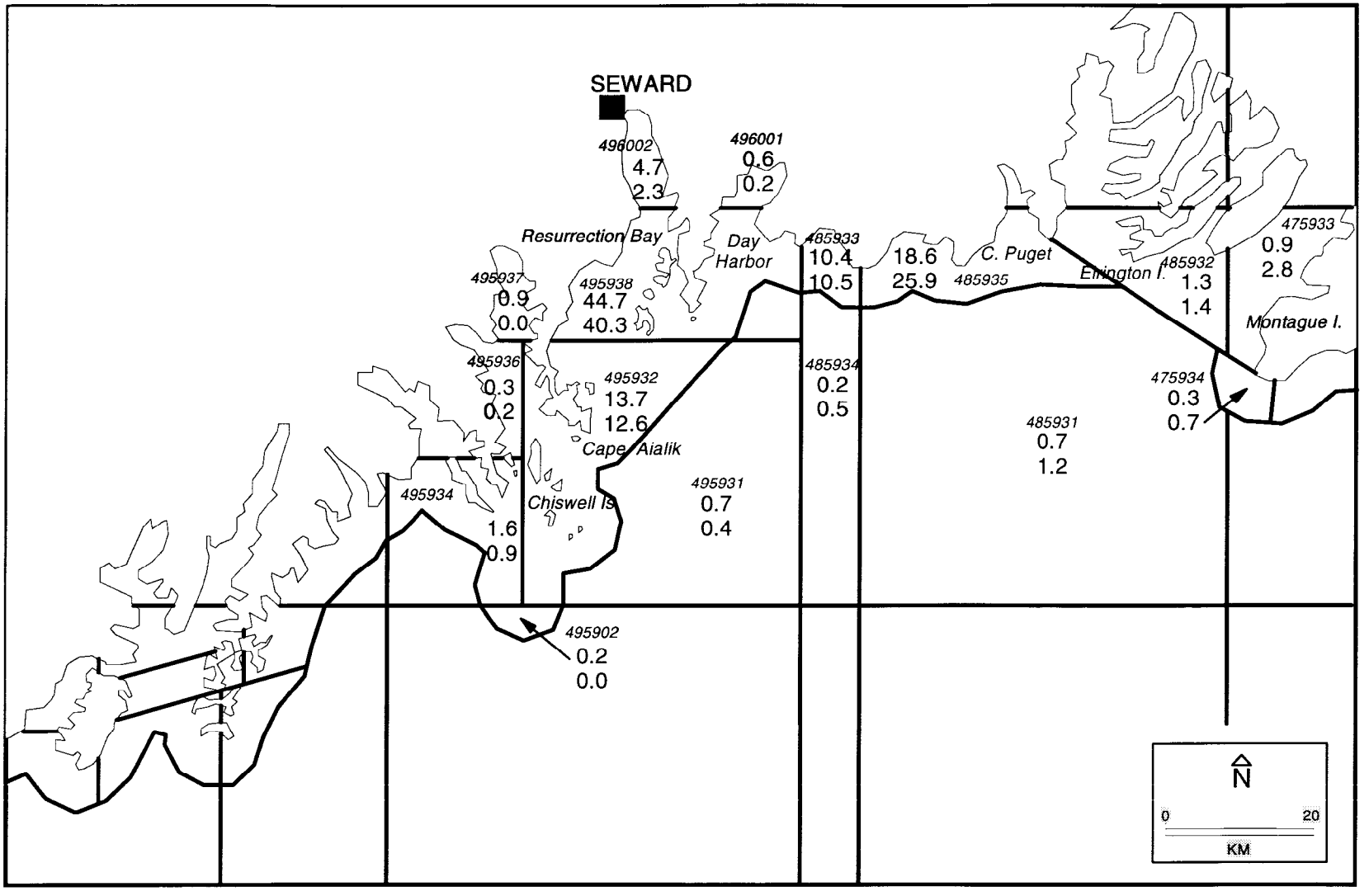

Figure 15.-Spatial distribution of recreational effort and halibut harvest by private anglers interviewed at Seward, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

heavily fished stat area by private anglers. Fishing pressure by the civilian charter fleet was more dispersed, with boats traveling over 100 km in search of halibut. Sixty-five percent of the effort and 78% of the charter harvest were east of Day Harbor (Figure 16). Nearly 41% of the charter harvest was from four stat areas adjacent to Elrington and Montague islands, a minimum of 80 km from the port of Seward. Effort and harvest by military charter boats were concentrated in waters near Cape Aialik and the Chiswell Islands (Figure 17). Twelve percent of the military charter harvest was from waters west of the Chiswell Islands and 18% was from waters east of Day Harbor.

Effort and harvest were widely distributed by the Valdez fleet throughout much of Prince William Sound. The private fleet concentrated harvest and effort in a north-south band from Valdez Arm to Hinchinbrook Entrance (Figure 18). Stat areas 466032 and 466033, in the northeast quadrant of the sound, accounted for 54% of the effort and 46% of the harvest by private anglers. Effort and harvest by the charter fleet were distributed farther from the port of Valdez than that of the private fleet (Figure 19). Stat areas 466032 and 466033, popular areas for private anglers, only accounted for 18% of the charter effort and 11% of the harvest. The Hinchinbrook Entrance area (stat areas 466001-05) accounted for 44% of the charter harvest, compared with 23% of the harvest by private anglers. Nearly 9% of the charter boat harvest was from stat area 476003, at least 125 km from the port of Valdez.

DISCUSSION

CHANGES IN HARVEST AND STOCK COMPOSITION

Changes in composition of the recreational harvest provide limited insight into changes in the halibut stock. The primary factors masking this relationship include selectivity of sport fishing gear, selective retention of certain sizes of fish, and discrepancies between the distribution of anglers and the distribution of fish. Estimates of sport harvest age composition have nevertheless reflected age composition of the stock. For example, the 1982 year class was relatively less abundant than adjacent year classes (Sullivan et al. 1995). This was reflected in the relatively weak showing of 10 year olds in the 1992 sport harvest (Meyer 1993) and 11 year olds in the 1993 harvest (Meyer 1994). The 1987 year class, which appeared exceptionally strong in the Bering Sea (Clark and Bakkala 1992), subsequently appeared strong in the sport harvest as 5 year olds at Kodiak in 1992 (Meyer 1993), as 6 year olds at Kodiak, Seward, and Valdez in 1993 (Meyer 1994), and as 7 year olds at all ports in 1994 (Figure 3). The strong showing of the 1988 year class as 5 year olds in the 1993 Kodiak sport harvest, and the widespread contribution of this year class as 6 year olds in 1994 suggest that it may be comparable in strength to the 1987 year class, at least in the Gulf of Alaska. If so, there may be significant increases in recruitment to sport and commercial fisheries from these year classes within the next few years.

Reinstatement of Deep Creek and Anchor Point in the study provided surprising results. The Central Cook Inlet fishery was last sampled in 1991. Sampling was discontinued the next 2 years because age, length, and sex composition of the 1991 harvest were not significantly different from that of Homer. Since 1991, however, the magnitude and composition of the harvest have changed dramatically. In fact, the 1994 Central Cook Inlet harvest was made up of younger and smaller halibut than any other subarea in Area 3A. These changes are probably the result of high abundance of the 1987 and 1988 year classes combined with declines in overall adult stock abundance.

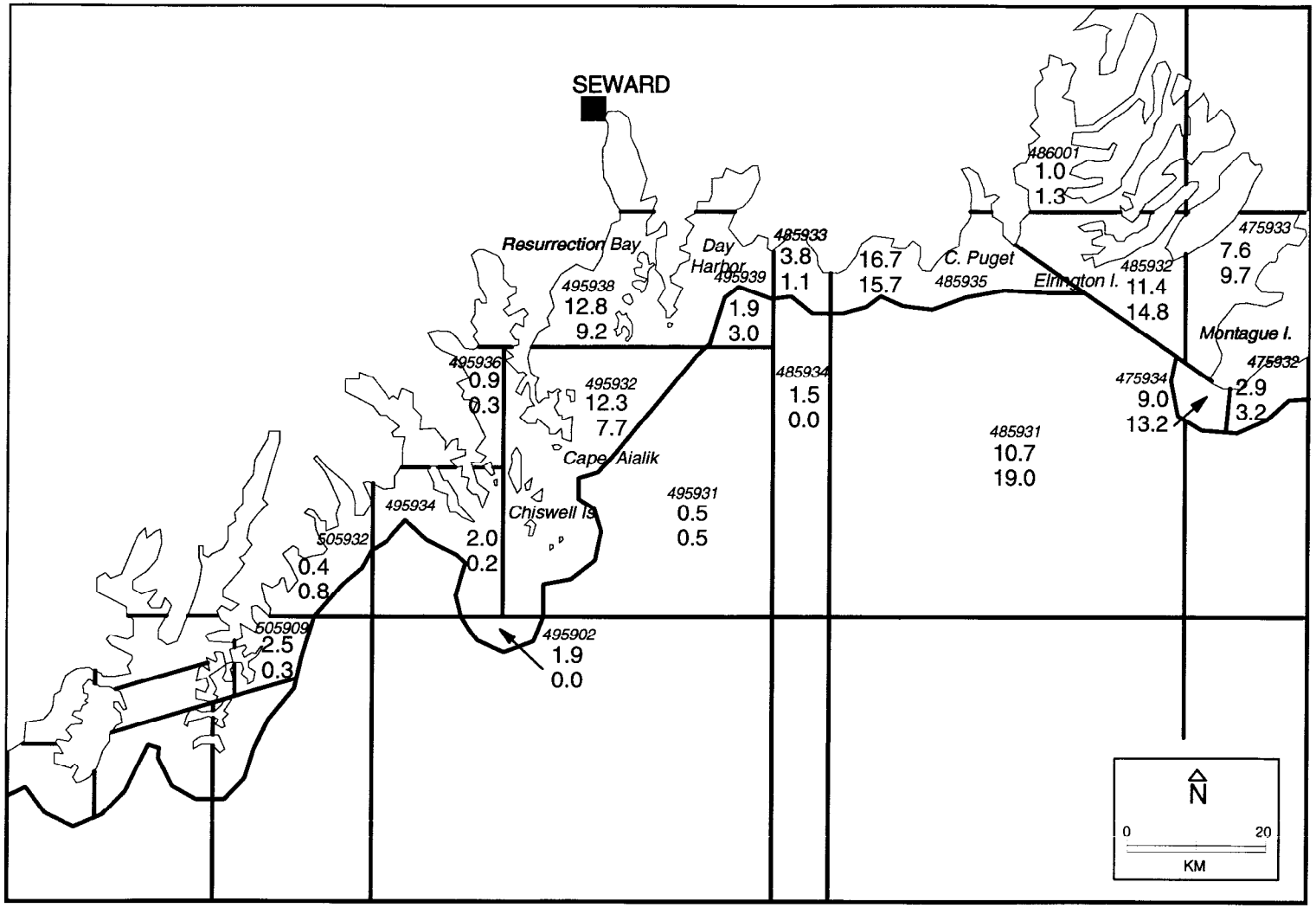

Figure 16.-Spatial distribution of recreational effort and halibut harvest by civilian charter anglers interviewed at Seward, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

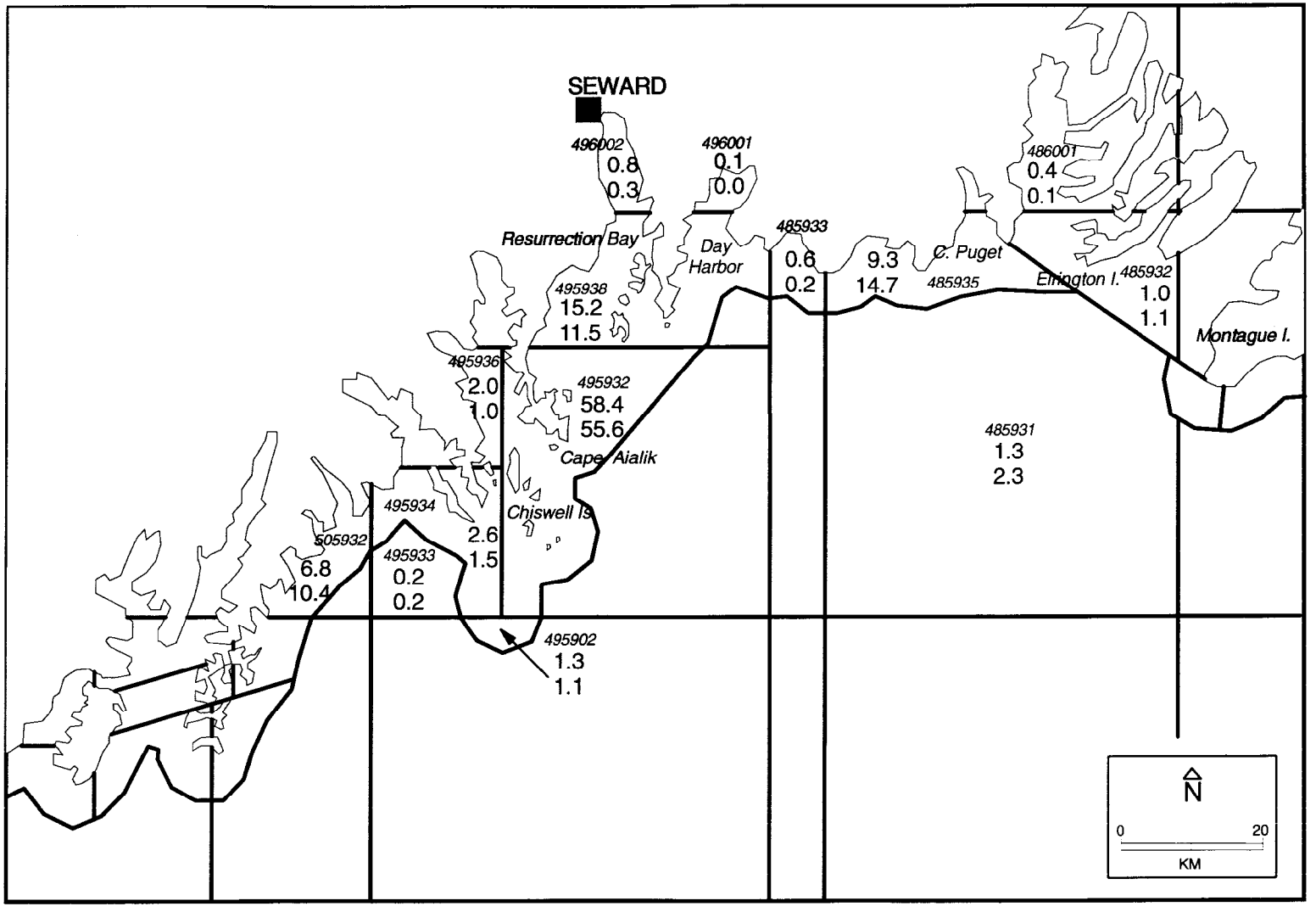

Figure 17.-Spatial distribution of recreational effort and halibut harvest by military charter anglers interviewed at Seward, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

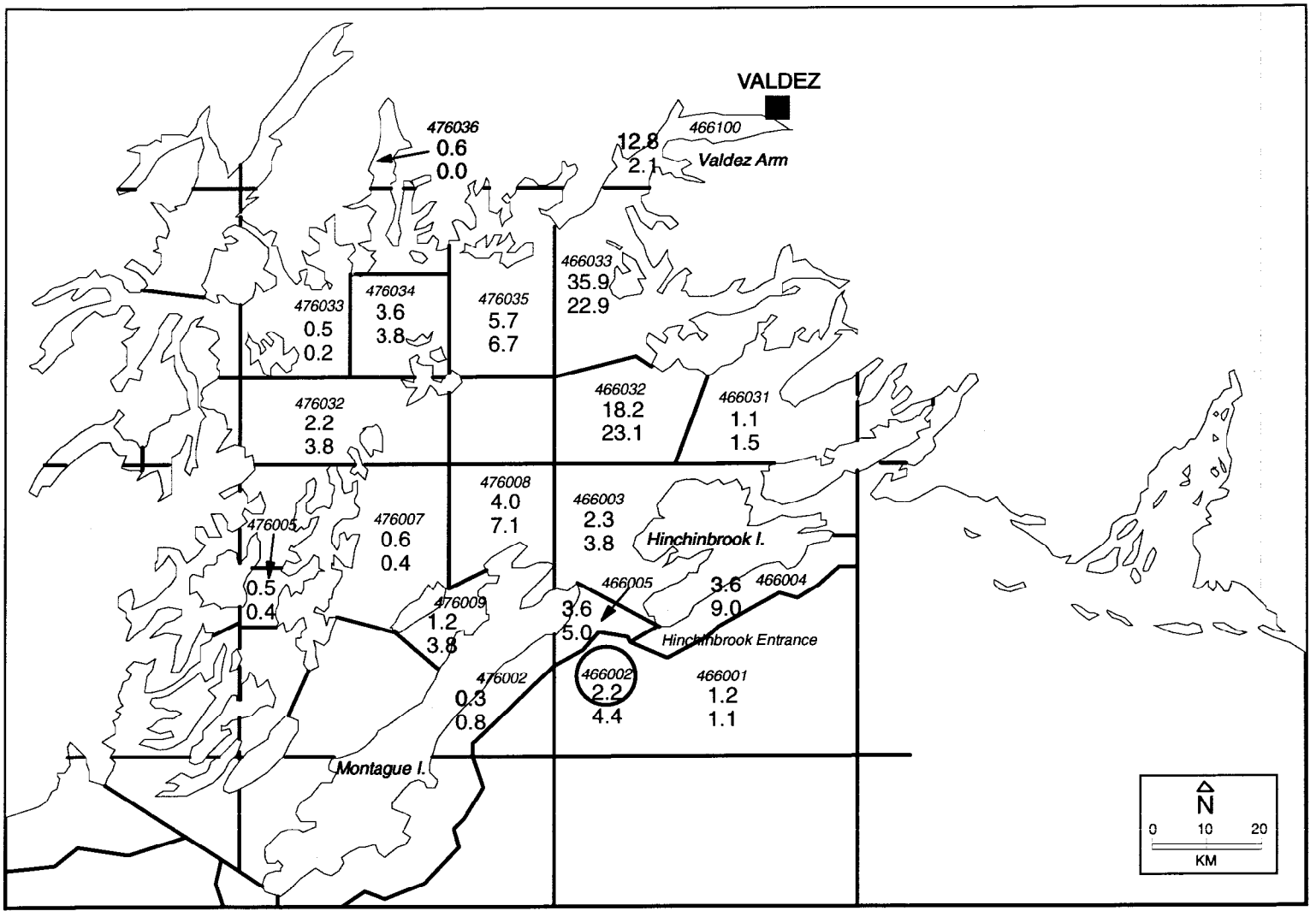

Figure 18.-Spatial distribution of recreational effort and halibut harvest by private anglers interviewed at Valdez, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

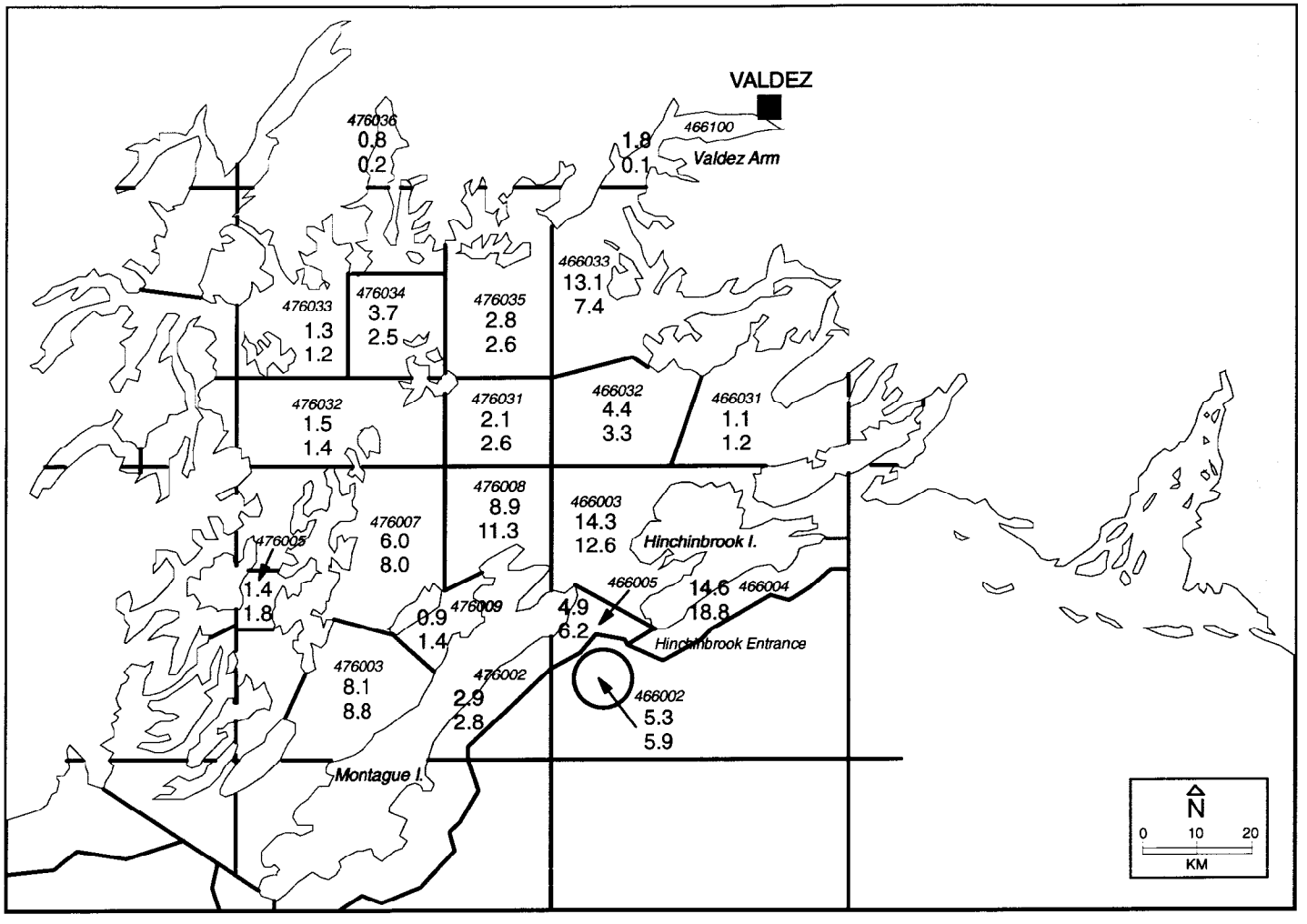

Figure 19.-Spatial distribution of recreational effort and halibut harvest by charter anglers interviewed at Valdez, 1994. The percentage of angler-days targeting halibut (upper number) and the percentage of fish harvested while targeting all species (lower number) are shown for each NMFS stat area (six-digit number).

Estimates of sex composition were consistent with past years, except that the proportion of females was notably lower in the Homer harvest in 1994. Females made up approximately 84% of the Homer harvest in 1992 and 80% in 1993, compared with 72% in 1994. The difference is probably due largely to stratification of the estimate by user group and incorporation of charter-caught fish cleaned at sea. Stratification gave more weight to the private harvest, and both private-caught fish and charter-caught fish cleaned at sea contained higher proportions of males.

Anglers continue to travel farther from port to fish for halibut, particularly in the North Gulf Coast subarea. Less than 15% of the North Gulf harvest was from waters east of Day Harbor in 1991 (Meyer 1992). By comparison, 43% of the private harvest and 78% of the civilian charter harvest were from these waters in 1994 (Figures 15 and 16). Central Cook Inlet anglers also report that they must fish farther from port to catch halibut. These reports could not be verified because stat area data were not collected in 1991.

Changes in the spatial distribution of harvest may be related to decreases in the abundance of fish of desired size near the ports. The charter fleet has shown the greatest expansion because it relies on larger, faster boats that are better equipped to travel farther. Interestingly, the percentage of the military charter harvest that was taken east of Day Harbor decreased from 35% in 1993 to 18% in 1994. The military charter fleet consists primarily of small ("six-pack") boats that are restricted by the military camp to fishing certain waters. This area restriction is a major factor controlling the distribution of the military charter harvest.

ACCURACY, PRECISION, AND ASSUMPTIONS

Stratification of most of the estimates of age, length, and sex composition, mean length, and mean weight by user group represented a significant change in data analysis from previous years. Stratification by user group probably increased the accuracy of subarea estimates because stratum weights estimated from the postal survey (Appendix A2) encompassed harvest from all locations, seasons, and times of day. For most subareas, there was a large difference in the estimated proportion of the harvest taken by each user group between the postal survey and this study. This discrepancy, noted in Meyer (1994), is likely due to nonrepresentative sampling. Namely, sampling was conducted only at the major ports with significant charter fleets, during the peak of the charter season (May-September), and during the peak times of day. Under this design, there would be a tendency to oversample the charter harvest. This study, for example, estimated that 84% of the Homer harvest was by charter anglers (Table 9), compared with the postal survey estimate of 60% for the Lower Cook Inlet subarea (Appendix A2). Similarly, this study estimated that charter anglers accounted for 77% of the Valdez halibut harvest, compared with the postal survey estimate of only 42% for the Prince William Sound subarea. In both of these subareas, there are numerous unsampled exit points that were probably dominated by private harvest. In the Central Cook Inlet fishery, however, where port sampling was conducted over a broad range of hours and included the vast majority of exiting anglers, estimates of the charter proportion of the harvest from the postal survey and this study were identical.

Incorporation of data from charter-caught halibut cleaned at sea at Homer likely also increased the accuracy of estimates of mean weight and sex composition for the Lower Cook Inlet subarea. Estimates prior to 1994 were based only on landed fish and were probably biased high. Mean net weight estimated only from landed fish in 1994 would have been 7% higher than the weighted

estimates presented in this report. This difference alone is equivalent to a difference in harvest biomass of 137,000 pounds.

Not all ports in Area 3A can be sampled with available funds. As noted earlier, extension of estimates for the primary ports to each subarea assumes that the biological characteristics are uniform within each user group and subarea. This assumption is less crucial when the sampled port accounts for a large share of the subarea harvest. This was the case in the Central Cook Inlet subarea, where Deep Creek and Anchor Point accounted for about 96% of the Central Cook Inlet harvest (McKinley *In Press*). This was also true for the North Gulf Coast subarea, where Seward is the only access point. This is not the case in the Kodiak, Lower Cook Inlet, and Prince William Sound subareas, however. Data are not currently available to evaluate this assumption in these areas, but differences would have to be very large, at least in the Kodiak and Prince William Sound subareas, to have much effect on overall estimates for Area 3A.

Although the accuracy of many estimates was increased from previous years, there was a significant drop in precision. The decrease was most notable in the Lower Cook Inlet and North Gulf Coast subareas and was due primarily to small sample sizes (and high variance) of private-caught fish. A major reason for this is that estimates were stratified postseasonally, following data collection. There was also the tendency to undersample the private harvest mentioned earlier. Precision of stratified estimates can be increased in the future through sampling design modifications.

RECOMMENDATIONS

Estimates should continue to be stratified by user group in order to maximize accuracy. Precision can be increased through changes in study design, such that sample size goals are established for each user group. This will require additional analysis of postal survey data to obtain estimates of the proportion of harvest (and associated variances) by each user group.

Under the current IPHC regulations, anglers may clean their fish and dispose of carcasses at sea, as long as they do so in a manner that does not prevent the determination of the number of fish harvested. The practice of cleaning at sea is becoming more common at all ports. As distance to the fishing grounds increases, some charter operators are taking advantage of the long run back to port to complete fish cleaning chores. Private anglers clean fish at sea to avoid congestion and disposal of carcasses on land. Future studies should continue to investigate and correct for possible bias introduced by selective cleaning of halibut at sea.

The objective of estimating the percentage of the effort and harvest attributable to each user group (objective 3) is probably no longer needed. It may be impossible to obtain unbiased estimates through sampling at only selected ports. For most ports, more accurate estimates are provided through the postal survey. Interviews should be continued, however, to estimate the spatial distribution of effort and harvest, catch rates, etc. These estimates may be valuable for detecting and understanding localized depletion and other changes due to interaction between gear groups.

Finally, sampling the Central Cook Inlet harvest at Deep Creek and Anchor Point was beneficial. Without data from this fishery, harvest biomass would likely have been significantly overestimated. Given the changes observed in this area since 1991, and the fact that this fishery

accounts for a significant portion of the harvest (34% in 1994), sampling of this fishery should continue.

ACKNOWLEDGMENTS

Several Alaska Department of Fish and Game personnel were instrumental in this study. Catherine Coon, Richard Gustin, Michael Parish, William Romberg, and Alan Heckart collected field data, assisted the public, and provided valuable insight on study design and sampling methods. Paul Cyr aged all halibut otoliths and assisted with data analysis. Patricia Hansen and Dave Bernard provided biometric review and variance formulations. Douglas Vincent-Lang provided overall project guidance, supervision, and perspective. Finally, Margaret Leonard whipped the report into shape for publication.

Numerous other individuals contributed invaluable assistance. Calvin Blood of the IPHC verified the assigned halibut ages. Jack Dyer and Leon Nelson of the Seward Military Recreation Camp provided military charter boat logbook data. Harbormasters throughout the area provided valuable information and cooperation to achieve sampling objectives. Most importantly, the vast majority of anglers and charter boat operators were curious, cooperative, and generous with information.

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APPENDIX A. HARVEST AND BIOMASS ESTIMATES

Appendix A1.-Estimated recreational harvest of Pacific halibut by subarea in IPHC Regulatory Area 3A, and Alaska statewide harvest, 1977-1994.

Year	Kodiak/ Afognak	Cook Inlet	North Gulf Coast	Prince William Sound	Yakutat	Area 3A	Alaska Statewide	Percent of Statewide
1977	994	13,466	1,705	1,247	428	17,840	23,244	76.8
1978	1,721	25,577	2,723	933	24	30,978	37,085	83.5
1979	3,013	26,997	2,902	1,691	78	34,681	47,705	72.7
1980	3,651	29,985	3,017	3,143	34	39,830	64,658	61.6
1981	6,858	38,721	3,443	2,495	65	51,582	74,212	69.5
1982	9,180	39,532	2,954	2,735	398	54,799	92,358	59.3
1983	8,545	60,126	2,619	3,493	682	75,465	117,042	64.5
1984	8,179	61,202	3,267	4,428	241	77,317	124,950	61.9
1985	7,303	63,158	5,934	4,527	520	81,442	127,634	63.8
1986	10,960	85,153	10,398	8,331	777	115,619	160,885	71.9
1987	9,869	78,431	7,171	4,379	1,194	101,044	145,829	69.3
1988	7,749	137,252	11,696	9,845	1,673	168,215	225,106	74.7
1989	10,435	126,917	7,251	8,697	772	154,072	229,016	67.3
1990	9,134	148,538	9,500	10,851	1,459	179,482	247,202	72.6
1991	12,089	148,646	13,818	12,733	2,112	189,398	266,523	71.1
1992	10,860	143,094	18,595	17,855	1,861	192,265	264,943	72.6
1993	14,169	162,404	25,534	19,716	2,752	224,575	313,147	71.7
1994	14,910	170,801	25,009	23,487	3,577	237,784	329,046	72.3

From: Mills 1979-1994, Howe et al. 1995.

Appendix A2.-Estimated recreational harvest by user group in IPHC Regulatory Area 3A, 1994.

Subarea	Estimated Number of Halibut Harvested			% Charter
	Charter	Private	Total	
Kodiak/Afognak	6,566	8,344	14,910	44.0
Central Cook Inlet	41,589	40,004	81,593	51.0
Lower Cook Inlet	53,163	36,045	89,208	59.6
North Gulf Coast	15,501	9,508	25,009	62.0
Prince William Sound	9,782	13,705	23,487	41.6
Yakutat	2,185	1,392	3,577	61.1
Total Area 3A	128,786	108,998	237,784	54.2

Estimates were compiled using unpublished data from M. Mills (ADF&G, Anchorage, personal communication).

Appendix A3.-Estimation of recreational harvest biomass in Area 3A, 1994.

Subarea	Data Source	User Group	Mean Net Weight (lb)	Number of Fish	Harvest Biomass (lb net)
Kodiak/Afognak	Kodiak	Private	24.712	8,344	206,197
		Charter	25.423	6,566	166,927
Central Cook Inlet	Deep Cr/ Anchor Pt.	Private	11.492	40,004	459,726
		Charter	15.059	41,589	626,289
Lower Cook Inlet	Homer	Private	22.001	36,045	793,026
		Charter	20.499	53,163	1,089,762
North Gulf Coast	Seward	Private	20.219	9,508	192,242
		Charter	19.270	15,501	298,705
Prince William Sound	Valdez	Private	21.288	13,705	291,752
		Charter	27.828	9,782	272,214
Yakutat	Valdez	Private	21.288	1,392	29,633
		Charter	27.828	2,185	60,804
TOTAL AREA 3A			18.871	237,784	4,487,277

Net weight was estimated from this report and the number of fish harvested by each user group is from Appendix A2.

APPENDIX B. 1994 DATA TABLES

Appendix B1.-Estimated proportions (p), by subarea, of each age group in the 1994 Area 3A recreational harvest.

	Kodiak/Afognak		Central Cook Inlet		Lower Cook Inlet		North Gulf Coast		Prince William Sound	
Age	p	SE	p	SE	p	SE	p	SE	p	SE
3	0.003	0.002	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
4	0.021	0.006	0.012	0.005	0.024	0.049	0.006	0.002	0.019	0.021
5	0.042	0.008	0.079	0.013	0.031	0.049	0.023	0.039	0.038	0.026
6	0.194	0.016	0.236	0.021	0.073	0.067	0.127	0.088	0.158	0.049
7	0.191	0.016	0.296	0.022	0.112	0.074	0.202	0.104	0.127	0.037
8	0.119	0.013	0.141	0.017	0.178	0.085	0.100	0.067	0.143	0.042
9	0.118	0.013	0.100	0.015	0.145	0.060	0.109	0.057	0.130	0.037
10	0.098	0.012	0.055	0.011	0.159	0.060	0.129	0.076	0.149	0.039
11	0.098	0.012	0.043	0.010	0.113	0.050	0.098	0.057	0.094	0.032
12	0.044	0.008	0.010	0.005	0.065	0.036	0.062	0.042	0.073	0.025
13	0.038	0.008	0.012	0.005	0.036	0.036	0.058	0.016	0.037	0.021
14	0.021	0.006	0.007	0.004	0.052	0.059	0.041	0.013	0.013	0.012
15	0.005	0.003	0.005	0.003	0.007	0.002	0.030	0.040	0.008	0.003
16	0.002	0.002	0.002	0.002	0.003	0.001	0.007	0.005	0.002	0.002
17	0.003	0.002	0.002	0.002	0.002	0.001	0.008	0.006	0.010	0.012
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix B2.-Observed frequencies and estimated proportions of male and female halibut harvested, by subarea and user group, in Area 3A in 1994.

Subarea/User Group	Number of Fish		Estimated Proportion		SE[a]
	Male	Female	Male	Female	
Kodiak/Afognak					
Private	52	308	0.144	0.856	0.019
Charter	43	239	0.152	0.848	0.021
Unknown	108	599	0.153	0.847	0.014
Total	203	1,146	0.150	0.850	0.010
Central Cook Inlet					
Private	29	207	0.123	0.877	0.021
Charter	78	482	0.139	0.861	0.015
Unknown	0	2	0.000	1.000	0.000
Total	107	691	0.134	0.866	0.012
Lower Cook Inlet					
Private	12	30	0.286	0.714	0.071
Charter-cleaned in port	177	694	0.203	0.797	0.014
Charter-cleaned at sea	72	94	0.434	0.566	0.039
Unknown	18	43	0.295	0.705	0.059
Total	279	861	0.281[b]	0.719[b]	0.083[b]
North Gulf Coast					
Private	16	36	0.308	0.692	0.065
Charter-civilian	125	222	0.360	0.640	0.026
Civilian-military	157	187	0.456	0.544	0.027
Unknown	2	4	0.333	0.667	0.221
Total	300	449	0.401	0.599	0.018
Prince William Sound					
Private	14	79	0.151	0.849	0.037
Charter	44	387	0.102	0.898	0.015
Unknown	17	55	0.236	0.764	0.050
Total	75	521	0.126	0.874	0.014

[a] Standard errors apply to both male and female proportions.

[b] Overall estimates for Lower Cook Inlet are stratified by user group.

Appendix B3.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for charter and private anglers in the Kodiak recreational fishery, 1994.

		Angler-Days			Halibut Harvest		
User Group	Stat Area	Number	p	SE	Number	p	SE(p)
Private	515801	0	0.000	0.000	0	0.000	0.000
	515802	0	0.000	0.000	0	0.000	0.000
	525731	189	0.168	0.011	150	0.152	0.011
	525732	53	0.047	0.006	63	0.064	0.008
	525733	861	0.764	0.013	739	0.749	0.014
	525805	20	0.018	0.004	27	0.027	0.005
	525807	0	0.000	0.000	0	0.000	0.000
	535734	0	0.000	0.000	0	0.000	0.000
	535803	4	0.004	0.002	7	0.007	0.003
		1,127			986		
Charter	515801	12	0.026	0.007	12	0.020	0.006
	515802	38	0.081	0.013	47	0.077	0.011
	525731	47	0.100	0.014	78	0.127	0.013
	525732	8	0.017	0.006	8	0.013	0.005
	525733	308	0.658	0.022	375	0.611	0.020
	525805	45	0.096	0.014	79	0.129	0.014
	525807	6	0.013	0.005	12	0.020	0.006
	535734	4	0.009	0.004	3	0.005	0.003
	535803	0	0.000	0.000	0	0.000	0.000
		468			614		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

Appendix B4.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for charter and private anglers in the Central Cook Inlet (Deep Creek/Anchor Point) recreational fishery, 1994.

		Angler-Days			Halibut Harvest		
User Group	Stat Area	Number	p	SE	Number	p	SE(p)
Private	515936	6	0.008	0.003	3	0.003	0.002
	515937	4	0.006	0.003	6	0.007	0.003
	515938	205	0.286	0.017	241	0.281	0.015
	515939	134	0.187	0.015	114	0.133	0.012
	516001	51	0.071	0.010	34	0.040	0.007
	516002	52	0.073	0.010	60	0.070	0.009
	525931	256	0.357	0.018	385	0.449	0.017
	526002	9	0.013	0.004	15	0.017	0.004
		717			858		
Charter	515936	0	0.000	0.000	0	0.000	0.000
	515937	22	0.042	0.009	28	0.031	0.006
	515938	89	0.170	0.016	153	0.170	0.013
	515939	7	0.013	0.005	14	0.016	0.004
	516001	12	0.023	0.007	12	0.013	0.004
	516002	15	0.029	0.007	17	0.019	0.005
	525931	347	0.663	0.021	622	0.693	0.015
	526002	31	0.059	0.010	52	0.058	0.008
		523			898		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

Appendix B5.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for charter and private anglers in the Homer recreational fishery, 1994.

		Angler-Days			Halibut Harvest		
User Group	Stat Area	Number	p	SE	Number	p	SE(p)
Private	515831	0	0.000	0.000	0	0.000	0.000
	515903	6	0.008	0.003	0	0.000	0.000
	515904	0	0.000	0.000	0	0.000	0.000
	515905	0	0.000	0.000	0	0.000	0.000
	515906	0	0.000	0.000	0	0.000	0.000
	515907	43	0.058	0.009	59	0.072	0.009
	515908	37	0.050	0.008	14	0.017	0.005
	515931	6	0.008	0.003	1	0.001	0.001
	515932	31	0.042	0.007	20	0.024	0.005
	515933	44	0.059	0.009	14	0.017	0.005
	515934	4	0.005	0.003	0	0.000	0.000
	515935	81	0.109	0.011	39	0.048	0.007
	515936	121	0.163	0.014	123	0.150	0.013
	515937	85	0.114	0.012	122	0.149	0.012
	515938	4	0.005	0.003	7	0.009	0.003
	525836	0	0.000	0.000	0	0.000	0.000
	525901	11	0.015	0.004	16	0.020	0.005
	525902	64	0.086	0.010	85	0.104	0.011
	525931	201	0.270	0.016	317	0.388	0.017
	525932	2	0.003	0.002	0	0.000	0.000
	526002	4	0.005	0.003	1	0.001	0.001
		744			818		
Charter	515831	55	0.024	0.003	108	0.026	0.002
	515903	25	0.011	0.002	30	0.007	0.001
	515904	42	0.019	0.003	83	0.020	0.002
	515905	333	0.147	0.007	570	0.137	0.005
	515906	48	0.021	0.003	69	0.017	0.002
	515907	55	0.024	0.003	94	0.023	0.002
	515908	0	0.000	0.000	0	0.000	0.000
	515931	27	0.012	0.002	47	0.011	0.002
	515932	0	0.000	0.000	0	0.000	0.000
	515933	3	0.001	0.001	3	0.001	0.000
	515934	0	0.000	0.000	0	0.000	0.000
	515935	3	0.001	0.001	0	0.000	0.000
	515936	57	0.025	0.003	72	0.017	0.002
	515937	76	0.034	0.004	132	0.032	0.003
	515938	0	0.000	0.000	0	0.000	0.000
	525836	186	0.082	0.006	370	0.089	0.004
	525901	30	0.013	0.002	48	0.012	0.002
	525902	644	0.284	0.009	1,259	0.302	0.007
	525931	673	0.297	0.010	1,274	0.305	0.007
	525932	10	0.004	0.001	14	0.003	0.001
	526002	0	0.000	0.000	0	0.000	0.000
		2,267			4,173		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

Appendix B6.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for civilian charter and private anglers in the Seward recreational fishery, 1994.

		Angler-Days			Halibut Harvest		
User Group	Stat Area	Number	p	SE	Number	p	SE(p)
Private	475932	0	0.000	0.000	0	0.000	0.000
	475933	8	0.009	0.003	16	0.028	0.007
	475934	3	0.003	0.002	4	0.007	0.004
	485931	6	0.007	0.003	7	0.012	0.005
	485932	11	0.013	0.004	8	0.014	0.005
	485933	91	0.104	0.010	59	0.105	0.013
	485934	2	0.002	0.002	3	0.005	0.003
	485935	163	0.186	0.013	146	0.259	0.018
	486001	0	0.000	0.000	0	0.000	0.000
	495902	2	0.002	0.002	0	0.000	0.000
	495931	6	0.007	0.003	2	0.004	0.003
	495932	120	0.137	0.012	71	0.126	0.014
	495933	0	0.000	0.000	0	0.000	0.000
	495934	14	0.016	0.004	5	0.009	0.004
	495936	3	0.003	0.002	1	0.002	0.002
	495937	8	0.009	0.003	0	0.000	0.000
	495938	391	0.447	0.017	227	0.403	0.021
	495939	0	0.000	0.000	0	0.000	0.000
	496001	5	0.006	0.003	1	0.002	0.002
	496002	41	0.047	0.007	13	0.023	0.006
	505909	0	0.000	0.000	0	0.000	0.000
	505932	0	0.000	0.000	0	0.000	0.000
		874			563		
Civilian	475932	34	0.029	0.005	37	0.032	0.005
	475933	90	0.076	0.008	112	0.097	0.009
	475934	106	0.090	0.008	152	0.132	0.010
	485931	126	0.107	0.009	219	0.190	0.012
	485932	135	0.114	0.009	170	0.148	0.010
	485933	45	0.038	0.006	13	0.011	0.003
	485934	18	0.015	0.004	0	0.000	0.000
	485935	197	0.167	0.011	181	0.157	0.011
	486001	12	0.010	0.003	15	0.013	0.003
	495902	23	0.019	0.004	0	0.000	0.000
	495931	6	0.005	0.002	6	0.005	0.002
	495932	145	0.123	0.010	88	0.077	0.008
	495933	0	0.000	0.000	0	0.000	0.000
	495934	24	0.020	0.004	2	0.002	0.001
	495936	11	0.009	0.003	3	0.003	0.002
	495937	0	0.000	0.000	0	0.000	0.000
	495938	151	0.128	0.010	106	0.092	0.009
	495939	23	0.019	0.004	34	0.030	0.005
	496001	0	0.000	0.000	0	0.000	0.000
	496002	0	0.000	0.000	0	0.000	0.000
	505909	29	0.025	0.005	3	0.003	0.002
	505932	5	0.004	0.002	9	0.008	0.003
		1,180			1,150		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

Appendix B7.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for Seward Military Recreation Camp charter boat anglers, 1994.

	Angler-Days			Halibut Harvest		
Stat Area	Number	p	SE	Number	p	SE(p)
485931	143	0.013	0.001	140	0.023	0.002
485932	107	0.010	0.001	65	0.011	0.001
485933	63	0.006	0.001	13	0.002	0.001
485935	1,014	0.093	0.003	902	0.147	0.005
486001	45	0.004	0.001	6	0.001	0.000
495902	146	0.013	0.001	67	0.011	0.001
495932	6,398	0.584	0.005	3,413	0.556	0.006
495933	23	0.002	0.000	14	0.002	0.001
495934	285	0.026	0.002	92	0.015	0.002
495936	223	0.020	0.001	61	0.010	0.001
495938	1,665	0.152	0.003	707	0.115	0.004
496001	11	0.001	0.000	0	0.000	0.000
496002	86	0.008	0.001	16	0.003	0.001
505932	740	0.068	0.002	638	0.104	0.004
	10,949			6,134		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

Appendix B8.-Estimated proportions (p) of effort and halibut harvest by NMFS stat area for charter and private anglers in the Valdez recreational fishery, 1994.

		Angler-Days			Halibut Harvest		
User Group	Stat Area	Number	p	SE	Number	p	SE(p)
Private	466001	8	0.012	0.004	6	0.011	0.005
	466002	14	0.022	0.006	23	0.044	0.009
	466003	15	0.023	0.006	20	0.038	0.008
	466004	23	0.036	0.007	47	0.090	0.013
	466005	23	0.036	0.007	26	0.050	0.010
	466031	7	0.011	0.004	8	0.015	0.005
	466032	118	0.182	0.015	121	0.231	0.018
	466033	232	0.359	0.019	120	0.229	0.018
	466100	83	0.128	0.013	11	0.021	0.006
	476002	2	0.003	0.002	4	0.008	0.004
	476003	0	0.000	0.000	0	0.000	0.000
	476005	3	0.005	0.003	2	0.004	0.003
	476007	4	0.006	0.003	2	0.004	0.003
	476008	26	0.040	0.008	37	0.071	0.011
	476009	8	0.012	0.004	20	0.038	0.008
	476031	0	0.000	0.000	0	0.000	0.000
	476032	14	0.022	0.006	20	0.038	0.008
	476033	3	0.005	0.003	1	0.002	0.002
	476034	23	0.036	0.007	20	0.038	0.008
	476035	37	0.057	0.009	35	0.067	0.011
	476036	4	0.006	0.003	0	0.000	0.000
		647			523		
Charter	466001	0	0.000	0.000	0	0.000	0.000
	466002	70	0.053	0.006	103	0.059	0.006
	466003	187	0.143	0.010	219	0.126	0.008
	466004	191	0.146	0.010	328	0.188	0.009
	466005	64	0.049	0.006	109	0.062	0.006
	466031	14	0.011	0.003	21	0.012	0.003
	466032	58	0.044	0.006	57	0.033	0.004
	466033	171	0.131	0.009	129	0.074	0.006
	466100	24	0.018	0.004	1	0.001	0.001
	476002	38	0.029	0.005	49	0.028	0.004
	476003	106	0.081	0.008	153	0.088	0.007
	476005	18	0.014	0.003	31	0.018	0.003
	476007	78	0.060	0.007	140	0.080	0.007
	476008	117	0.089	0.008	197	0.113	0.008
	476009	12	0.009	0.003	24	0.014	0.003
	476031	28	0.021	0.004	46	0.026	0.004
	476032	20	0.015	0.003	24	0.014	0.003
	476033	17	0.013	0.003	21	0.012	0.003
	476034	49	0.037	0.005	44	0.025	0.004
	476035	37	0.028	0.005	45	0.026	0.004
	476036	10	0.008	0.002	4	0.002	0.001
		1,309			1,745		

Effort is in angler-days targeted on halibut or nonspecific bottomfish.

APPENDIX C. LIST OF DATA FILES.

Appendix C1.-Names and contents of 1994 halibut biological and interview data files archived with ADF&G, Division of Sport Fish, Anchorage.

Filename	Format	Description
Q7540BA4.DTA	ASCII	Kodiak biological data
19200BA4.DTA	ASCII	Central Cook Inlet biological data
10030BA4.DTA	ASCII	Homer biological data (fish cleaned in port)
10030BB4.DTA	ASCII	Homer biological data (charter fish cleaned at sea)
10020BA4.DTA	ASCII	Seward biological data
J0010BA4.DTA	ASCII	Valdez biological data
HFSPEC94.DAT	ASCII	Field specification file for biological data files
KINT94.XLS	Excel 5.0	Kodiak interview data
CCIINT94.XLS	Excel 5.0	Central Cook Inlet interview data
HINT94.XLS	Excel 5.0	Homer interview data
SINT94.XLS	Excel 5.0	Seward interview data
ARMY94.XLS	Excel 5.0	Seward Army Recreation Camp logbook data
USAF94.XLS	Excel 5.0	Seward Air Force Recreation Camp logbook data
VINT94.XLS	Excel 5.0	Valdez interview data