Fishery Data Series No. 05-32

Pot Shrimp Stock Assessment Survey Results from 1996–2003 in Districts 3, 7, 12, and 13 of Southeastern Alaska

by

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and

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June 2005

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

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

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

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

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
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
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
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	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
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.
minute (angular)	'
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
variance	
population	Var
sample	var

FISHERY DATA REPORT NO. 05-32

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ABSTRACT

The purpose of this document is to present a summary of the pot shrimp survey data collected from all of the districts surveyed to date in southeastern Alaska in order to facilitate its use in the management of this fishery. The format used is intended to provide a consistent and complete summary by district using the common denominators subdistrict, year, survey type and mesh size.

Data was summarized for all survey years, 1996 to 2003 and all surveyed areas which include Cordova Bay in Section 3-A of District 3, Ernest Sound in District 7, Tenakee Inlet in District 12, and Hoonah Sound in Section 13-C of District 13. Summaries of bycatch species prevalence, catch per unit effort (survey pot) by weight and number, trends in mean carapace length, length/weight relation, and size at maturity (L_{50}) were completed for all gear types fished for 24 hours in all areas, and years.

The summary presented here shows moderate declines in the size of shrimp in Districts 3 and perhaps also in 7, suggesting recruitment as well as growth over-fishing in these districts. Less obvious declines in the size of shrimp may be observed in District 12. In District 13 the average carapace length has also declined slightly but multiple size classes are still evident in the length frequency histograms suggesting a more stable population.

Key words: Spot shrimp, *Pandalus platyceros*, coonstripe shrimp, *Pandalus hypsinotus* Southeast Alaska, Shrimp management, Pandalid, Stock assessment methods

INTRODUCTION

The spot shrimp fishery in Southeastern Alaska is currently the only viable commercial pot fishery for shrimp in the state. Spot shrimp, *Pandalus platyceros*, comprise the majority of the landed weight; the remainder is primarily coonstripe shrimp, *P. hypsinotus*. Since 1960, the fishery has undergone a 10-fold increase in the number of participating vessels. This caused concern for conservation of shrimp stocks, which led to increasing restrictions, including limited entry in 1996. Vessel configuration is a function of market demand and has evolved from smaller vessels with a limited fresh local market to larger catcher-processors, which sell frozen whole shrimp, primarily to the Japanese market. There is also a very limited live market. The season has shortened from year-round in 1981 to the current season, which by regulation begins on October 1, and ends February 28 or once target guideline harvest levels (GHLs) have been achieved. Districts in which harvest has not reached the GHL by February 28 may be reopened by emergency order May 15 of the following year. The season length is variable by district but in recent years has ranged from 4 to 338 days. Guideline harvest ranges (GHRs) were established by emergency order for each district in 1995. In general, the upper end of each GHR was based on the average harvest for the five fishing seasons from 1990/91 through 1994/95. For districts with no long-term harvest data arbitrary 20,000-lb GHLs were established to allow for development of the fishery while providing some upper harvest ceiling. These emergency order GHRs were put into regulation in 1997. Subsequently the upper ends of several GHRs have been increased based upon fishery performance and on stock assessment survey results. Regulations describing and limiting gear were established in 1997. They specify a minimum mesh size of 1 ¾-inch stretch (44.5 mm) and two categories of pot configuration, ‘large’ having a bottom perimeter of greater than 124 but less than 153 inches and ‘small’ with a bottom perimeter of 124 inches or less, with associated limits of 100 large or 140 small pots. The implementation of GHR’s has led to more active management, with inseason monitoring of catch and closure of districts by emergency order. However, this approach has inherent risks. There may only be a weak relationship between historical harvest and the sustainability of current harvest levels, particularly under changing environmental and ecological conditions.

The primary management concerns for this fishery include unknown mortality associated with prolonged holding and discard of small shrimp while fishers process the catch, and under-reporting or non-reporting of catch. Additionally, it is suspected that the minimum mesh size restriction may not function to reduce the catch of small shrimp when pots are pulled frequently with short soak times. Spot and coonstripe shrimp are protandric hermaphrodites, changing into females, as they grow larger. Since the harvest is primarily of larger shrimp, removal of an excessive proportion of these females could affect the reproductive potential of the stocks. Long-term effects on recruitment and stock strength due to this harvest approach are not known.

Spot shrimp may be fairly long-lived. In Unakwik Inlet, Prince William Sound, they have been reported to live in excess of 7 years in age (Kimker et al. 1996). This species may also be fairly sedentary within suitable habitat; tag recoveries made over a 3-year period were all made within 0.9 mile (1.7 km) of their release site in Unakwik Inlet. In addition, the patchy spatial structure of spot shrimp habitat may result in aggregated populations that may be more vulnerable to serial depletion, particularly for those stocks near fishing ports, or within isolated fjords that have good fishing grounds (Orensanz et al. 1998). Species having a highly predictable spatial distribution require more conservative management in order to achieve long-term sustainability.

This report summarizes information collected during pot surveys, conducted seasonally prior to and following the commercial fishery in 4 districts of southeastern Alaska from 1996 to 2003. Survey protocol development continues to evolve as assumptions are evaluated and methods are refined. The current goal of the pot shrimp survey program is to characterize spot and coonstripe shrimp size composition and relative abundance in 2 subdistricts of each district surveyed. This information is used to make recommendations on preseason GHLs to achieve a sustainable harvest and to adjust regulatory GHRs when necessary. A secondary goal is to estimate the population size for each surveyed area. However, a thorough catch analysis of shrimp pot fishing behavior must be completed before reliable population estimates can be obtained.

OBJECTIVES

1. Estimate a preseason index of abundance of spot and coonstripe shrimp within each district surveyed, in order to evaluate interannual trends in population size.
2. Describe the size and sex composition of spot shrimp in each district surveyed, in order to determine spot shrimp relative size class strength.
3. Estimate the postseason index of abundance of spot and coonstripe shrimp, for each surveyed area in order to estimate harvest rate and preseason population size.

METHODS

Pandalid shrimp species *P. platyceros* (spot shrimp), *P. hypsinotus* (coonstripe shrimp), *P. borealis* (northern or pink shrimp), *Pandalopsis dispar* (sidestripe shrimp), and *P. tridens* (yellow leg shrimp) were captured using longlined conical pots set by an Alaska Department of Fish and Game (ADF&G) or chartered commercial vessel. Surveys lasted from 5 to 10 days depending on the year and management unit (district) surveyed. Each survey covered at least 2 adjacent subdistricts within a district, thus minimizing running time while still covering a relatively large area. Also, subdistricts chosen were relatively protected so that fishing time lost due to poor weather conditions was minimized. Those subdistricts having the highest average commercial catches were surveyed. Prior to determining longlined pot set locations, one or more successful commercial fishers in each district were interviewed to identify areas of highest spot

shrimp abundance. Within these areas, twelve set start locations along the 50-fathom (90 meter) isobath were chosen using a systematic sample design with randomly chosen start points (Thompson 1992). Arcview Geographic Information System (GIS) was used to delineate the 50-fathom line. This resulted in sampling locations centered at approximately the 50-fathom isobath, but crossing the 30 to 70-fathom (55 to 128 meters) isobaths. In all surveyed districts, during the second or third year of survey, the less productive sets were eliminated and set start locations were established in the most productive habitats only. These new locations became the 'index' set locations that were fished each year. The objective of establishing index set locations was to minimize the variability in catch rates due to habitat quality in order to better evaluate interannual trends in the shrimp populations.

Survey areas, in decreasing order of commercially harvested pounds, are in Districts 3, 7, 13, and 12. These districts were chosen because they generally support the largest commercial harvest of spot shrimp within the respective management areas of Ketchikan, Petersburg, Sitka and Juneau (Figure 1; Table 1).

GEAR AND SETTING

1996 Pilot Study: District 7

The first ADF&G shrimp pot stock assessment survey was conducted in District 7 in 1996. Its primary objective was to test gear in order to establish a standard method with which to survey shrimp stocks harvested by the pot fishery. A variety of setting styles, pot types and mesh sizes were tested. These included individual pyramid pots with a 4 by 4 ft. (1.2 by 1.2 m) base, and 2 types of longlined cone pots; one 42 inches (106 cm) in diameter with 1 1/8-inch (28.6 mm) stretch mesh and four tunnels (referred to henceforth as "small mesh" pots), the other 42 inches in diameter with 1 ¾-inch (44.5 mm) stretch mesh and 3 tunnels ("large mesh" pots). The large, individually set pyramid pots were time consuming to set and retrieve and had consistently lower catches than the smaller pots when paired comparisons were made. The result was that fewer pots could be fished and fewer shrimp captured and sampled. The longlined cone pots were easier to set and retrieve and had higher catches. It was also determined that ten 10-pot strings of the smaller, conical pots spaced 20 fathoms (36 m) apart on a longline could be easily set and retrieved in a day. Subsequently a spacing interval of 10 fathoms was established to mimic that of commercial gear. Based on comparisons of catch rates, this pot spacing seemed to be adequate to minimize effects of adjacent pots attracting shrimp from one another, thus providing discrete samples of shrimp within the fished habitat for any given pot within a string. Only data from the longlined cone pots set in this survey is presented here.

1997 Survey: District 3

In 1997, a survey of District 3 was conducted aboard a commercially chartered vessel in order to allow for cost recovery of the shrimp captured. Five subdistricts were surveyed, 103-21, 103-23, 103-25, 103-30, and 103-40 (Figure 1). Longlined cone pots were used, including 30 each of the 42-inch diameter large (L) and small (S) mesh cone pots tested during the 1996 pilot study and described above, and 90 of the charter vessel-owned (V), 38-in diameter, 1 ¾-in mesh, 3-tunnel cone pots. Ten longline strings with 15 pots each were arranged identically, interspersing pots at a spacing of 10 fathoms, as follows: VVLVSVLVSVLVSVV. This ordering was chosen to intersperse pots in a systematic fashion, and to put the large and small mesh pots away from ends where anecdotal evidence suggests that pots are most likely to fish poorly. Pots were baited with bait jars filled to capacity with approximately 0.75 lb (0.34 kg) of chopped herring and hanging

bait equivalent to 1/3 of a chum salmon or 1/2 of a pink salmon. Pots were snapped onto groundline.

At the beginning of the survey, ten 15-pot longlined sets were pulled daily, but by day 3 it was necessary to reduce effort to 6 sets daily as pulling and sampling 10 sets was found to be too time intensive. Depths from 26 to 75 fathoms were fished. Set starting points were spaced at 1/4 to 1/2 nautical mile intervals along the 50-fathom isobath. Pot sets were pulled in a leapfrog manner, re-setting immediately in order to achieve a consistent mean soak time of 22.5 hours.

1998–2003 Surveys: Districts 3, 7, 12, and 13

Twelve subdistricts in 4 districts were fished during 1998–2003 surveys (Table 1). However, not all subdistricts were sampled in each year. Survey effort distribution for the two pilot surveys and subsequent pre and postseason surveys is summarized in Table 1. To reduce variability in the catches due to differences in habitat type, index longline set locations were established in 1998 for the District 3 preseason surveys. Standard soak periods, baiting protocols, index set locations and data collection methods began with the September 1999 preseason surveys for Districts 7 and 13, and with the 2000 preseason survey for District 12. Prior to standardization, index set start locations were chosen systematically using Arcview GIS with a random start along the 50-fathom isobath. Index set locations were targeted within known spot shrimp habitat. Each set was deployed from shallow to deep in order to sample 30 to 80 fathom depths. In the field, set start locations were adjusted by moving perpendicularly to the shore to the appropriate depth. The set start and end coordinates were recorded using differential geographical positioning systems (DGPS) and during subsequent pre- and postseason surveys have been duplicated as precisely as possible given wind and current conditions.

For each longlined pot set, the following data were collected: the latitude and longitude coordinates for each end of the set, date and time setting began and ended, the order in which the beginning and ending buoys were set, the number of pots, set length, distance between pots, and the set depths of the first, fifth (middle), and last pots.

During each survey, 6 longlined sets of ten 42-in diameter conical pots were pulled daily after soaking for 20–24 hours. Two pulling days were spent in each subdistrict. Half of the pots were large mesh pots while the other half was small mesh pots. Small and large type pots were snapped alternately at 10-fathom spacing onto neutrally buoyant marked groundline. Each pot was baited with 2 pints of chopped herring and either 1/3 of an in-the-round chum salmon or 1/2 of a pink salmon. Bait was not thawed more than 12 hours prior to use.

Before pulling a set, the coordinates given by differential geographic position system (DGPS) for each end of the set were compared to that recorded during setting by running nearby each buoy and noting its location and number. If the set had drifted or was in a location significantly different from where it was set, the coordinates at the time of pulling were used instead of those recorded during setting. The date and time pulling began and ended, and the bottom type as indicated by mud, coral, glass sponge or gravel on the pot or longline was noted.

BIOLOGICAL SAMPLING

As each pot came aboard, its contents were dumped into a basket pre-labeled with pot order. Next, non-shrimp bycatch species were removed, identified, and counted. The total weight of all bycatch species was recorded when time allowed. The shrimp catch was sorted by species, and then counted and the total weight for each shrimp species taken to the nearest 0.01 kg using an

Ohaus electronic balance. Prior to 2000, only total shrimp weight was measured. For each set, 3 small and 3 large mesh pots (excluding the end pots) were randomly selected for further sampling of shrimp. Sampling was conducted either during pulling or between pulls depending upon the vessel deck configuration.

For each of the 6 pots selected for sampling, carapace lengths of spot, coonstripe, northern, and sidestripe shrimps were measured to the nearest 0.5 mm. If the catch in a sampled pot was small, carapace lengths on all shrimp caught were measured. Large catches of shrimp were sub-sampled at rates ranging from 1/2 to 1/15 of pot contents. Shrimp were usually sub-sampled by number but were sub-sampled by weight when pot contents became prohibitively large for counting. The presence or absence of eggs and parasites, soft-shell condition, and percentage of dead eggs on ovigerous females were noted for all sampled spot and coonstripe shrimps.

Each day, shrimp were collected throughout the day from a combination of sampled pots and sets for collection of individual weights later. In order to sample the entire size range, shrimp were held on ice or refrigerated and measured at the end of the day, while at anchor. Weighing samples onboard while at anchor minimized the effects of boat motion on variable scale readings. These shrimp were measured for carapace length, whole weight and tail weight to the nearest 1.0 g for a sample of up to 10 spot shrimp with and 10 without eggs, from each of eight 5-mm size categories between 20 and 60 mm CL.

Finally, each day, two randomly selected grab samples of approximately 50 shrimp each, were taken from two unsampled pots for later determination of sexual stage by ADF&G staff. During two of the District 7 surveys, shrimp samples were sexed onboard.

ANALYSIS

Although soak time experiments were conducted concurrently with pre and postseason surveys in Districts 3 and 7 in 2001 and 2002, for the purposes of this report, only longlined shrimp pot sets with standard soak times of approximately 24 hours have been analyzed. Although some data on coonstripe shrimp was collected during surveys, particularly in District 7, only spot shrimp results are presented here. We hope to include coonstripe in a subsequent version of this report.

Catch rates and soak times

Spot shrimp catch rates were determined for each year, area, survey type (pre or postseason), and mesh size in terms of kg/pot, and no./pot. Gear soak time was also calculated for each year, area, survey type (pre or postseason), and mesh size. Both were calculated as simple arithmetic averages as follows:

$$\overline{X} = \frac{\sum x_i}{n}$$

Standard deviation of the two catch rates and of soak time were calculated according to the formula:

$$\sqrt{\frac{n\sum x_i^{\,2} - (\sum x_i)^2}{n(n-1)}}$$

Where:

n = is number of pots set

and

x_i = is variously either the: weight of spot shrimp, number of spot shrimp or soak time depending on which standard error is being calculated.

Average carapace length

Spot shrimp average carapace lengths were determined for each year, area, survey type (pre or postseason), and mesh size. First individual pot average carapace lengths were calculated as a weighted average with subsample rate as the weighting factor as follows:

$$\overline{CL} = \frac{\sum (CL_i * SS_i)}{\sum SS_i}$$

Where:

$\overline{CL}$ = Average carapace length in an individual pot

and

CL_i = an individual shrimp carapace length measurement

and

SS_i = an individual subsample rate

After this, a simple arithmetic average of the pot average carapace lengths was used to determine the average carapace length for the year, area, survey type and mesh size. Once again, the standard deviation of the average carapace length is calculated according to the formula:

$$\sqrt{\frac{n\sum x^2 - (\sum x)^2}{n(n-1)}}$$

Where:

n = is the number of pots sampled

x = is the CL_i

Length weight relationship

The length-weight relationship was calculated by conducting a simple linear regression of natural log transformations of carapace length in terms of mm as the independent, and weight in terms of grams as the dependent variable as follows:

$$y = mx + b$$

Where:

y = ln(weight, grams)

x = ln(carapace length, mm)

Size at sex

The size at sex relationship was determined by summing the number of animals of each sex by carapace length and dividing the number of females by the total number to determine the percent female according to the following. This relationship was subsequently scatter-plotted to permit graphical estimation of the length at which 50% of shrimp are female or L_{50}.

$$\%Female_{CL} = \frac{n_{CLF}}{n_{CLT}}$$

Where:

n_{CLF} = number of females at carapace length

and

n_{CLT} = number of shrimp at carapace length

Length frequency

The catch rate at carapace length for each district, subdistrict, project, mesh size, and year combination was determined by summing the subsample rates for each carapace length and dividing by the number of pots set according to the following. Prior to this determination, data was filtered to remove data from pots soaked for overly long (>36 hrs) or short (<16 hrs) time periods.

$$CR_{CL} = \frac{\sum SS_{CL}}{n}$$

Where:

CR_{CL} = catch rate of shrimp at carapace length

$\sum SS_{CL}$ = sum of the subsample rates of shrimp at carapace length

n = number of pots set

RESULTS

For all districts, the number of discrete longlined sets of shrimp pots varied for all surveys from 4 to 18 with between 20 and 270 pots being set per district (Table 1). An estimated 460,000 spot shrimp have been captured during pre- and postseason pot shrimp surveys in southeastern Alaska since 1996 in a total of 6,420 pots fished (Tables 1, and 2). Of those, about 119,000 have been measured, weighed, sexed, noted for presence or absence of eggs, checked for parasites and examined for shell condition. This represents a mean sub-sample rate of approximately 20% of all shrimp captured.

Other Pandalid shrimp species captured included the northern shrimp, sidestripe shrimp, yellowleg pandalid, dock shrimp, *Pandalus danae*, humpy shrimp, *Pandalus goniurus,* and the Hippolytid shrimp, the spiny lebbeid, *Lebbeus groenlandicus* (Table 3).

Non-shrimp bycatch species of commercial importance in order of frequency of capture were Tanner crab, *Chionoecetes bairdi*, brown box crab, *Lopholithodes foraminatus,* Pacific red

octopus, *Octopus rubescens*, Walleye pollock, *Theragra chalcogramma*, Quillback rockfish, *Sebastes maliger*, sablefish, *Anoplopoma fimbria*, Pacific cod, *Gadus macrocephalus*,Dungeness crab *Cancer magister*, Yelloweye rockfish, *Sebastes ruberrimus*, red king crab, *Paralithodes camtschaticus*, and golden king crab *Lithodes aequispinus*. Other, non-commercially important species captured in survey shrimp pots, in order of approximate decreasing numerical abundance included species such as squat lobster, *Munida quadrispina*, decorator crabs, *Oregonia gracilis*, lyre crabs, *Hyas lyratus*, hermit crabs, *Pagurus* spp., Oregon triton, *Fusitriton oregonensis*, and *Buccinum* spp. snails, unidentified starfish, sunflower stars, *Pycnopodia helianthoides*, sculpins (family Cottidae). Fifty-one bycatch categories were identified for all years, surveys, mesh types and areas fished (Table 4, Table 5, Table 6, Table 7, and Table 8).

DISTRICT 3

Catch composition

For all years surveyed approximately 204,895 total spot shrimp are estimated to have been caught using 2,070 pots fished during preseason surveys and 91,364 spot shrimp from 659 pots fished during postseason surveys in District 3 from 1997 to 2003 (Tables 1, and 2). Of these, a mean of about 20 percent of the catch for preseason and 24 percent for postseason surveys were sampled (Tables 1, and 2). A mean of 34,149 shrimp were captured during preseason and 22,841 during postseason surveys (Table 2).

Northern shrimp were occasionally captured in survey pots, as were a number of other species of non-commercially important shrimp including species such as the spiny lebbeid, *Lebbeus groenlandicus* (Table 3). Tanner crab, *Chionoecetes bairdi*, squat lobster, *Munida quadrispina*, decorator crab, *Oregonia gracilis*, hermit crab, *Pagurus* spp., box crab, *Lopholithodes foraminatus*, and lyre crab, *Hyas* spp., were the most prevalent crustaceans with Pacific Octopus, *Octopus dolfeini* and sponges also represented in the catch from survey pots for District 3 for all years surveyed (Table 4, and Table 5). Sablefish, *Anoplopoma fimbria*, Quillback rockfish, *Sebastes maliger*, and Walleye pollock, *Theragra chalcogramma*, were the most abundant fish species. *Buccinum* spp. snails and corals were not prevalent (Table 4, and Table 5). In total, 41 separate taxonomic groups are represented in catches from District 3 surveys, with 14 species prevalent greater than 1% of total by catch species.

Catch rates

Mean and standard error of soak time (hours), weight of catch (kg), numbers caught, weight (kg) per hour, number per hour, and total number of pots sampled were tabulated for pre- and postseason surveys from 1996 to 2003 for all of District 3 and separately by subdistrict (Table 9, Table 10, and Table 11). The preseason survey soak times averaged 22.9 hours for all years of the survey. An average of 77 small and 90 large mesh pots were sampled annually during surveys in District 3. The average catch was 5.3 (+/– 3.47) kg or 211 (+/– 133) shrimp for small mesh pots and 4.6 (+/– 2.8) kg or 138 (+/– 88) shrimp for large mesh pots (Table 9).

Postseason soak times averaged 24.1 hours. A mean of 82 small and 82 large mesh pots were sampled annually during postseason surveys. Mean catch rates and variability of mean catch rates were lower than during preseason surveys, 4.6 (+/– 3.13) kg or 192 (+/– 129) animals and 3.4 (+/– 2.46) kg or 115 (+/– 76) animals respectively for small and large mesh pots (Table 9).

No interannual trends in catch rate in terms of kg or number of shrimp are apparent during preseason surveys in District 3 when Subdistricts 103-23 and 103-25 are combined (Table 9).

Nor are clear interannual trends evident when the two surveyed subdistricts are considered separately (Table 10 and Table 11). However, preseason survey catch rates, in terms of both number and weight for both small and large mesh pots were generally greater than postseason survey catch rates. The overall variability around the mean number and weight of shrimp caught was greater for small mesh as compared to large mesh pots, as small mesh pots catch more total shrimp (Table 10 and Table 11). Variability in catch rate was generally greater for pre than postseason surveys.

Size composition

Expectedly, preseason shrimp catches from 1998 to 2003 consisted of more large shrimp than postseason (Figure 2, Figure 3, and Figure 4). Dominant size classes also appear to be detectable and may be able to be tracked through time, and possibly through removal by the fishery. The pre and postseason length frequency histograms for District 3 (Figure 2) and Subdistricts 103-23 and 103-25 (Figure 3 and Figure 4) show an annual reduction in the abundance of the larger size classes. The loss of these larger size classes is also evident in examining the progression of length frequency histograms from 1998 to 2003 (Figure 2, Figure 3, and Figure 4).

In order to quantitatively describe interannual trends in shrimp size, we calculated the mean carapace length (CL), and its standard deviation (Table 12, and Table 13). The mean carapace length in pre and postseason surveys has declined for all mesh sizes and subdistricts except for small mesh in 103-23 preseason (Table 12, and Table 13).

The length weight relationship for spot shrimp was calculated for each district, project, and year for shrimp with and without eggs. It shows considerable variability (Table 14). Low regression r^2 coefficients in some years and areas may be associated with small sample sizes.

The length at which 50% of shrimp are female or $L_{50\%}$ is 37–39 mm CL in District 3 (Table 15; Figure 5). This is the smallest size at transition of any surveyed district (Table 15) and appears to have declined slightly over the survey period. However small sample sizes in some years and the fact that size at sex data is only available beginning in 2000 hinders detection of trends.

DISTRICT 7

Catch composition

A cumulative total of 1,262 pots were set during preseason fishery surveys with an additional 450 pots set during postseason surveys. Annually, an average of 210 pots were set during preseason and 225 pots during postseason surveys of District 7 (Table 1). Approximately 30,200 spot shrimp have been captured in District 7 since preseason surveys began in 1996, for a mean of 5,033 spot shrimp captured annually. About 50% of these shrimp have been sampled for biological data. A total of approximately 11,700 coonstripe shrimp are also estimated to have been captured, of which about 5,600 or about 60 percent have been sampled for biological data. A mean of 1,957 coonstripe shrimp were captured each year during combined pre- and postseason surveys (Table 2). Subdistricts 107-20 and 107-40, which support much of the commercial harvest of coonstripe shrimp in District 7 were consistently surveyed from 1996–2002 however 107-40 was not sampled in 2003. Because the number of coonstripe captured in any one subdistrict and year is too low to permit any detection of trends coonstripe data are not presented here.

Invertebrates captured during the District 7 survey included: northern shrimp, sidestriped shrimp, humpy shrimp, (Table 3), squat lobster, Tanner crabs, hermit crabs, North Pacific octopus, lyre and box crabs, starfish, and sea urchins (Table 4 and Table 6). The most common fishes included: sculpins and the occasional Quillback Rockfish or Walleye Pollock Sablefish were not as common as in District 3. Sponges and corals were not commonly reported. Thirty-six separate taxonomic groups are represented from surveys of Ernest Sound since 1996. Nine species occurred at levels greater than 1% of the total bycatch species. Overall, the diversity of bycatch species attracted to survey gear in District 7 is slightly less than for District 3, although the species richness and makeup is fairly similar. More northern shrimp are captured in this area than in Districts 3 or 12 as some of the randomly selected survey pot locations are on sandy and silty bottoms. Squat lobster, a commercially important invertebrate in other parts of the world and North Pacific octopus, a permitted commercial bycatch species in southeastern Alaska pot shrimp fisheries, were more prevalent in surveys conducted in District 7 than in catches from surveys in other districts.

Catch rates

Mean and standard error of soak time (hrs), weight of catch (kg), numbers caught, kg per hour, number per hour, and total number of pots sampled were tabulated for pre- and postseason surveys from 1996–2003 for all of District 7 and separately by subdistrict (Table 16 and Table 17). The preseason survey soak times in 107-20 averaged about 19.6 hours for small and large mesh pots for all years of the survey. On the average 65 pots were sampled in 107-20 each year. The shorter soak times relative to District 3 are probably because longlined pot sets were not immediately reset after pulling because run time between fishing areas is greater as prime spot shrimp habitat is less dense in this area. The mean catch in 107-20 was 1.2 (+/– 1.4) kg or 39 (+/– 51) shrimp for small mesh pots and 1.0 (+/– 1.22) kg or 30 (+/– 34) shrimp for large mesh pots (Table 16, and Table 17).

Postseason soak times ranged from 17-22 hours. Mean catches were lower than during preseason surveys (Table 17).

Detection of annual trends in shrimp catch rate for District 7 is complicated by the fact that only Subdistrict 107-20 has been consistently fished for the entire survey period: 1996, and 1999–2003, and catches were not weighed in 1996. No trends in catch rate were observed for this subdistrict; all differences in terms of both number/pot and kg/pot were within a standard deviation of the mean (Table 16, and Table 17). Postseason surveys in District 7 were conducted during 2001 and 2002. Postseason mean catch rates, district-wide for all years of the survey, were approximately half what was caught during preseason surveys by both kg and number, however, this difference is within a standard deviation of the mean (Table 16, and Table 17). Variability in catch rates was also slightly higher for preseason surveys as compared to postseason by both weight and number (Table 16, and Table 17). Mean catch and variability about the mean by weight and number were highest in 107-10 during 2003 (Table 16, and Table 17).

Size composition

As expected, more large spot shrimp were captured during preseason than postseason surveys in Subdistrict 107-20 of District 7 (Figure 6) and the 40 mm size class disappears and reappears, generally declining in strength from 1999–2003. In 2001 and 2002 surveys an additional size class of pre-recruit shrimp, with a mode of 23–27 mm CL appeared (Figure 6). Thus, given that the size of complete recruitment to the gear is 36 mm CL, the 2002 survey year's catch consisted primarily of 2 pre-recruited size-classes, one mode at 27 mm and another at 34 mm CL and a recruited year class at 40 mm (Figure 6). In 2003 only the 34-mm mode was apparent. Data are not shown pooled on a district-wide basis as for other districts as the subdistrict composition of the survey in District 7 changed each year (Table 12, and Table 13).

In order to quantitatively describe interannual trends in shrimp size, we calculated average carapace length and its standard deviation for each mesh size subdistrict and year (Table 18 and Table 19). There are no observable consistent trends. It should be noted that average carapace lengths in District 7 are substantially higher than in District 3.

Length weight relationships for District 7 also exhibit considerable variability between years and areas (Table 14). This appears again to be partially a function of small sample size in some years but real in other years.

Length at 50% female or $L_{50\%}$ for District 7 is 42 to 43.5 mm CL and may have declined slightly over the sample period but again small sample sizes make it difficult to accurately estimate this parameter in many seasons (Table 15; Figure 7).

DISTRICT 12

Catch composition

Subdistricts of Tenakee Inlet have been surveyed during September of 2000, 2002 and 2003 (Table 1). During these surveys, a cumulative total of 759 pots were set in four different subdistricts for a mean of 190 pots per area (Table 1). An estimated total of 66,399 spot shrimp and 5,305 coonstripe shrimp were captured during these preseason surveys. This equates to a mean of 22,133 spot shrimp and 1,768 coonstripe caught per survey. Of the spot shrimp, 25 percent (16,835) were measured (Table 2). The Tenakee Inlet portion of District 12 supports a lucrative, fast-paced fishery with a guideline harvest level of 20,000 lbs of fairly large-sized shrimp typically harvested less than a week.

Based on the bycatch species composition, Tenakee Inlet may hold a different type of habitat than the other surveyed areas. Thirty-one taxonomic groups have been identified during surveys (Table 4 and Table 7). Invertebrates captured during the District 12 survey included occasional northern and humpy shrimps (Table 3), and a variety of crabs including lyre and decorator crabs, hermit and scale crabs and several types of snails including predominantly Hairy Triton and Buccinum species (Table 4 and Table 7). Siliceous and soft sponges as well as corals are more prevalent than in other surveyed districts. Fish species encountered include sculpins and Walleye pollock (Table 7). Bairdi Tanner crabs and North Pacific octopus were not as prevalent as in other districts surveyed.

Catch rates

During the period surveyed, catch in numbers and by weight has increased in District 12 (Table 21). A mean of 5.4 (+/– 3.1) kg or 165 (+/– 96) shrimp were caught in small mesh and 4.6 (+/– 3.0) kg or 119 (+/– 67) shrimp were caught in large mesh pots (Table 21). All subdistricts surveyed had strong catch rates in terms of kg per pot, which generally increased through time for both mesh sizes fished (Table 21, and Table 22). Postseason surveys have not been conducted in District 12.

Size composition

Length frequency histograms show a decline in larger size modes and corresponding increase in smaller size modes over the period 2000 to 2003 (Figure 6). Length frequency histograms for spot shrimp captured in 2003 in Tenakee Inlet are unimodal around 35 mm CL for both large and small mesh (Figure 6). By comparison, histograms collected for samples from the same set locations for 2000 and 2002 show at least 3 size classes of shrimp with modes at 46, 39, and 31 mm CL (Figure 8).

Trends are difficult to detect with only 3 seasons of survey data but more subdistricts have a decline in average carapace length over the period 2000–2003 than stay the same (Table 24).

A length weight relationship for spot shrimp in District 12 has been calculated but regression coefficients are low for all but eggless shrimp (Table 14).

The size at transition or $L_{50\%}$ for District 12 is 43 to 44 mm CL. This is slightly larger than District 7 and much larger than District 3 (Table 26; Figure 10). No trends are evident over the short time period and small sample size is a constraint.

DISTRICT 13

Catch composition

The same three subdistricts of Hoonah Sound, 113-55, 57, and 58, have been surveyed preseason from 1999 to 2003. A cumulative total of 1,220 pots have been set in District 13, with a mean of 407 pots set per subdistrict surveyed (Table 1). These pots caught a total of about 63,212 spot shrimp, of which 32 percent (20,235) were sampled (Table 2). This averages to about 12,642 spot shrimp and 2,260 coonstripe shrimp caught each survey. Approximately 11,000 coonstripe shrimp were caught during surveys, of which about 25 percent were sampled. The proportion of coonstripe relative to spot shrimp captured in the District 13 survey is similar to that of District 7.

Non-target shrimp species captured during the surveys in order of decreasing abundance included northern, and sidestripe shrimp (Table 3). A total of 24 different groups of non-shrimp taxonomic bycatch categories were identified from surveys in District 13 (Table 4 and Table 8). Comparing those species most prevalent, Hoonah Sound survey catches contained more lyre and decorator crabs as well as the ubiquitous squat lobster. Snails, hermit crabs and Tanner crabs were also captured in small numbers. Walleye pollock, sculpins and an occasional Quillback rockfish represent the majority of fishes captured by survey pot gear (Table 4 and Table 8).

Catch rates

Catch rates by weight and number have increased during the 1999–2003 period in District 13 however the increase is within a standard deviation of the mean (Table 21, and Table 23). Survey gear was fished in all subdistricts of District 13 for a mean of 19.6 hours, capturing a mean of 4.3 (+/– 3.4) kg for small mesh and 3.6 (+/– 2.7) kg for large mesh pots. Catch rates ranged from 3.5 to 5.1 kg in small mesh pots and 3.2 to 4.3 kg in large mesh pots (Table 21, and Table 23). No postseason surveys were conducted in District 13.

Size composition

Length frequency histograms for 1999–2003 preseason surveys in District 13 show a trend of slight declines in the 46 and strong increases in the 31 mm CL mode. However, strong modes of larger shrimp were still evident in the 2003 preseason survey results (Figure 9).

Although mean carapace length declined slightly from 2000–2003, the decline is within a standard deviation of the mean (Table 25). Shrimp are slightly larger on average than District 3 and similar in size to Districts 7 and 12.

A length weight relationship for spot shrimp in District 13 has been calculated, regression coefficients are highest for eggless shrimp (Table 14).

The size at transition or $L_{50\%}$ for District 13 is 41 to 43.5 mm CL and shows some evidence of a slight decline. This is slightly smaller than District 12 but much larger than District 3 (Table 26; Figure 10).

DISCUSSION

The loss of larger size classes in the length frequency histograms, declines in the average carapace length and declines in L_{50} described herein for District 3, and to a lesser extent for Districts 7 and 12, are troubling. However, sample sizes should be increased for the size at sex and length/weight sampling to increase precision of these estimates and improve confidence in our ability to detect trends. Since Pandalid shrimp are protandric hermaphrodites, the harvest is primarily females and thus a decline in large shrimp is a decline in the spawning population size. While the precise spawning population level necessary to maintain adequate recruitment is unknown there is a strong potential for recruitment over fishing inherent in this management strategy, especially as female fecundity is related to size. From the standpoint of maximizing value of the product, reductions in the population of large shrimp may mean that a given age class of shrimp is being harvested at too small a size, before it has a chance to achieve its maximal yield in terms of pounds, resulting in growth over fishing (Boutillier and Bond 1999). This affects economic yield doubly as larger shrimp are more valuable. The optimal size at first harvest is a function of shrimp life history, size at transition to female, fecundity at size, natural mortality, growth, and price at size. Shrimp stocks in British Columbia are managed to avoid

growth and recruitment overfishing by a minimum size limit and an escapement management strategy in which shrimp catches are sampled intensively inseason and the fishery is closed annually when a March 'spawner index' of 1 female per standard pot is achieved (Boutillier and Bond 1999). This management regime has proved so successful in maximizing the value of the fishery that the size limit has been increased twice, once at the request of the commercial fleet. However, this management strategy requires an intensive, inseason, on the grounds sampling program, and a good understanding of relative catches of the various types of commercial pot gear.

Preseason catch per unit effort of shrimp in terms of pounds and numbers may not be a reliable indicator of stock status. This is because catch rates of small shrimp remain strong, even increasing in spite or because of a decline in large shrimp abundance. In fact, it appears that the abundance of large shrimp affects the catchability of small shrimp. This is evident in two ways. First, interannual reductions in the catch rate of large size classes are almost always coupled with increases in the catch rate of small size classes. Second, modes of very small shrimp are most apparent in postseason surveys.

The inter-annual decline in the proportion of large shrimp in District 3 was evident 1–2 years earlier in the postseason than preseason survey. This may be because shrimp in this area enter and saturate gear preseason disguising any real trends in abundance. Since the catchability of large shrimp is higher than that of small shrimp, the proportion of large shrimp remaining postseason may be a better indicator of the spawning stock status. Particularly since the fall fishery is followed by a spring egg hatch period.

Without a good understanding of pot gear fishing dynamics, decreases in the abundance of large shrimp size classes could be misinterpreted as recruitment events. Soak time experiments were initiated to better understand the relationship between soak period and number and size of the catch. Preliminary results from District 3 indicate that the average carapace length of shrimp captured increased with increasing soak period. However, there was no change in the catch in terms of weight. This indicates that a few large shrimp replace many small shrimp with increases in the soak period.

An index that should be developed is the catch rate of large shrimp. A biologically meaningful definition of 'large' shrimp should be determined first. Economically, a management goal is to maximize the production of large shrimp, thus an index of the catch rate of 'XL' or greater shrimp, which are 42–54 g or 40–43 mm CL for egged shrimp, could be meaningful. Biologically, the L^{50} or length at which 50% of shrimp have transitioned to female for each area would be useful. The L^{50} varies by year and district, but was respectively approximately 37, 42, 41, and 41 mm CL, respectively for Districts 3, 7, 12, and 13 in 2003.

There is evidence that shrimp pots have a negative impact on habitat, though the magnitude and biological significance is unknown. Shrimp pots are frequently littered with glass sponge debris; this is particularly common in District 3. Sponges are evidence of a structurally complex bottom in this area, which may help to maintain the large numbers of small shrimp caught in this area. Since sponges are extremely fragile as well as very old, there is potential for longlined shrimp pot gear to impact this and other habitats, particularly when pots are pulled frequently or gear is aggregated.

Although spot shrimp are fairly sedentary once they become adults (Kimker et al. 1996), little is known about their larval recruitment dynamics. Depending on water currents, upwelling

conditions and larval retention gyres, the stocks that we have surveyed could be considered part of a larger southeastern Alaska or even Eastern Pacific metapopulation. Although observations are made herein on the varying sizes of spot shrimp in each surveyed area, it is unclear whether these differences are environmentally or genetically based or both. Little is known of shrimp genetic stock structure. While localized depletion may remove adult shrimp from certain areas, it is unclear where the larval source of each population is so larval advection into the area from another adult population could repopulate it. Small-scale oceanographic conditions may also affect shrimp survival and growth rates. Until more is known of shrimp genetics the most conservative assumption is that multiple local stocks exist.

Stock assessment surveys are one of several research tools for the management of the southeastern Alaska pot shrimp fishery. In addition, samples of commercial harvest, at dockside, and on the grounds are also used in setting annual harvest levels. However, given the well documented ability of fishers to maintain catch rates while population sizes decreases (Orensanz et al. 1998) the survey provides an important fishery-independent view of stock status. As only a portion of the important shrimp grounds are currently surveyed, continuing to improve the usefulness of sampling data must also be a focus. Management recommendations of appropriate harvest levels are made separately to facilitate examination of all data sources. However it is clear that trends are emerging, particularly in District 3, which should be scrutinized to determine whether reductions of harvest levels are warranted.

RESEARCH PRIORITIES

The most pressing research need for the southeastern Alaska pot shrimp fishery is a more detailed biometric analysis of existing survey data. An important end product of this analysis should be a change-in-ratio population estimate of harvested size classes. Preliminary work has been done on this priority (Clark and Love 2003).

Also of great importance is further soak-time research in order to adjust the survey protocol to best represent shrimp population trends since, at least in District 3, pots saturate very quickly. Reinstituting the postseason survey should also be considered if resources become available. Industry catcher-processors routinely document daily harvest by size class for their own purposes. They have expressed willingness to voluntarily supply this data to the department. This could be a very valuable data source and should be developed and its stock assessment uses evaluated.

Of lesser priority is an investigation into the reason for the large differences in shrimp size between Districts. In District 3, the L^{50} is consistently smaller than for other areas surveyed. Age and L^{50} for a related Pandalid shrimp, the northern pink shrimp, *Pandalus borealis* has been reported to increase when growth rate slows; growth rate appears to be a function of both intrinsic (shrimp density) (Charnov and Anderson 1989; Savard et al. 1994) and extrinsic (water temperature) factors, slowing at higher densities and colder water temperatures (Appollonio et al. 1986; Savard and Parsons 1990; Skuladottir et al. 1991; Berrigan and. Charnov 1994). Similar factors probably also drive the maturation rate of spot shrimp. Spot shrimp may also achieve larger maximum sizes when growth is lowered by lower water temperatures (Berrigan and Charnov 1994). Integration of water temperature profiling into the pot shrimp sampling protocols would allow detection of interannual and spatial trends in water temperature conditions shedding some light on this question.

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TABLES AND FIGURES

Table 1. –Total number of longlined cone pots fished by district, subdistrict, and year of survey during 1996, and 1997 pre-season pilot surveys, and 1998–2003 pre and post-season surveys.

			Year							
Project	**District**	**Subdistrict**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Grand Total**
		103-21		165							165
		103-23		150	120	120	120	120	30		660
	3	103-25		270	120	120	120	120	30	120	900
		103-30		165							165
		103-40		180							180
	3 Total			930	240	240	240	240	60	120	2,070
		107-10	50							120	170
		107-20	112			180	180	110	150	150	882
	7	107-30					30		30		60
Preseason		107-40	30			30	30		60		150
	7 Total		192	0	0	210	240	110	240	270	1,262
		112-41					60		40	40	140
		112-42					20		20	20	60
	12	112-45					120		132	130	382
		112-48					60		57	60	177
	12 Total		0	0	0	0	260	0	249	250	759
		113-55				60	80	70	70	70	350
	13	113-57				60	70	70	70	70	340
		113-58				120	110	100	100	100	530
	13 Total					240	260	240	240	240	1,220
Preseason Total			192	930	240	690	1,000	590	789	880	5,311
	3	103-23			120		120		30		270
		103-25			120		120	119	30		389
	3 Total		0	0	240	0	240	119	60	0	659
Postseason		107-20						120	150		270
	7	107-30						30	30		60
		107-40						60	60		120
	7 Total		0	0	0	0	0	210	240	0	450
Postseason Total			0	0	240	0	240	329	300	0	1,109
Grand Total			192	930	480	690	1,240	919	1,089	880	6,420

Table 2.–Estimated number captured and total number sampled for spot and coonstripe shrimp during the 1996–2003 pot shrimp surveys in southeastern Alaska.

	1996	1997	1998	1999	2000	2001	2002	2003	Total
District 3-Preseason									
# spot shrimp captured		32,992	23,742	25,748	27,893	26,460	41,848	26,212	204,895
# spot shrimp sampled		4,273	4,477	4,613	4,007	5,532	8,542	8,925	40,369
# coonstripe captured		454	467	576	1,269	759	961	1,489	5,975
# coonstripe sampled		126	185	248	167	104	75	106	1,011
District 3-Postseason									
# spot shrimp captured			17,597		27,611	18,365	27,791		91,364
# spot shrimp sampled			3,763		4,931	4,467	8,517		21,678
# coonstripe captured			348		1,129	518	1,167		3,162
# coonstripe sampled			140		148	71	104		463
District 7-Preseason									
# spot shrimp captured	8,575			1,810	3,774	1,654	3,737	10,650	30,200
# spot shrimp sampled	4,727			1,508	916	564	2,606	6,788	17,109
# coonstripe captured	4,535			865	2,020	502	1,951	1,869	11,742
# coonstripe sampled	1,901			485	586	333	1,434	865	5,604
District 7-Postseason									
# spot shrimp captured						2,348	1,823		4,172
# spot shrimp sampled						1,654	1,523		3,177
# coonstripe captured						858	515		1,373
# coonstripe sampled						858	515		1,373
District 12-Preseason									
# spot shrimp captured					14,350		21,451	30,598	66,399
# spot shrimp sampled					3,866		4,983	7,986	16,835
# coonstripe captured					2,062		1,241	2,002	5,305
# coonstripe sampled					228		492	116	836
District 13-Preseason									
# spot shrimp captured				12,091	11,188	8,914	13,741	17,278	63,212
# spot shrimp sampled				1,918	4,335	3,618	5,222	5,142	20,235
# coonstripe captured				1,431	1,077	1,885	4,530	2,377	11,300
# coonstripe sampled				95	73	164	126	82	540
Grand Total									
spot shrimp captured	8,575	32,992	41,339	39,649	84,816	57,741	110,392	84,738	460,242
spot shrimp sampled	4,727	4,273	8,240	8,039	18,055	15,835	31,393	28,841	119,403
coonstripe captured	4,535	454	815	2,872	7,557	4,522	10,365	7,737	38,856
coonstripe sampled	1,901	126	325	828	1,202	1,530	2,746	1,169	9,827

[1)] 1998 Postseason survey conducted in February of 1999

Table 3.–Estimated number of non-target shrimp species captured during pre and post-season surveys, of Districts 3, 7, 12 and 13 from 1996–2003.

Year	Common Name	Scientific name	District 3	District 7	District 12	District 13	Total
1996	shrimp, unspecified	Infraorder Caridea					0
	northern shrimp	*Pandalus borealis*		3,727			3,727
	sidestriped shrimp	*Pandalopsis dispar*		14			14
	humpy shrimp	*Pandalus goniurus*		5			5
							0
1997	shrimp, unspecified	Infraorder Caridea	14				14
	northern shrimp	*Pandalus borealis*	24				24
	sidestriped shrimp	*Pandalopsis dispar*					0
	humpy shrimp	*Pandalus goniurus*					0
							0
1998	shrimp, unspecified	Infraorder Caridea					0
	northern shrimp	*Pandalus borealis*	32				32
	sidestriped shrimp	*Pandalopsis dispar*					0
	humpy shrimp	*Pandalus goniurus*					0
							0
1999	shrimp, unspecified	Infraorder Caridea		521			521
	northern shrimp	*Pandalus borealis*	21	854		3,267	4,142
	sidestriped shrimp	*Pandalopsis dispar*				1	1
	humpy shrimp	*Pandalus goniurus*					0
							0
2000	shrimp, unspecified	Infraorder Caridea	64	577		4	645
	northern shrimp	*Pandalus borealis*	121	2,512	1,012	1,463	5,108
	sidestriped shrimp	*Pandalopsis dispar*					0
	humpy shrimp	*Pandalus goniurus*			7		7
							0
2001	shrimp, unspecified	Infraorder Caridea	8	712		20	740
	northern shrimp	*Pandalus borealis*	54	3,788		3,583	7,425
	sidestriped shrimp	*Pandalopsis dispar*		1		3	4
	humpy shrimp	*Pandalus goniurus*					0
							0
2002	shrimp, unspecified	Infraorder Caridea	28	1,040	2	4	1,074
	northern shrimp	*Pandalus borealis*	201	4,429	394	6,733	11,757
	sidestriped shrimp	*Pandalopsis dispar*		6		4	10
	humpy shrimp	*Pandalus goniurus*					0
							0
2003	shrimp, unspecified	Infraorder Caridea		84		7	91
	northern shrimp	*Pandalus borealis*	13	104	97	139	353
	sidestriped shrimp	*Pandalopsis dispar*				1	1
	humpy shrimp	*Pandalus goniurus*					0
							0
Total	shrimp, unspecified	Infraorder Caridea	114	2,934	2	35	3,085
	northern shrimp	*Pandalus borealis*	466	15,414	1,503	15,185	32,568
	sidestriped shrimp	*Pandalopsis dispar*	0	21	0	9	30
	humpy shrimp	*Pandalus goniurus*	0	5	7	0	12

Table 4.–Number of bycatch species captured by district for all pots set during pre-and postseason surveys from 1996–2003.

			District				
Common name	**Scientific name or group**	**Code**	**3**	**7**	**12**	**13**	**Total**
Squat lobster	*Munida quadrispina*	999	565	1,924	18	1,207	3,714
Bairdi Tanner crab	*Chionoecetes bairdi*	931	698	588	124	550	1,960
Decorator crab	*Oregonia gracilis*	311	229	29	105	767	1,130
Lyre crab	Hyas spp.	314	192	67	463	308	1,030
Snail	Class Gastropoda	890	3	16	754	228	1,001
Hermit crab	*Pagurus spp.*	313	145	364	90	48	647
Starfish	Class Asteroidea	380	189	307	4	1	501
Hairy triton snail	*Fusitriton oregonenis*	361	57	29	221	99	406
Buccinum snail	Buccinum spp.	360	1	14	253	22	290
Brown box crab	*Lopholithodes foraminatus*	900	100	124	6	4	234
North Pacific octopus	*Octopus dofleini*	870	74	127	19	11	231
Spiny Lithode crab	*Acantholithodes hispidus*	312	131	28	13	10	182
Sculpin	Family Cottidae	160	17	119	20	23	179
Sea urchin	Class Echinoidea	896		163			163
Scale crab	*Placetron wosnessenskii*	315	21	18	73	14	126
Walleye Pollock	*Theragra chalcogramma*	270	6	22	60	23	111
Sponge, soft & glass	Phylum Porifera	355	44	32	10	19	105
Quillback rockfish	*Sebastes maliger*	147	60	25	2	8	95
Sablefish	*Anoplopoma fimbria*	710	70	1	1	1	73
Pacific cod	*Gadus macrocephalus*	110	14	25	4	21	64
Sunflower star	*Pycnopodia helianthoides*	381	13	34	1	2	50
Shiner perch	*Cymatogaster aggregata*	CA	31				31
Coral	Class Anthozoa	899	2	1	6	14	23
Whelk	*Nuptunea spp.*	362	3	6	8		17
Pacific hagfish	*Eptatretus stouti*	212	4	9			13
Dungeness crab	*Cancer magister*	910	8	2	1		11
Prickleback	Family Stichaeidae	208	1	5	3	1	10
Graceful crab	Cancer gracilis	310	9		1		10
Miscellaneous invertebrates	Bryozoans, Tubeworms, Crinoids	MI		8	2		10
Great sculpin	*Myoxocephalus polyacanthocephalus*	342	1	7			8
Lamp shells	Phylum Brachiopoda	301		1	2	3	6
Wrymouth	Family Cryptacanthodidae	211	3		2		5
Pacific tomcod	*Microgadus proximus*	250	1	4			5
Spiny dogfish shark	*Squalus acanthias*	691	1	4			5

-continued-

			District				
Common name	**Scientific name or group**	**Code**	**3**	**7**	**12**	**13**	**Total**
Redbanded rockfish	*Sebastes babcocki*	153	4				4
Red rock crab	*Cancer productus*	CP	4				4
Kelp greenling	*Hexagrammos decagrammus*	194	4	0	0	0	4
Wolf eel	*Anarrhichthyes ocellatus*	217	3				3
Groundfish species		100		2			2
Flounder family	Family Pleuronectidae	120			2		2
Yelloweye rockfish	*Sebastes ruberrimus*	145	1	1			2
Sea urchin, red	*Strongylocentrotus franciscanus*	892		2			2
Redstripe rockfish	*Sebastes proriger*	158		1			1
Pacific herring	*Clupea harengus pallasi*	230	1				1
Red Irish Lord	*Hemilepidotus hemilepidotus*	346	1				1
Ratfish	*Hydrolagus colliei*	371	1				1
Green sea urchin	*Strongylocentrotus droebachiensis*	893		1			1
Sea cucumber	Class Holothuroidea	895			1		1
Red king crab	*Paralithodes camtschaticus*	921			1	1	1
Golden king crab	*Lithodes aequispinus*	923	1				1
Searcher	*Bathymaster signatus*	BS	1				1

Table 5. –Number of bycatch species captured in all pots set in District 3 during pre-and postseason surveys from 1997–2003.

			Year							
Common name	**Scientific name or group**	**Code**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**Total**
Bairdi Tanner crab	Chionoecetes bairdi	931	128	41	117	140	111	24	137	698
Squat lobster	Munida quadrispina	999	165	35	106	126	104	17	12	565
Decorator crab	Oregonia gracilis	311		3	62	17	113	16	18	229
Lyre crab	Hyas spp.	314	151	30	3	4	1		3	192
Starfish	Class Asteroidea	380	48	21	45	30	35	6	4	189
Hermit crab	Pagurus spp.	313	30	5	26	13	43	21	7	145
Spiny Lithode crab	Acantholithodes hispidus	312	58	6	20	17	10	11	2	124
Brown box crab	Lopholithodes foraminatus	900	12	4	32	21	17	9	5	100
North Pacific octopus	Octopus dofleini	870	30	10	11	13	10			74
Sablefish	Anoplopoma fimbria	710	2		54	14				70
Quillback rockfish	Sebastes maliger	147	26	5	8	5	12		4	60
Hairy Triton Snail	Fusitriton oregonenis	361	36	2	6	3	10			57
Sponge, soft & glass	Phylum Porifera	355	1	1	13	7	12	1	9	44
Shiner perch	Cymatogaster aggregata	CA			25	4	2			31
Scale crab	Placetron wosnessenskii	315	13	2	4	2				21
Sculpin	Family Cottidae	160	13		2	1	1			17
Pacific cod	Gadus macrocephalus	110	4		3	1	6			14
Sunflower star	Pycnopodia helianthoides	381	4	1	1		6		1	13
Graceful crab	Cancer gracilis	310		1	8					9
Dungeness crab	Cancer magister	910		1	5	1			1	8
Walleye Pollock	Theragra chalcogramma	270					2	4		6
Redbanded rockfish	Sebastes babcocki	153	2						2	4
Pacific hagfish	Eptatretus stouti	212				1	3			4
Red rock crab	Cancer productus	CP		1		1			2	4
Kelp greenling	Hexagrammos decagrammus	194	1	0	0	1	2	0	0	4
Wrymouth	Family Cryptacanthodidae	211							3	3
Wolf Eel	Anarrhichthyes ocellatus	217					3			3
Whelk	Nuptunea spp.	362				1	2			3
Snail	Class Gastropoda	890		1		2				3
Coral	Class Anthozoa	899			2					2
Yelloweye rockfish	Sebastes ruberrimus	145	1							1
Prickleback	Family Stichaeidae	208					1			1
Pacific herring	Clupea harengus pallasi	230					1			1
Pacific tomcod	Microgadus proximus	250			1					1
Great sculpin	Myoxocephalus polyacanthocephalus	342			1					1
Red Irish Lord	Hemilepidotus hemilepidotus	346	1							1
Buccinum snail	Buccinum spp.	360							1	1
Ratfish	Hydrolagus colliei	371				1				1
Spiny dogfish shark	Squalus acanthias	691			1					1
Golden king crab	Lithodes aequispinus	923					1			1
Searcher	Bathymaster signatus	BS		1						1

Table 6. –Number of bycatch species captured in all pots set in District 7 during pre-and postseason surveys from 1996, 1999, and 2000–2003**.**

Common name	Scientific name or group	Code	Year						
			1996	1999	2000	2001	2002	2003	Total
Squat lobster	*Munida quadrispina*	999	855		99	293	209	468	1,924
Bairdi Tanner crab	*Chionoecetes bairdi*	931	79		29	47	427	6	588
Hermit crab	*Pagurus spp.*	313	39	21	39	69	143	53	364
Starfish	Class Asteroidea	380	37	3	33	59	89	86	307
Sea urchin	Class Echinoidea	896	5		14	28	39	77	163
North Pacific octopus	*Octopus dofleini*	870	23	2	15	25	51	11	127
Brown box crab	*Lopholithodes foraminatus*	900	4	11	22	36	25	26	124
Sculpin	Family Cottidae	160	35	1	9	9	42	23	119
Lyre crab	*Hyas spp.*	314	9	14	20	2	17	5	67
Sunflower star	*Pycnopodia helianthoides*	381	3	4	3	3	17	4	34
Sponge, soft & glass	Phylum Porifera	355	5				3	24	32
Decorator crab	*Oregonia gracilis*	311	14			6	4	5	29
Hairy Triton Snail	*Fusitriton oregonenis*	361	21				2	6	29
Spiny Lithode crab	*Acantholithodes hispidus*	312	0	2	0	9	7	10	26
Pacific cod	*Gadus macrocephalus*	110	2				7	16	25
Quillback rockfish	*Sebastes maliger*	147	2		3	12	1	7	25
Walleye Pollock	*Theragra chalcogramma*	270	3		1	9	8	1	22
Scale crab	*Placetron wosnessenskii*	315	1	2	4	5	4	2	18
Snail	Class Gastropoda	890			8	5	3		16
Buccinum snail	*Buccinum spp.*	360	1				13		14
Pacific hagfish	*Eptatretus stouti*	212	2		2	1	1	3	9
Miscellaneous invertebrates	Bryozoans, Tubeworms, Crinoids	MI	1				2	5	8
Great sculpin	*Myoxocephalus polyacanthocephalus*	342				4	3		7
Whelk	*Nuptunea spp.*	362	3			1	1	1	6
Prickleback	Family Stichaeidae	208	1	1	1	1	1		5
Pacific tomcod	*Microgadus proximus*	250					4		4
Spiny dogfish shark	*Squalus acanthias*	691	1		2		1		4
Groundfish		100	1		1				2
Sea urchin, red	*Strongylocentrotus franciscanus*	892				2			2
Dungeness crab	*Cancer magister*	910			1		1		2
Yelloweye rockfish	*Sebastes ruberrimus*	145	1						1
Redstriped rockfish	*Sebastes proriger*	158		1					1
Lamp shells	Phylum Brachiopoda	301	1						1
Sablefish	*Anoplopoma fimbria*	710	1						1
Green sea urchin	*Strongylocentrotus droebachiensis*	893		1					1
Coral	Class Anthozoa	899	1						1

Table 7. –Number of bycatch species captured in all pots set in District 12 during preseason surveys in 2000, 2002, and 2003.

Common name	Scientific name or group	Code	Year			
			2000	2002	2003	Total
Snail	Class Gastropoda	890	670	84		754
Lyre crab	*Hyas spp.*	314	67	213	183	463
Buccinum snail	*Buccinum spp.*	360	53		200	253
Hairy triton snail	*Fusitriton oregonenis*	361	108	92	21	221
Bairdi Tanner crab	*Chionoecetes bairdi*	931	58	39	27	124
Decorator crab	*Oregonia gracilis*	311	70	35		105
Hermit crab	*Pagurus spp.*	313	51	29	10	90
Scale crab	*Placetron wosnessenskii*	315	34	23	16	73
Walleye Pollock	*Theragra chalcogramma*	270	10	30	20	60
Sculpin family	Family Cottidae	160	5	13	2	20
North Pacific octopus	*Octopus dofleini*	870	6	4	9	19
Squat lobster	*Munida quadrispina*	999	9	1	8	18
Spiny Lithode crab	*Acantholithodes hispidus*	312	3	5	5	13
Sponge, soft & glass	Phylum Porifera	355	7	2	1	10
Whelk	*Nuptunea spp.*	362	5		3	8
Coral	Class Anthozoa	899	5	1		6
Brown box crab	*Lopholithodes foraminatus*	900	1	2	3	6
Pacific cod	*Gadus macrocephalus*	110	2	1	1	4
Starfish	Class Asteroidea	380	1	3		4
Prickleback	Family Stichaeidae	208		3		3
Flounder family	Family Pleuronectidae	120			2	2
Quillback rockfish	*Sebastes maliger*	147	2			2
Wrymouth	Family Cryptacanthodidae	211	2			2
Lamp shells	Phylum Brachiopoda	301	2			2
Miscellaneous invertebrates	Bryozoans, Tubeworms, Crinoids	MI	2			2
Graceful crab	*Cancer gracilis*	310			1	1
Sunflower star	*Pycnopodia helianthoides*	381	1			1
Sablefish	*Anoplopoma fimbria*	710	1			1
Sea cucumber	Class Holothuroidea	895		1		1
Dungeness crab	*Cancer magister*	910			1	1
Red king crab	*Paralithodes camtschaticus*	921	1			1

Table 8. –Number of bycatch species captured in all pots set in District 13 during preseason surveys, from 1999 to 2003.

Common name	Scientific name or group	Code	Year					
			1999	2000	2001	2002	2003	Total
Squat lobster	*Munida quadrispina*	999	193	82	138	446	348	1,207
Decorator crab	*Oregonia gracilis*	311		126	203	216	222	767
Bairdi Tanner crab	*Chionoecetes bairdi*	931	172	53	202	84	39	550
Lyre crab	*Hyas spp.*	314	187	33	22	31	35	308
Snail	Class Gastropoda	890	83	36	81	21	7	228
Hairy triton snail	*Fusitriton oregonenis*	361	2	28	33	20	16	99
Hermit crab	*Pagurus spp.*	313	18	6	7	8	9	48
Sculpin	Family Cottidae	160	1	11	2	4	5	23
Walleye Pollock	*Theragra chalcogramma*	270	11		3	5	4	23
Buccinum snail	*Buccinum spp.*	360			1		21	22
Pacific cod	*Gadus macrocephalus*	110	7	3	3	3	5	21
Sponge, soft & glass	Phylum Porifera	355	4	2	4	8	1	19
Scale crab	*Placetron wosnessenskii*	315	5	4	4	1		14
Coral	Class Anthozoa	899	5	2	2	2	3	14
North Pacific octopus	*Octopus dofleini*	870	3	1	4	1	2	11
Spiny Lithode crab	*Acantholithodes hispidus*	312	1		6	2	1	9
Quillback rockfish	*Sebastes maliger*	147	4		3	1		8
Brown box crab	*Lopholithodes foraminatus*	900	3	1				4
Lamp shells	Phylum Brachiopoda	301				3		3
Sunflower star	*Pycnopodia helianthoides*	381			2			2
Prickleback	Family Stichaeidae	208			1			1
Starfish	Class Asteroidea	380				1		1
Sablefish	*Anoplopoma fimbria*	710	1					1
Red king crab	*Paralithodes camtschaticus*	921				1		1

Table 9.–Pre- and postseason pot shrimp surveys in District 3, 1997–2003. Mean and standard deviation of soak time, and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled for small and large mesh pots.

Project	Mesh	Year	Avg. wt., kg.	St. dev. Avg. wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs.	St. dev. Avg. soak	No. pots sampled
Pre	1.125	1997			147.5	91.72	22.2	2.23	106
		1998			196.4	112.04	21.3	3.26	72
		1999			240.0	140.12	22.1	3.93	67
		2000	4.8	4.32	185.6	168.66	22.4	4.20	87
		2001	3.0	4.09	141.3	175.72	21.0	4.26	120
		2002	7.8	2.58	328.8	115.18	25.3	1.25	25
		2003	5.7	2.90	238.6	126.55	25.8	2.08	60
		Avg.	5.3	3.47	211.2	132.86	22.9	3.03	76.7
	1.75	1997			86.8	72.94	22.2	2.23	200
		1998			135.2	93.84	21.3	3.27	71
		1999			146.3	83.61	22.1	3.88	66
		2000	4.1	4.01	133.2	123.58	22.4	4.17	88
		2001	2.3	2.94	78.3	98.03	20.8	4.09	118
		2002	6.8	2.31	217.8	79.08	25.3	1.31	28
		2003	5.1	2.05	170.8	66.78	25.8	2.08	60
		Avg.	4.6	2.83	138.3	88.27	22.8	3.00	90.1
Post	1.125	1999			150.4	97.55	20.2	5.72	72
		2000	5.8	3.88	239.6	158.97	21.4	3.84	73
		2001	3.5	3.51	152.0	152.53	25.4	14.18	141
		2002	4.6	2.01	227.1	105.75	29.4	11.26	40
		Avg.	4.6	3.13	192.3	128.70	24.1	8.75	81.5
	1.75	1999			99.6	59.46	20.2	5.95	68
		2000	4.4	3.19	146.6	100.99	21.3	3.78	69
		2001	2.8	2.76	93.5	90.93	25.4	14.22	140
		2002	3.1	1.43	120.6	50.91	29.4	11.23	50
		Avg.	3.4	2.46	115.1	75.57	24.1	8.80	81.8

Table 10. –Preseason pot shrimp surveys in subdistricts of District 3, 1997–2003. Mean and standard deviation of soak time, and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. wt., kg.	St. dev. Avg. wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs	St. dev. Avg. soak	No. pots sampled
1.125	103-21	1997			132.2	70.52	22.8	1.30	23
	103-23	1997			135.4	89.06	21.4	0.92	19
		1998			191.0	93.43	21.4	4.48	36
		1999			249.3	133.34	19.2	3.32	32
		2000	3.6	2.38	153.3	104.88	20.0	2.04	35
		2001	2.5	3.57	119.9	170.64	19.2	1.73	60
		2002	7.1	2.89	334.5	140.85	24.9	0.64	13
		Avg.	4.4	2.95	187.9	114.67	21.3	2.1	31
	103-25	1997			121.5	56.96	20.9	2.35	26
		1998			201.9	129.12	21.2	1.18	36
		1999			231.4	147.45	24.7	2.27	35
		2000	5.5	5.12	207.3	198.59	24.0	4.51	52
		2001	3.6	4.51	162.7	179.54	22.8	5.21	60
		2002	8.5	2.06	323.1	91.00	25.8	1.56	12
		2003	5.7	2.90	238.6	126.55	25.8	2.08	60
		Avg.	5.8	3.65	212.4	132.74	23.6	2.7	40
	103-30	1997			153.4	114.56	22.9	2.40	18
	103-40	1997			205.3	110.94	23.4	2.65	20
1.75	103-21	1997			65.7	48.09	22.7	1.21	43
	103-23	1997			78.2	48.26	21.5	0.96	39
		1998			111.5	73.98	21.4	4.48	36
		1999			143.9	77.38	19.1	3.19	30
		2000	2.6	2.29	91.0	77.28	20.0	2.02	36
		2001	1.5	2.33	52.5	79.45	19.2	1.73	60
		2002	6.0	2.21	199.6	79.07	24.7	0.64	13
		Avg.	3.4	2.28	106.1	69.07	21.2	2.0	37
	103-25	1997			97.1	67.78	20.6	2.44	44
		1998			159.5	106.26	21.2	1.16	35
		1999			148.3	89.51	24.7	2.24	36
		2000	5.1	4.60	162.5	140.79	24.0	4.51	52
		2001	3.1	3.29	104.9	108.51	22.5	5.06	58
		2002	7.5	2.24	236.0	79.30	25.8	1.55	15
		2003	5.1	2.05	170.8	66.78	25.8	2.08	60
		Avg.	5.2	3.05	154.2	94.13	23.5	2.7	43
	103-30	1997			88.6	93.31	23.1	2.16	29
	103-40	1997			103.1	94.54	23.2	2.59	45

Table 11. –Postseason pot shrimp surveys in subdistricts of District 3, 1999, 2000, and 2002. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. wt., kg.	St. dev. Avg. wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs	St. dev. Avg. soak	No. pots sampled
1.125	103-23	1990			180.6	106.76	17.8	6.82	35
		2000	3.8	2.83	183.5	142.75	19.0	2.02	37
		2002	4.9	2.28	256.4	92.23	22.1	1.03	12
		Avg.	4.4	2.56	206.8	113.91	19.6	3.29	28
	103-25	1990			121.8	79.21	22.4	3.19	37
		2000	7.7	3.85	297.4	155.76	23.8	3.71	36
		2001	3.5	3.51	152.0	152.53	25.4	14.18	141
		2002	4.5	1.92	214.5	110.72	32.5	12.22	28
		Avg.	5.2	3.09	221.3	139.67	27.2	10.04	68
1.75	103-23	1990			87.1	57.04	17.6	7.07	33
		2000	2.2	1.77	81.6	64.91	19.0	2.08	35
		2001							
		2002	2.1	1.41	80.2	62.33	22.1	1.02	15
		Avg.	2.2	1.59	80.9	63.62	20.6	1.55	25
	103-25	1990			111.2	60.12	22.6	3.21	35
		2000	6.7	2.67	213.6	87.05	23.7	3.65	34
		2001	2.8	2.76	93.5	90.93	25.4	14.22	140
		2002	3.6	1.21	139.9	30.50	32.5	12.18	35
		Avg.	4.4	2.21	149.0	69.49	27.2	10.02	70

Table 12. –Preseason pot shrimp surveys in subdistricts of District 3, 1997–2003. Mean and standard deviation of average carapace length by mesh size.

Mesh size	Subdistrict	Year	Avg. CL, mm	St. dev of Avg. CL
1.125	103-21	1997	34.1	2.8
1.125	103-23	1997	32.4	2.2
		1998	33.7	2.0
		1999	34.6	2.2
		2000	34.3	3.4
		2001	30.8	5.6
		2002	31.7	1.8
		Avg.	32.9	
1.125	103-25	1997	38.5	2.0
		1998	37.0	1.9
		1999	38.3	1.7
		2000	37.0	2.1
		2001	34.3	1.6
		2002	33.8	0.6
		2003	34.6	1.3
		Avg.	36.2	
1.125	103-30	1997	33.4	2.1
1.125	103-40	1997	34.2	1.9
1.75	103-21	1997	37.2	1.9
1.75	103-23	1997	37.0	1.7
		1998	36.9	1.2
		1999	36.8	1.3
		2000	36.4	1.4
		2001	34.7	1.9
		2002	35.9	1.2
		Avg.	36.3	
1.75	103-25	1997	40.3	1.8
		1998	38.7	1.3
		1999	40.0	1.8
		2000	38.2	2.2
		2001	36.3	1.5
		2002	36.8	0.9
		2003	36.6	1.7
		Avg.	38.1	
1.75	103-30	1997	37.0	1.8
1.75	103-40	1997	37.0	2.1

Table 13. –Postseason pot shrimp surveys in subdistricts of District 3, 1999-2002. Mean and standard deviation of average carapace length by mesh size.

Mesh size	Subdistrict	Year	Avg. CL,mm	St. dev of Avg. CL
1.125	103-23	1999	32.6	1.7
		2000	32.9	2.1
		2002	30.3	1.5
.		Avg.	31.9	
1.125	103-25	1999	36.3	2.1
		2000	34.9	1.5
		2001	33.6	1.5
		2002	31.9	1.1
		Avg.	34.2	
1.75	103-23	1999	36.1	1.4
		2000	34.7	1.4
		2002	33.6	1.3
		Avg.	34.8	
1.75	103-25	1999	38.6	1.5
		2000	37.2	1.4
		2001	36.3	1.3
		2002	34.4	0.7
		Avg.	36.6	

Table 14. –Linear regressions of carapace length versus weight for spot shrimp with and without eggs in pre and post-seasons surveys of Districts 3, 7, 12, and 13, 1996–2003.

			With eggs		Without eggs	
District	**Project**	**Year**	**Regression**	**r^2 value**	**Regression**	**r^2 value**
3	Pre	2000	$Wt, g = e^{(2.8402*\ln(CL,mm)-6.9302)}$	0.9696	$Wt, g = e^{(2.8145*\ln(CL,mm)-6.8933)}$	0.8961
		2001	$Wt, g= e^{(2.772*\ln(CL,mm)-6.5957)}$	0.8487	$Wt, g = e^{(1.1459*\ln(CL,mm)-1.0164)}$	0.3903
		2002	$Wt, g = e^{(2.5576*\ln(CL,mm)-5.821)}$	0.7836	$Wt, g = e^{(2.9736*\ln(CL,mm)-7.4066)}$	0.9639
		2003	$Wt, g = e^{(2.8451*\ln(CL,mm)-6.8822)}$	0.7566	$Wt, g= e^{(2.7417*\ln(CL,mm)-6.5598)}$	0.9294
	Post	2000	$Wt, g = e^{(2.7661*\ln(CL,mm)-7.012)}$	0.8508	$Wt, g = e^{(2.6915*\ln(CL,mm)-6.8344)}$	0.9499
		2001	$Wt, g = e^{(2.8362*\ln(CL,mm)-6.8407)}$	0.8571	$Wt, g = e^{(2.9301*\ln(CL,mm)-7.2498)}$	0.9416
		2002	$Wt, g = e^{(3.0215*\ln(CL,mm)-7.466)}$	0.8898	$Wt, g = e^{(2.9388*\ln(CL,mm)-7.2061)}$	0.9589
7	Pre	1996	$Wt, g = e^{(2.866*\ln(CL,mm)-6.8467)}$	0.9743	$Wt, g = e^{(2.8786*\ln(CL,mm)-6.9991)}$	0.9876
		1999	$Wt, g = e^{(2.5589*\ln(CL,mm)-5.6033)}$	0.7583	$Wt, g = e^{(2.692*\ln(CL,mm)-6.2685)}$	0.8742
		2000	$Wt, g = e^{(0.1793*\ln(CL,mm) + 3.4332)}$	0.0689	$Wt, g = e^{(2.7666*\ln(CL,mm)-6.5739)}$	0.9087
		2001	$Wt, g = e^{(2.5771*\ln(CL,mm)-5.7253)}$	0.8529	$Wt, g = e^{(2.9022*\ln(CL,mm)-7.081)}$	0.9464
		2002	$Wt, g = e^{(2.8675*\ln(CL,mm)-6.8528)}$	0.3966	$Wt, g = e^{(2.8328*\ln(CL,mm)-6.834)}$	0.9563
		2003	$Wt, g = e^{(2.6219*\ln(CL,mm)-5.9222)}$	0.3807	$Wt, g = e^{(2.8868*\ln(CL,mm)-7.0246)}$	0.9067
	Post	2001	$Wt, g = e^{(2.8551*\ln(CL,mm)-6.7692)}$	0.9053	$Wt, g = e^{(2.9176*\ln(CL,mm)-7.1359)}$	0.9583
		2002	$Wt, g = e^{(2.7511*\ln(CL,mm)-6.3461)}$	0.8714	$Wt, g = e^{(2.8471*\ln(CL,mm)-6.874)}$	0.919
12	Pre	2000	$Wt, g = e^{(3.8519*\ln(CL,mm)-10.973)}$	0.5377	$Wt, g = e^{(3.1023*\ln(CL,mm)-8.1275)}$	0.6392
		2002	$Wt, g = e^{(2.3824*\ln(CL,mm)-5.0551)}$	0.7569	$Wt, g = e^{(2.8806*\ln(CL,mm)-7.0179)}$	0.9792
		2003	$Wt, g = e^{(2.8688*\ln(CL,mm)-6.9243)}$	0.8085	$Wt, g = e^{(2.8092*\ln(CL,mm)-6.7596)}$	0.931
13	Pre	2000	$Wt, g = e^{(4.541*\ln(CL,mm)-13.606)}$	0.7942	$Wt, g = e^{(3.0542*\ln(CL,mm)-8.0695)}$	0.7858
		2001	$Wt, g = e^{(2.1925*\ln(CL,mm)-4.3247)}$	0.7934	$Wt, g = e^{(2.825*\ln(CL,mm)-6.8389)}$	0.9756
		2002	$Wt, g = e^{(2.7747*\ln(CL,mm)-6.5608)}$	0.8344	$Wt, g = e^{(2.8939*\ln(CL,mm)-7.0556)}$	0.9817
		2003	$Wt, g = e^{(2.4449*\ln(CL,mm)-5.3667)}$	0.8413	$Wt, g = e^{(2.8713*\ln(CL,mm)-7.0097)}$	0.9756

Table 15.–Spot shrimp percent female at carapace length for pre and post season surveys in District 3, 2000-2003.

	District 3						
	Pre				Post		
Carapace length, mm	2000	2001	2002	2003	2000	2001	2002
17						0%	
18		0%					
19							
19.5			0%	0%			
20							
20.5							
21			0%	0%		0%	
21.5		0%		0%		0%	
22						0%	
22.5			0%	0%		0%	0%
23				0%		0%	0%
23.5		0%		0%		0%	0%
24	0%			0%		0%	0%
24.5		0%				0%	0%
25	0%	0%		0%		0%	0%
25.5		0%				0%	0%
26		0%	0%			0%	0%
26.5		0%	0%	0%		0%	0%
27	0%	0%	0%	0%		0%	0%
27.5		0%	0%	0%		0%	0%
28	0%	0%	0%	0%		0%	0%
28.5	0%	0%	0%	0%		0%	0%
29	0%	0%	0%	0%		0%	0%
29.5	0%	0%	0%	0%	0%	0%	0%
30	0%	0%	0%	0%	0%	0%	0%
30.5	0%	0%	0%	0%	0%	0%	0%
31	0%	0%	0%	0%	0%	0%	0%
31.5	0%	3%	0%	0%	0%	0%	0%
32	0%	0%	0%	2%	0%	0%	0%
32.5	0%	0%	0%	0%	0%	0%	0%
33	0%	0%	0%	0%	0%	0%	0%
33.5	13%	4%	0%	0%	0%	1%	0%
34	7%	8%	0%	0%	0%	5%	20%
34.5	8%	6%	4%	2%	0%	9%	6%
35	30%	12%	6%	2%	0%	12%	25%
35.5	33%	19%	0%	2%	10%	15%	30%
36	22%	24%	13%	4%	0%	18%	65%
36.5	0%	19%	31%	24%	22%	30%	54%
37	15%	**30%**	**38%**	**47%**	33%	30%	**50%**
37.5	14%	**60%**	**80%**	35%	67%	**42%**	**50%**
38	71%	71%	64%	63%	40%	**70%**	75%
38.5	100%	88%	90%	60%	43%	68%	90%
39	60%	86%	100%	86%	40%	75%	71%
39.5	**50%**	93%	100%	81%	67%	88%	86%
40	63%	100%	100%	91%	**57%**	100%	100%
40.5	100%	100%	100%	100%	100%	100%	100%
41	100%	100%	100%	94%	75%	100%	100%
41.5	100%	100%	100%	100%	100%	96%	100%

-continued

Table 15.–Page 2 of 2.

	District 3						
	Pre				Post		
Carapace length, mm	**2000**	**2001**	**2002**	**2003**	**2000**	**2001**	**2002**
42	100%	100%	100%	100%	86%	100%	100%
42.5	100%	100%		100%	100%	100%	100%
43	50%	100%	100%	100%	100%	100%	
43.5	100%	100%	100%	100%	100%	100%	100%
44		100%	100%	100%	100%	100%	
44.5	100%	100%	100%	100%		100%	
45		100%		100%		100%	
45.5	100%	100%		100%		100%	
46	100%					100%	
46.5		100%	100%		100%	100%	
47	67%	100%		100%		100%	
47.5		100%			100%	100%	
48		100%				100%	
48.5						100%	
49						100%	
49.5					100%		
sample size, n	198	798	375	1,049	204	1,695	689

Table 16. –Preseason pot shrimp surveys in sudistricts of District 7, 1996, 1999, and 2000–2003. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. weight, kg.	St. dev. Avg. Wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs	St. dev. Avg. soak	No. pots sampled
1.125	107-10	1996			121.9	92.73	18.6	1.59	10
		2003	2.3	1.77	128.5	122.55	19.0	2.82	57
	107-20	1996			23.5	20.30	23.7	3.51	39
		1999	0.3	0.37	17.6	20.18	18.0	2.48	59
		2000	0.9	0.96	28.7	31.33	18.5	1.79	86
		2001	2.2	2.07	69.1	81.40	20.4	2.17	59
		2002	1.3	1.93	47.7	90.32	17.9	2.07	75
		2003	1.4	1.66	46.3	62.87	19.3	2.78	72
		Avg.	1.2	1.40	38.8	51.07	19.6	2.47	65
	107-30	2000	1.7	1.60	48.5	49.70	19.3	0.58	15
		2001	0.9	1.44	23.6	38.49	15.5	0.81	15
		2002	1.5	1.14	41.8	31.32	20.3	1.69	15
		Avg.	1.4	1.39	38.0	39.84	18.4	1.03	15
	107-40	1996			14.8	11.18	20.9	0.85	4
		1999			13.3	15.70	16.2	0.00	3
		2000	0.2	0.28	4.1	6.13	16.5	0.18	15
		2001	0.4	0.53	6.5	8.50	16.9	0.80	30
		2002	0.1	0.15	1.4	2.58	16.2	0.57	30
		Avg.	0.2	0.32	8.0	8.82	17.3	0.48	16
1.75	107-10	1996			60.4	55.02	18.6	1.53	40
		2003	1.2	0.72	45.9	28.76	18.9	2.86	60
		2004	1.0	0.77	32.3	24.52	19.6	1.94	60
		Avg.	1.1	0.75	46.2	36.10	19.0	2.11	53
	107-20	1996			26.7	21.27	21.8	4.60	54
		1999	0.3	0.46	15.3	16.42	18.0	2.46	56
		2000	1.0	1.08	26.0	30.28	18.5	1.75	84
		2001	1.7	1.92	46.3	52.41	20.4	2.18	60
		2002	1.1	1.29	30.2	37.73	17.9	2.07	75
		2003	1.1	1.37	33.0	43.39	19.2	2.67	74
		Avg.	1.0	1.22	29.6	33.58	19.3	2.62	67
	107-30	2000	1.9	1.36	51.1	39.42	19.3	0.58	15
		2001	0.8	0.88	21.7	23.92	15.5	0.81	15
		2002	1.3	0.80	34.4	23.06	20.3	1.69	15
		Avg.	1.3	1.01	35.7	28.80	18.4	1.03	15
	107-40	1996			27.6	45.32	20.9	0.58	15
		1999			8.1	15.08	16.4	0.21	7
		2000	0.3	0.77	7.6	17.77	16.5	0.18	14
		2001	0.3	0.41	5.6	7.23	16.9	0.80	30
		2002	0.1	0.20	2.3	3.50	16.2	0.57	30
		Avg.	0.2	0.46	10.2	17.78	17.4	0.47	19

Table 17. –Postseason pot shrimp surveys in subdistricts of District 7, 2001 and 2002. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. weight, kg.	St. dev. Avg. Wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs	St. dev. Avg. soak	No. pots sampled
1.125	107-20	2001	1.0	1.62	35.0	69.14	18.7	4.00	60
		2002	0.5	0.73	21.8	40.07	19.3	1.18	75
	107-30	2001	0.3	0.44	8.1	11.96	20.7	0.64	15
		2002	0.2	0.24	5.1	8.16	16.9	0.80	15
	107-40	2001	0.5	0.76	12.9	21.07	22.1	2.90	30
		2002	0.4	0.52	8.4	13.05	20.0	0.78	30
1.75	107-20	2001	0.7	0.80	19.4	23.62	18.7	4.00	60
		2002	0.4	0.49	11.3	16.73	19.3	1.18	75
	107-30	2001	0.3	0.52	7.0	10.63	20.7	0.64	15
		2002	0.2	0.31	5.1	7.31	16.9	0.80	15
	107-40	2001	0.6	1.02	12.6	20.15	22.3	2.78	29
		2002	0.4	0.36	6.9	7.39	20.0	0.78	30

Table 18.–Preseason pot shrimp surveys in subdistricts of District 7, 1996, 1999, and 2000–2003. Mean and standard deviation of average carapace length by mesh size.

Mesh size	Subdistrict	Year	Avg. CL, mm	St. dev of Avg. CL
1.125	107-10	1996	32.5	2.9
		2003	30.8	2.5
1.125	107-20	1996	38.8	3.6
		1999	35.5	4.1
		2000	37.6	3.6
		2001	39.1	3.2
		2002	37.8	4.2
		2003	37.3	4.6
		Avg.	37.7	
1.125	107-30	2000	38.5	2.9
		2002	39.1	1.6
1.125	107-40	1996	38.5	2.8
		1999	40.5	1.8
		2000	40.2	1.9
		2002	44.3	5.3
		Avg.	40.9	
1.75	107-10	1996	35.8	2.9
		2003	34.7	2.1
1.75	107-20	1996	40.2	2.5
		1999	37.1	3.3
		2000	38.6	2.7
		2001	39.9	2.6
		2002	39.6	3.4
		2003	39.4	3.5
		Avg.	39.1	
1.75	107-30	2000	39	2.3
		2002	40.1	1.5
1.75	107-40	1996	41.6	2.4
		1999	40.8	6.7
		2000	41.0	2.9
		2002	43.4	4.9
		Avg.	41.7	

Table 19.–Postseason pot shrimp surveys in subdistricts of District 7 in 2001, and 2002. Mean and standard deviation of average carapace length by mesh size.

Mesh size	*Subdistrict*	*Year*	*Avg. CL, mm*	*St. dev of Avg. CL*
1.125	107-20	2001	36.8	3.4
		2002	37.4	6.2
1.125	107-30	2001	35.7	5.7
		2002	36.9	4.0
1.125	107-40	2001	41.5	5.5
		2002	40.4	4.5
1.75	107-20	2001	39.1	3.0
		2002	39.0	4.0
1.75	107-30	2001	42.1	5.7
		2002	37.9	5.2
1.75	107-40	2001	43.1	3.4
		2002	43.5	8.1

Table 20.–Spot shrimp percent female at carapace length for District 7 preseason surveys in 2000–2003 and post season surveys in 2001 and 2002.

	District 7					
		Pre			Post	
Carapace length, mm	**2000**	**2001**	**2002**	**2003**	**2001**	**2002**
19				0%		
19.5						
20						
20.5				0%		
21	0%			0%		
21.5				0%		0%
22			0%	0%		
22.5				0%		0%
23	0%			0%		0%
23.5				0%		0%
24			0%	0%	0%	0%
24.5			0%	0%	0%	0%
25	0%	0%	0%	0%	0%	0%
25.5			0%	0%	0%	0%
26	0%		0%	0%	0%	0%
26.5			0%	0%	0%	0%
27	0%		0%	0%	0%	0%
27.5			0%	0%	0%	0%
28	0%		0%	0%	0%	0%
28.5				0%	0%	0%
29			0%	0%	0%	0%
29.5			0%	0%	0%	0%
30	0%		0%	0%	0%	0%
30.5			0%	0%	0%	0%
31	0%	0%	0%	0%	0%	0%
31.5		0%	0%	0%	0%	0%
32	0%	0%	0%	0%	0%	13%
32.5		0%	0%	0%	0%	0%
33	0%	0%	0%	0%	0%	0%
33.5		0%	0%	0%	0%	0%
34	0%	0%	0%	0%	0%	0%
34.5		0%	0%	0%	0%	0%
35	0%	0%	0%	4%	0%	6%
35.5		0%	0%	0%	0%	17%
36	0%	0%	0%	3%	0%	0%
36.5		0%	0%	9%	0%	8%
37	0%	0%	0%	0%	0%	14%
37.5		0%	0%	6%	0%	0%
38	0%	0%	13%	3%	0%	0%
38.5		0%	0%	13%	11%	0%
39	0%	0%	7%	13%	10%	0%
39.5		0%	9%	11%	40%	17%
40	3%	0%	33%	28%	0%	0%
40.5		17%	0%	21%	13%	**50%**
41	9%	0%	22%	29%	27%	**0%**
41.5		17%	0%	32%	13%	**50%**
42	40%	14%	**40%**	**50%**	25%	40%
42.5		**25%**	**63%**	67%	**40%**	0%
43	**56%**		**50%**	60%	**33%**	67%

-continued-

Table 20.–Page 2 of 2.

	District 7					
		Pre			Post	
Carapace length, mm	**2000**	**2001**	**2002**	**2003**	**2001**	**2002**
43.5		**100%**	83%	83%	**83%**	20%
44	63%	**50%**	75%	83%	75%	67%
44.5		100%	67%	79%	80%	100%
45	77%	100%	57%	100%	75%	100%
45.5		100%	40%	90%	100%	50%
46	100%	100%	81%	89%	100%	67%
46.5		100%	100%	100%	100%	67%
47	93%	50%	67%	100%	86%	75%
47.5		100%	100%	100%	100%	100%
48	82%	100%	100%	100%	100%	100%
48.5		100%	100%	100%	100%	100%
49	100%		100%	100%	100%	100%
49.5			100%	100%	100%	100%
50	100%			100%	100%	100%
50.5			100%	100%	100%	
51	100%	100%	100%			
51.5			100%			100%
52	100%		100%		100%	100%
52.5				100%	100%	100%
53	100%	100%	100%			
53.5		100%			100%	100%
54						100%
54.5						
55	100%					
55.5						
56	100%					100%
56.5			100%			100%
57						100%
59.5						100%
60					100%	
60.5						100%
62	100%					
sample size, n	519	111	334	1,134	288	319

Table 21. –Preseason pot shrimp surveys District 12 in 2000, 2002, and 2003 and 13 in 1999–2003. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

District	Mesh	Year	Avg. Wt., kg.	St. dev. Avg. Wt.	Avg. no.	St. dev. Avg. no.	Avg. soak time, hrs.	St. dev. Avg. soak	No. pots sampled
12	1.125	2000	2.6	2.61	95.9	66.42	20.4	2.71	72
		2002	6.0	3.20	179.8	93.73	19.8	5.46	129
		2003	7.5	3.44	219.3	127.57	17.9	3.20	123
		Avg.	5.4	3.08	165.0	95.91	19.4	3.79	108
	1.75	2000	2.5	2.59	83.7	56.36	20.4	2.71	72
		2002	5.0	3.09	121.4	63.04	19.5	5.47	113
		2003	6.2	3.38	153.5	81.42	18.1	3.34	126
		Avg.	4.6	3.02	119.5	66.94	19.3	3.84	104
13	1.125	1999			85.4	76.77	24.6	10.25	78
		2000	3.7	4.09	97.7	103.31	19.8	1.66	56
		2001	3.5	2.86	91.0	81.30	21.3	3.62	99
		2002	4.3	3.43	146.6	117.47	18.8	3.00	132
		2003	5.1	3.85	183.3	135.48	18.7	3.12	120
		Avg.	4.3	3.38	140.3	111.42	19.6	3.25	117
	1.75	1999			71.5	58.12	25.7	10.80	76
		2000	3.0	3.25	75.2	76.21	19.7	1.66	55
		2001	3.2	2.62	74.3	64.38	21.4	3.63	97
		2002	3.2	2.38	89.0	65.13	18.8	2.92	117
		2003	4.3	3.14	124.7	86.29	18.7	3.11	117
		Avg.	3.6	2.71	96.0	71.93	19.6	3.22	110

Table 22. –Preseason pot shrimp surveys subdistricts of District 12, 2000, 2002, and 2003. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. Wt., kg.	St. dev. Avg. Wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs.	St. dev. Avg. soak	No. pots sampled
1.125	112-41	2000	1.3	1.84	45.1	52.59	15.5	0.91	12
		2002	5.0	2.49	161.2	80.40	25.7	2.78	20
		2003	5.1	2.71	172.1	92.86	21.3	2.81	19
		Avg.	3.8	2.35	126.1	75.28	20.8	2.17	17
	112-42	2000	4.1	2.63	133.3	91.70	17.7	0.38	6
		2002	5.0	3.30	224.4	142.71	29.2	1.77	15
		2003	7.9	2.73	321.0	107.30	23.6	1.52	10
		Avg.	5.7	2.89	226.2	113.90	23.5	1.22	10
	112-45	2000	4.1	2.27	89.8	55.69	21.6	1.00	36
		2002	7.2	3.53	199.9	101.88	17.7	3.27	65
		2003	8.3	3.80	254.8	116.50	16.6	2.31	64
		Avg.	6.5	3.20	181.5	91.36	18.6	2.19	55
	112-48	2000			129.4	64.72	22.1	1.53	18
		2002	4.5	1.33	140.6	33.40	15.6	2.21	29
		2003	7.1	2.55	127.3	119.94	16.7	1.47	30
		Avg.	5.8	1.94	132.4	72.69	18.1	1.74	26
1.75	112-41	2000	1.6	1.90	35.7	41.49	15.5	0.91	12
		2002	3.8	2.51	106.9	66.10	25.2	2.52	17
		2003	4.5	2.60	129.9	72.35	21.8	3.11	20
		Avg.	3.3	2.34	90.8	59.98	20.8	2.18	16
	112-42	2000	3.7	2.50	94.2	64.82	17.7	0.38	6
		2002	3.5	2.37	97.9	51.43	29.3	1.79	13
		2003	7.2	8.32	105.3	60.47	23.6	1.52	10
		Avg.	4.8	4.40	99.1	58.91	23.5	1.23	10
	112-45	2000	3.8	2.49	77.5	51.42	21.6	1.00	36
		2002	6.5	3.34	153.9	62.10	17.5	3.38	56
		2003	6.6	2.58	177.8	67.80	16.8	2.38	66
		Avg.	5.6	2.80	136.4	60.44	18.6	2.25	53
	112-48	2000			124.6	44.18	22.1	1.53	18
		2002	3.6	1.58	87.1	41.02	15.4	2.10	27
		2003	6.1	2.39	128.4	106.04	16.7	1.47	30
		Avg.	4.9	1.99	113.4	63.75	18.1	1.70	25

Table 23.–Preseason pot shrimp surveys subdistricts of District 13, 1999–2003. Mean and standard deviation of soak time and catch rate in terms of weight and numbers per pot for spot shrimp, and total number of pots sampled by mesh size.

Mesh	Subdistrict	Year	Avg. Wt., kg.	St. dev. Avg. Wt.	Avg. no.	St. dev. Avg. no.	Avg. soak, hrs.	St. dev. Avg. soak	No. pots sampled
1.125	113-55	1999			19.6	18.01	18.8	0.42	24
		2000	1.2	1.16	31.7	31.33	18.5	1.26	19
		2001	2.8	1.86	71.7	69.37	20.9	4.32	34
		2002	6.3	2.97	242.2	100.03	18.6	2.74	38
		2003	5.8	4.25	214.8	151.88	17.7	2.70	35
		Avg.	4.0	2.56	116.0	74.12	18.9	2.29	30
	113-57	1999			123.8	49.03	25.3	1.21	18
		2000	2.3	2.72	62.0	80.64	19.8	1.38	14
		2001	1.8	1.85	69.3	49.42	22.2	3.44	17
		2002	1.8	2.52	60.6	88.84	19.8	3.61	41
		2003	2.4	2.76	88.9	108.99	21.9	1.90	35
		Avg.	2.1	2.46	80.9	75.38	21.8	2.31	25
	113-58	1999			110.0	85.06	28.2	13.91	36
		2000	6.7	4.47	173.9	106.78	20.7	1.45	23
		2001	4.5	3.33	112.4	93.09	21.3	3.13	48
		2002	4.8	3.25	144.5	95.22	18.1	2.42	53
		2003	6.4	3.31	226.4	106.30	17.2	2.38	50
		Avg.	5.6	3.59	153.4	97.29	21.1	4.66	42
1.75	113-55	1999			10.9	9.50	18.7	0.42	21
		2000	1.2	1.44	29.8	34.30	18.5	1.26	19
		2001	2.5	1.83	47.9	47.88	20.9	4.45	32
		2002	4.3	2.12	120.3	54.37	18.4	2.74	35
		2003	4.4	3.29	128.1	93.56	17.7	2.70	35
		Avg.	3.1	2.17	67.4	47.92	18.8	2.31	28
	113-57	1999			110.5	38.96	25.2	1.24	20
		2000	2.3	1.78	61.3	48.28	19.9	1.38	15
		2001	2.2	2.43	69.7	48.70	22.2	3.44	17
		2002	1.7	2.22	49.1	70.13	20.1	3.43	34
		2003	2.5	2.66	73.9	75.38	22.0	1.85	33
		Avg.	2.2	2.27	72.9	56.29	21.9	2.27	24
	113-58	1999			85.6	56.39	30.3	14.29	35
		2000	5.2	4.00	124.1	90.80	20.7	1.51	21
		2001	4.0	2.92	93.5	72.69	21.5	3.07	48
		2002	3.6	2.14	94.5	54.48	18.2	2.40	48
		2003	5.6	2.76	156.5	72.03	17.2	2.39	49
		Avg.	4.6	2.96	110.8	69.28	21.6	4.73	40

Table 24.–Preseason pot shrimp surveys subdistricts of District 12, 2000, 2002, and 2003. Mean and standard deviation of average carapace length by mesh size.

Mesh size	Subdistrict	Year	Avg. CL, mm	St. dev of Avg. CL
1.125	112-41	2000	33.0	4.0
		2002	37.0	3.0
		2003	35.4	1.7
		Avg.	35.1	
1.125	112-42	2000	36.0	2.7
		2002	34.1	2.6
		2003	34.3	0.8
		Avg.	34.8	
1.125	112-45	2000	41.2	3.0
		2002	38.7	2.3
		2003	37.5	1.5
		Avg.	39.1	
1.125	112-48	2000	40.8	1.5
		2002	35.5	2.9
		2003	36.9	1.1
		Avg.	37.7	
1.75	112-41	2000	38.1	3.9
		2002	38.2	3.1
		2003	38.1	1.5
		Avg.	38.1	
1.75	112-42	2000	38.8	1.1
		2002	37.6	1.3
		2003	37.5	1.4
		Avg.	38.0	
1.75	112-45	2000	41.6	1.9
		2002	40.4	3.2
		2003	38.4	1.4
		Avg.	40.1	
1.75	112-48	2000	41.1	1.3
		2002	37.1	1.7
		2003	37.9	0.7
		Avg.	38.7	

Table 25. –Preseason pot shrimp surveys subdistricts of District 13, 1999–2003. Mean and standard deviation of average carapace length by mesh size.

Mesh size	*Subdistrict*	*Year*	*Avg. CL, mm*	*St. dev of Avg. CL*
1.125	113-55	1999	35.7	3.1
		2000	36.2	3.2
		2001	35.6	3.3
		2002	34.4	2.4
		2003	34.7	2.0
		Avg.	35.3	
1.125	113-57	1999	39.8	1.7
		2000	39.6	2
		2001	37.7	3.3
		2002	37.5	2.3
		2003	36.5	1.7
		Avg.	38.2	
1.125	113-58	1999	37.3	3.5
		2000	38.9	2.9
		2001	36.0	2.8
		2002	35.8	2.4
		2003	35.7	2.5
		Avg.	36.7	
1.75	113-55	1999	37.2	1.4
		2000	38.5	2.1
		2001	39.3	1.5
		2002	37.4	1.5
		2003	36.6	2.0
		Avg.	37.8	
1.75	113-57	1999	40.4	1.4
		2000	39.0	0.7
		2001	39.7	2.1
		2002	37.4	1.5
		2003	36.6	2.0
		Avg.	38.6	
1.75	113-58	1999	38.6	1.9
		2000	39.8	2.1
		2001	37.9	2.1
		2002	38.3	1.5
		2003	38.6	1.8
		Avg.	38.6	

Table 26 .–Spot shrimp percent female at carapace length for pre and postseason surveys in Districts 12 in 2000, 2002, and 2003 and District 13 in 2000-2003.

	District 12			District 13			
		Pre			Pre		
Carapace length, mm	**2000**	**2002**	**2003**	**2000**	**2001**	**2002**	**2003**
20							0%
20.5				0%		0%	0%
21						0%	
21.5				0%		0%	
22						0%	0%
22.5					0%	0%	
23						0%	0%
23.5		0%	0%			0%	0%
24		0%		0%		0%	
24.5						0%	
25		0%		0%		0%	
25.5		0%				0%	
26		0%					
26.5		0%		0%	0%	0%	
27		0%		0%	0%	0%	0%
27.5		0%			0%	0%	0%
28		0%		0%	0%	0%	0%
28.5		0%		0%	0%	0%	0%
29		0%	0%	0%		0%	0%
29.5		0%	0%	0%	0%	0%	0%
30	0%	0%		0%		0%	0%
30.5		0%	0%	0%	0%	0%	0%
31	0%	0%	0%	0%	0%	0%	0%
31.5	0%	0%		0%	0%	0%	0%
32	0%	0%	0%	0%	0%	0%	0%
32.5		0%	0%	0%	0%	0%	0%
33		0%	0%	0%	0%	0%	0%
33.5		0%	0%	0%	0%	0%	0%
34		0%	0%	0%	0%	0%	0%
34.5	0%	0%	0%	0%	0%	0%	0%
35	0%	0%	0%	0%	0%	0%	0%
35.5		0%	0%	0%	0%	0%	0%
36		0%	0%	11%	0%	0%	0%
36.5	0%	0%	0%	0%	0%	0%	0%
37	0%	0%	0%	0%	0%	0%	0%
37.5	0%	0%	0%	0%	0%	5%	12%
38	0%	0%	0%	8%	0%	0%	0%
38.5	0%	0%	0%	0%	8%	0%	5%
39	0%	0%	0%	13%	8%	13%	19%
39.5	0%	0%	0%	0%	0%	25%	45%
40	0%	7%	0%	0%	0%	25%	33%
40.5	0%	13%	43%	44%	0%	33%	42%
41	7%	15%	0%	100%	0%	38%	**50%**
41.5	0%	38%		71%	20%	**67%**	**40%**
42	33%	33%	0%	89%	38%	**40%**	**77%**
42.5	75%	67%	0%	63%	27%	79%	**50%**
43	75%	**40%**	100%	100%	40%	83%	64%
43.5	**57%**	**60%**	100%	60%	54%	80%	43%

-continued-

Table 26.–Page 2 of 2.

Carapace length, mm	District 12 Pre 2000	2002	2003	District 13 Post 2000	2001	2002	2003
44	80%	**50%**	100%	100%	100%	100%	100%
44.5	100%	75%		100%	100%	100%	100%
45	100%	75%	0%	100%	100%	90%	100%
45.5	90%	100%	100%	100%	100%	100%	100%
46	100%	100%	100%	100%	100%	100%	67%
46.5	100%	100%	75%	50%	100%	100%	100%
47	100%	100%	100%	100%		100%	
47.5	100%	100%	100%	0%	100%	100%	100%
48	100%	100%	100%		100%		100%
48.5	100%	100%	100%	75%			100%
49	100%	100%	100%	67%		100%	
49.5	100%	100%	100%				100%
50	100%	100%	100%	100%	100%		100%
50.5	100%	100%		100%			
51		100%	100%			100%	
51.5		100%					
52		100%	100%				100%
52.5			100%				
53							100%
53.5	100%	100%					
54							
54.5							
55							
55.5		100%					
sample size, n	134	455	224	231	275	406	404

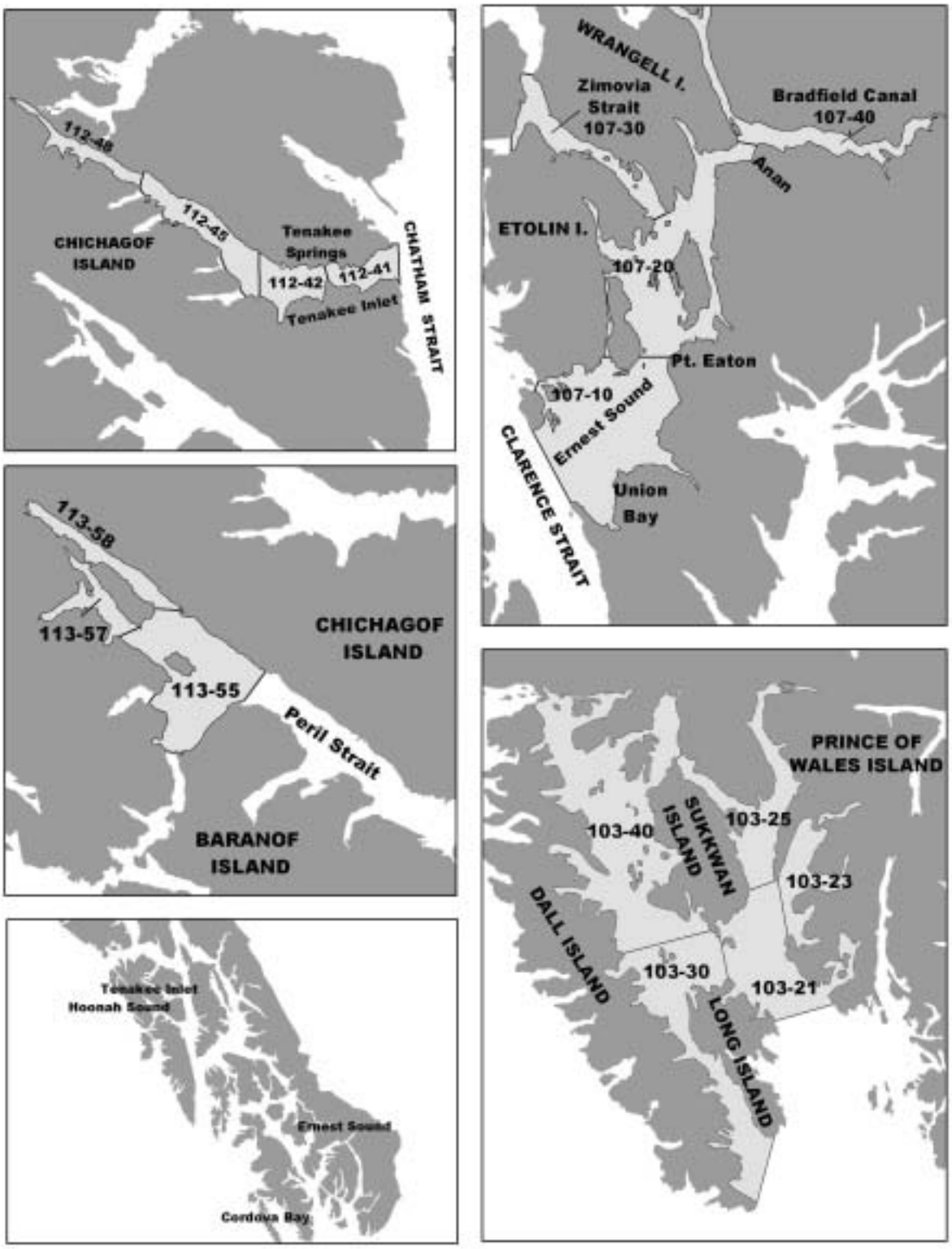


Figure 1.–Pot shrimp survey locations; Districts 3 (Cordova Bay), 7 (Ernest Sound), 12 (Tenakee Inlet) and 13 (Hoonah Sound) in southeastern Alaska.

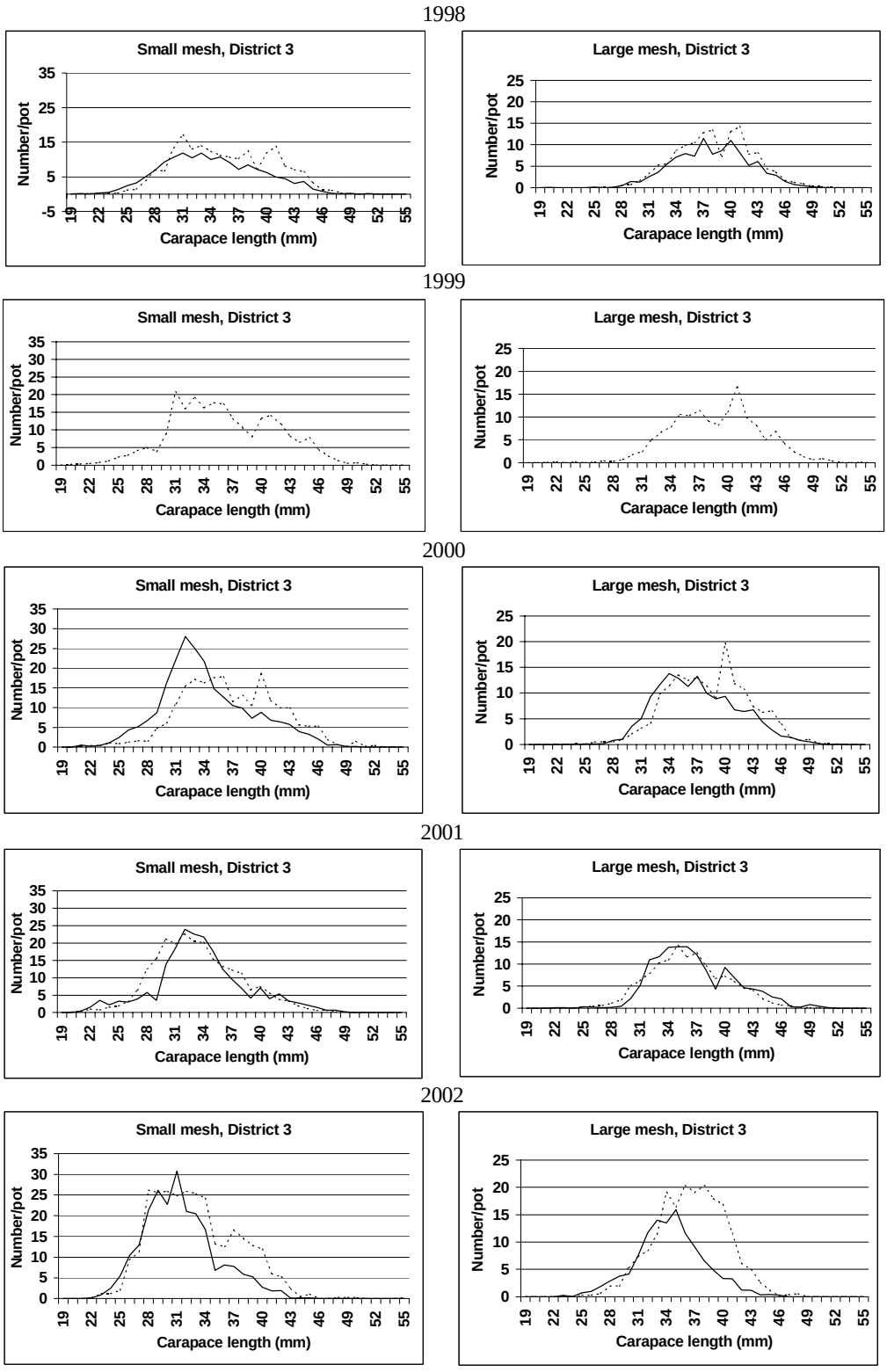


Figure 2.–District 3, Subdistricts 103-23 and 103-25 combined. Catch rate by size of spot shrimp in small and large mesh pots fished 16–36 hours during 1998–2002 pre- and postseason surveys. Dotted line is pre-season and solid post-season survey.

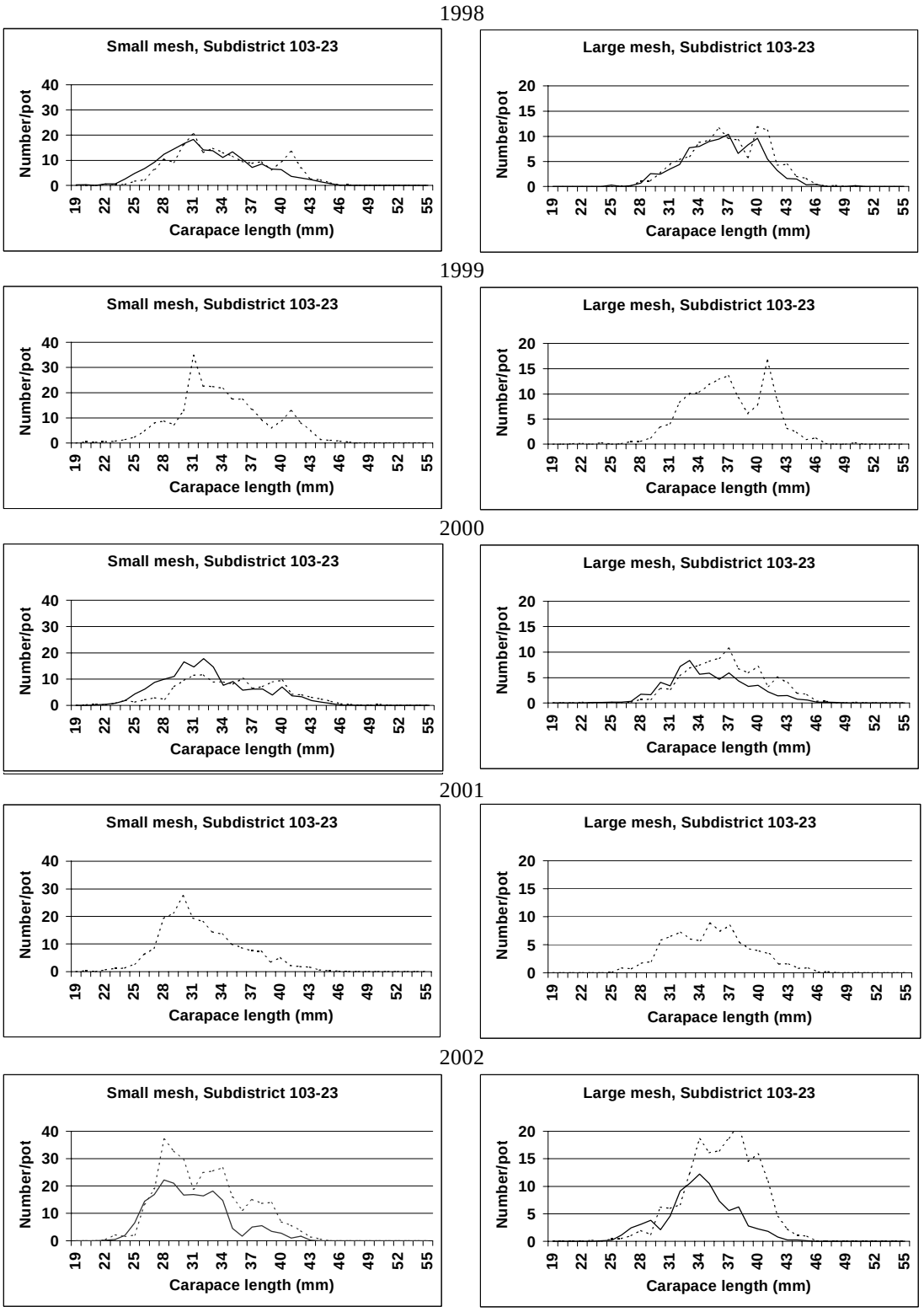


Figure 3.–District 3, Subdistrict 103-23. Catch rate by size of spot shrimp in small and large mesh pots fished 16–36 hours during 1998–2002 pre- and post season surveys. Dotted line is pre-season and solid post-season survey.

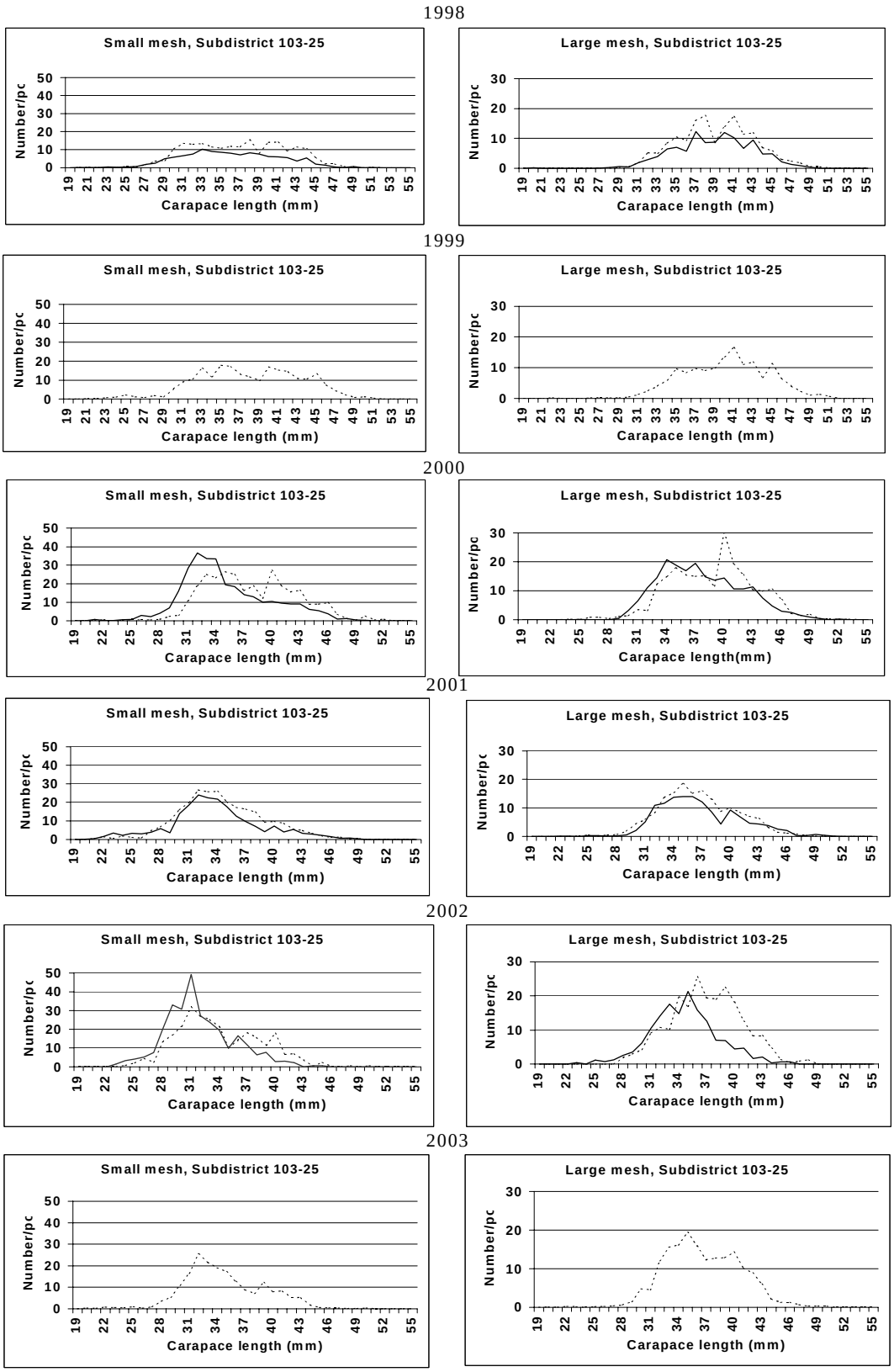
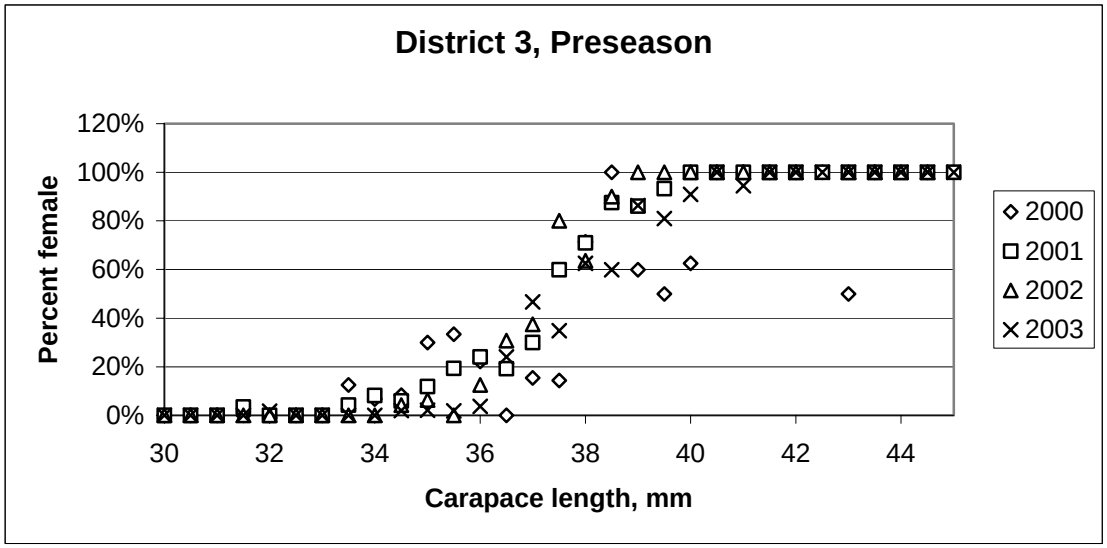


Figure 4.–District 3, Subdistrict 103-25. Catch rate by size of spot shrimp in small and large mesh pots fished for 16–36 hours during 1998–2003 pre- and post season surveys. Dotted line is pre-season and solid post-season survey.



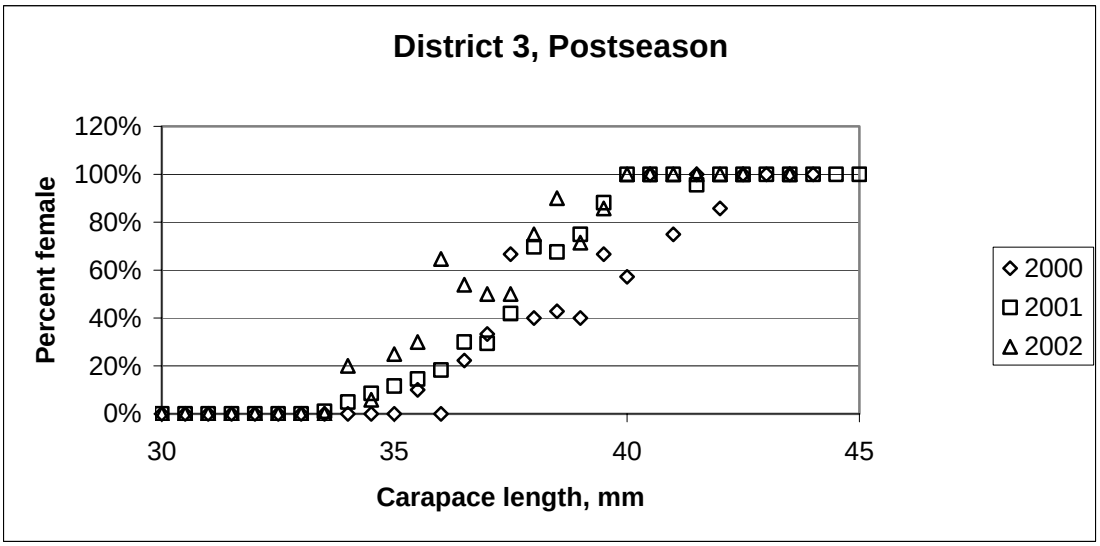


Figure 5.–District 3. Percent female at size determined from spot shrimp samples taken during 2000–2003 preseason and 2000–2002 and post season surveys.

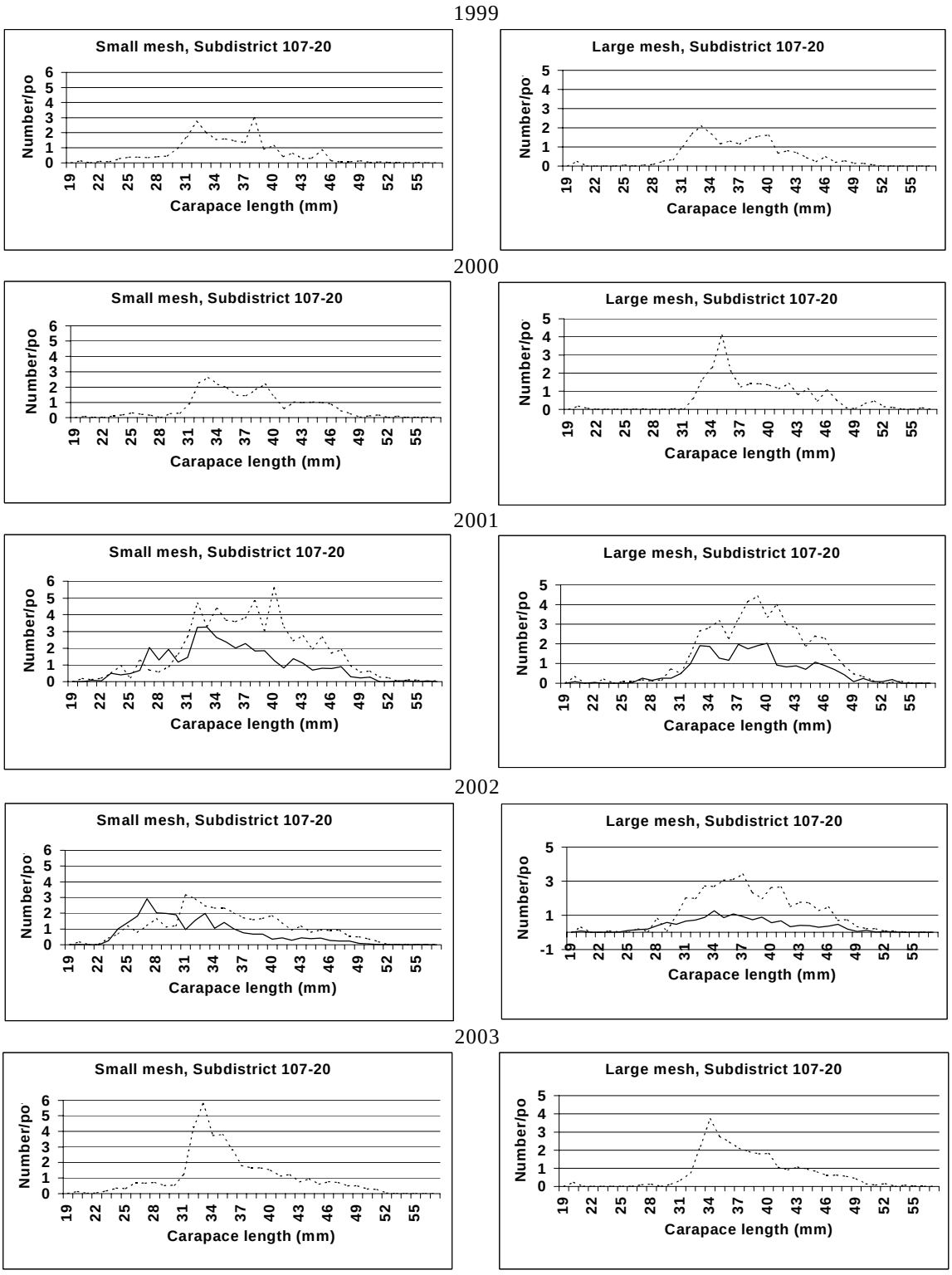
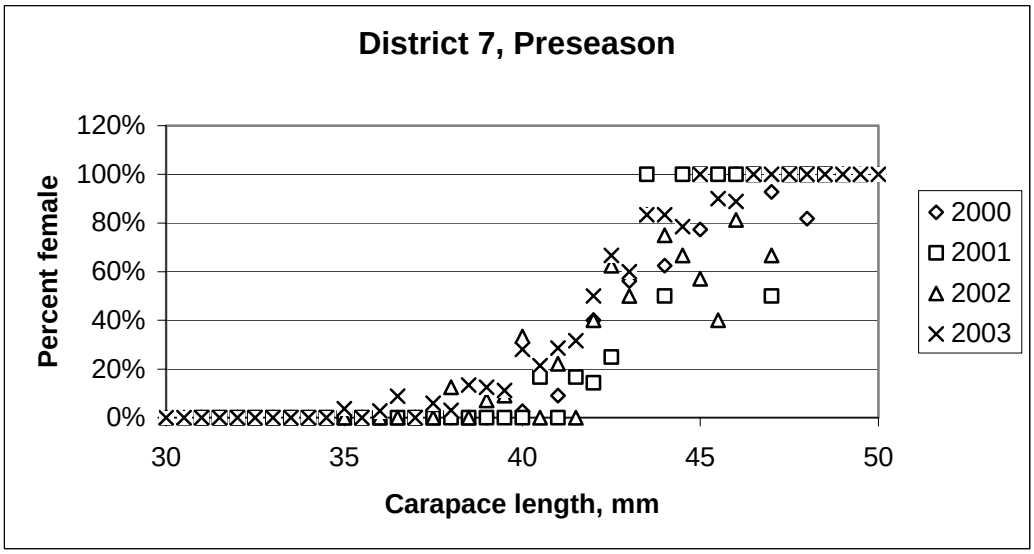


Figure 6.–District 7, Subdistrict 107-20. Catch rate by size of spot shrimp, in small and large mesh pots fished 16–36 hours during 1999–2003 pre and post-season surveys. Dotted line is pre-season and solid post-season survey.



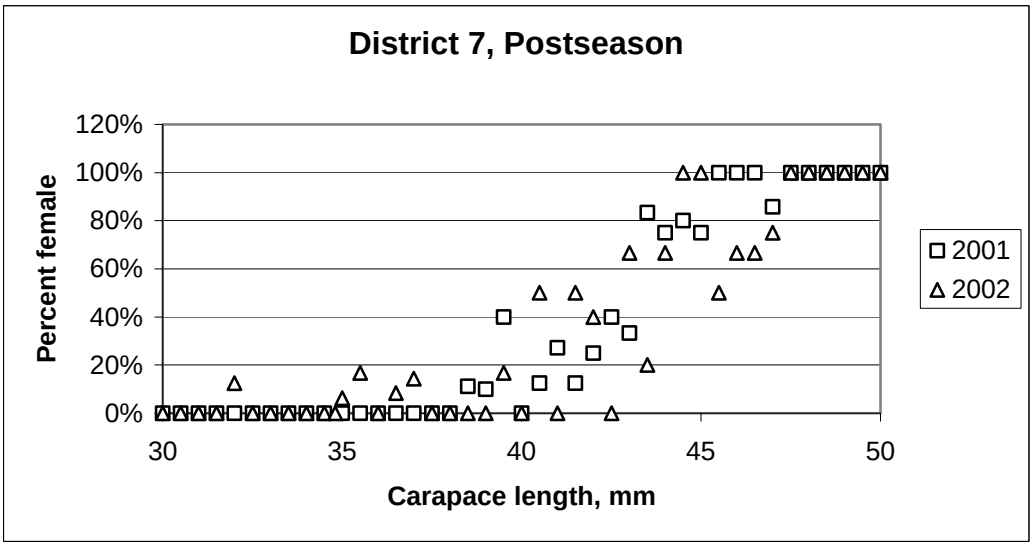


Figure 7. –District 7. Percent female at size determined from spot shrimp samples taken during 2000–2003 preseason- and 2001 and 2002 post season surveys.

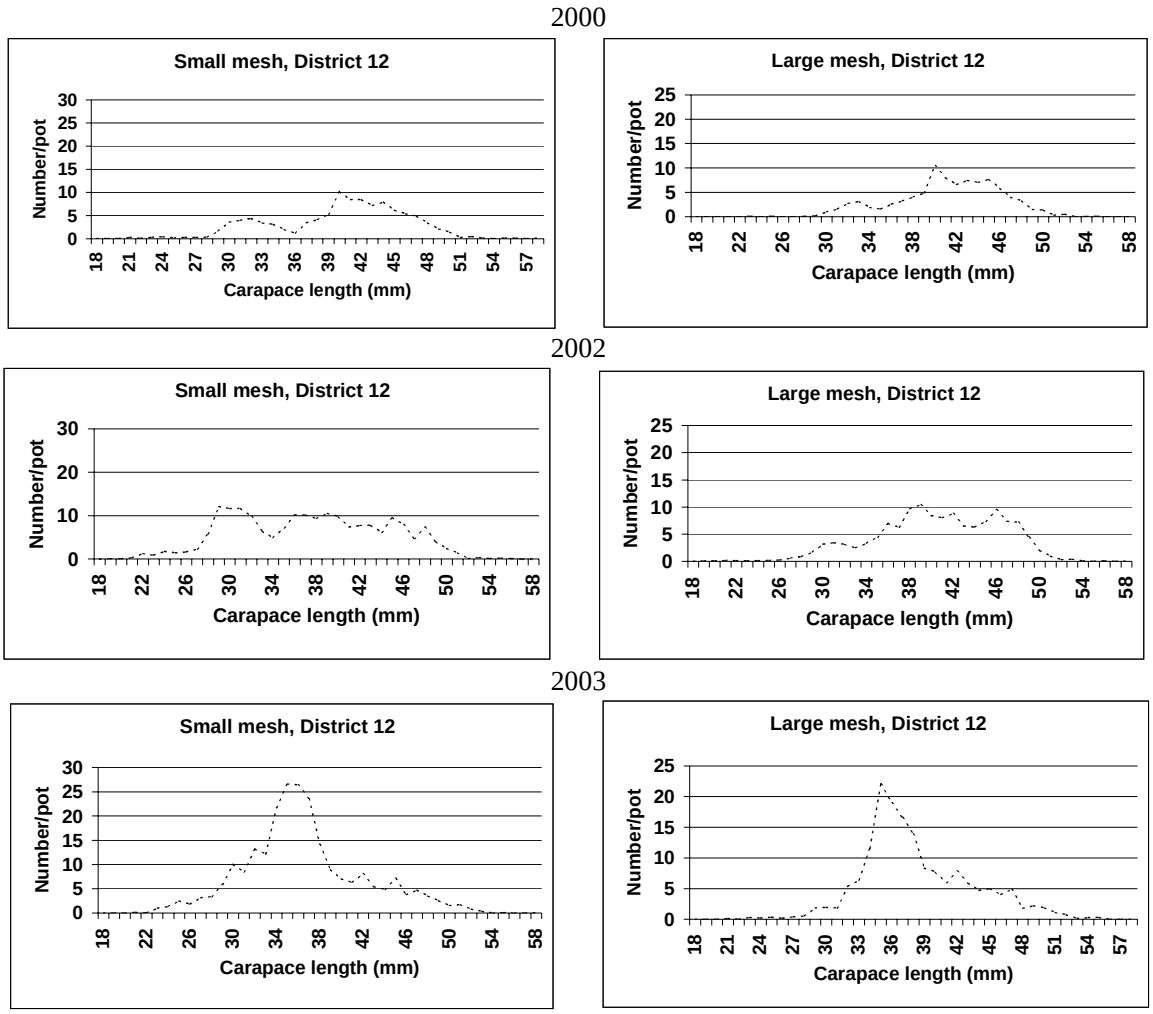


Figure 8. –District 12. Catch rate by size of spot shrimp, for small and large mesh pots fished for 16–36 hours during 2000–2003 preseason surveys.

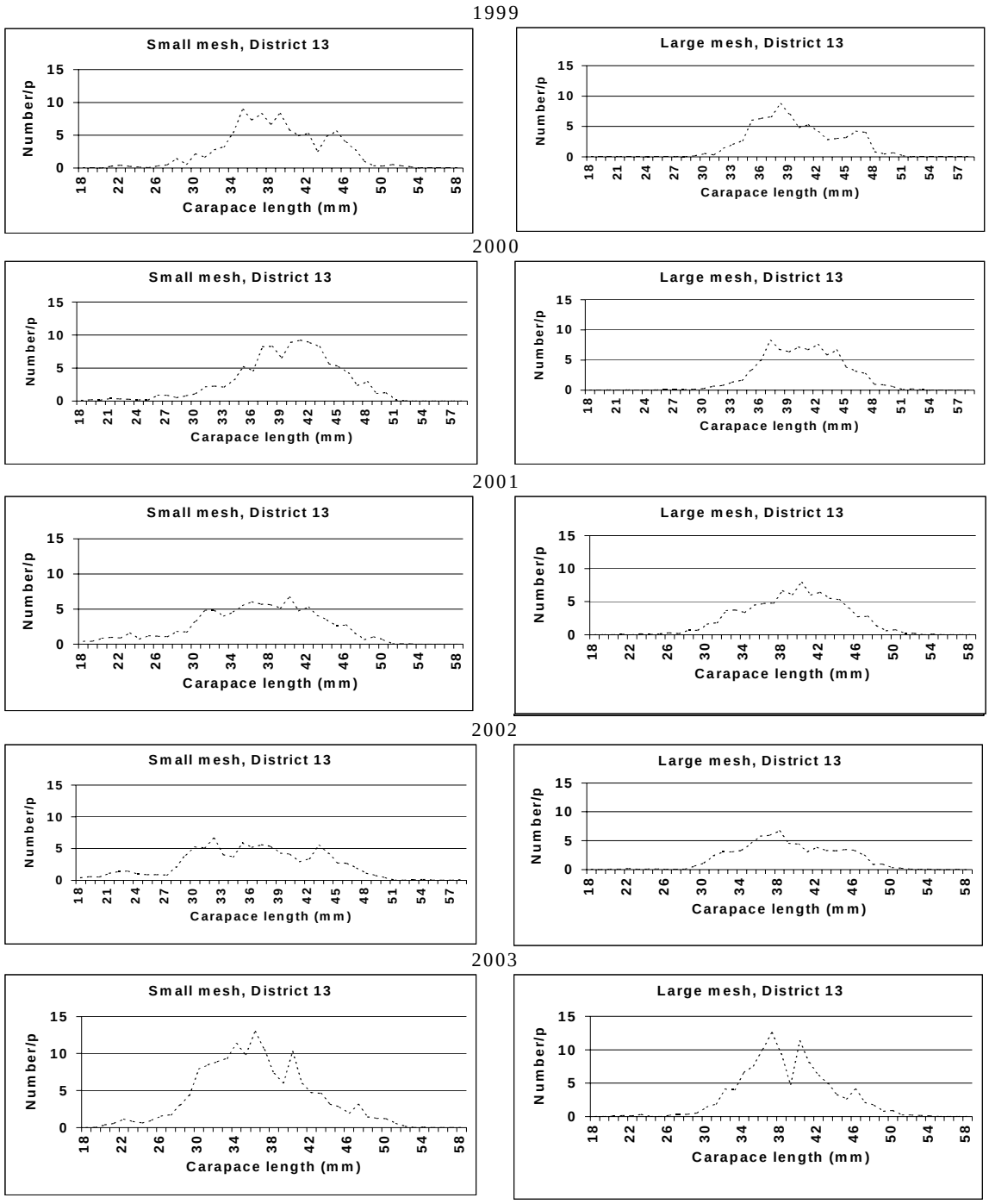
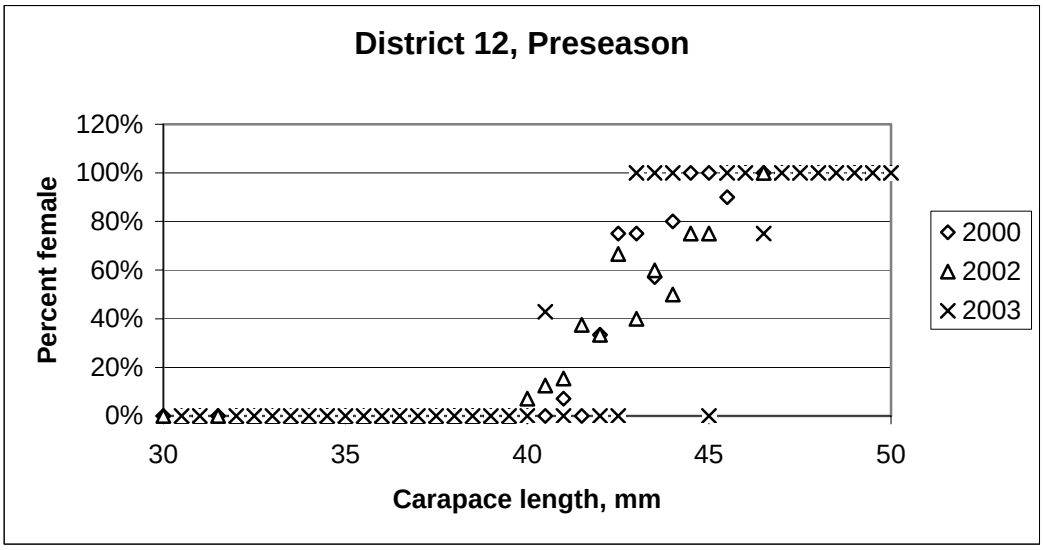


Figure 9. –District 13. Catch rate by size of spot shrimp, for small and large mesh pots fished 16–36 hours during 1999–2003 preseason surveys.



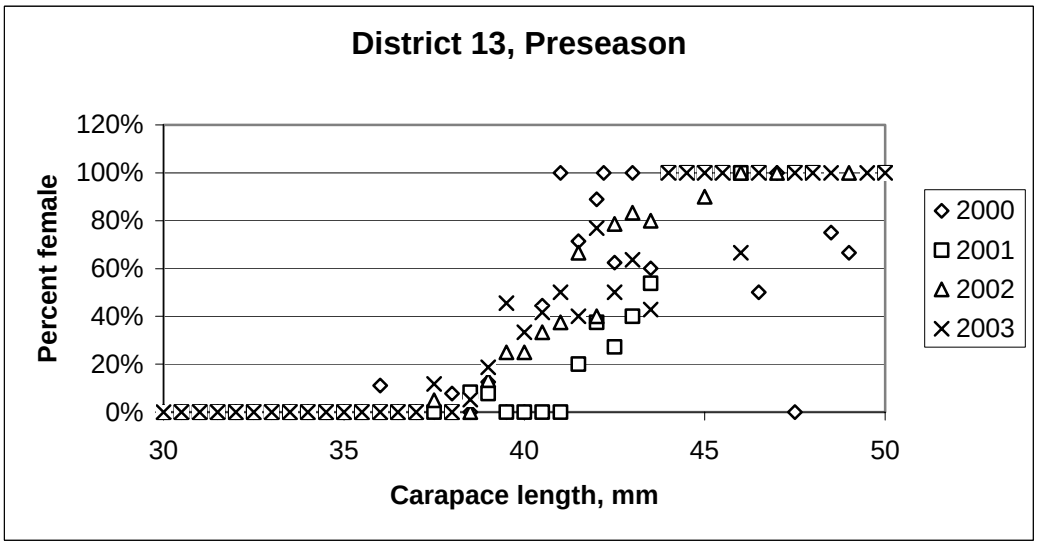


Figure 10.–Districts 12 and 13. Percent female at size determined from spot shrimp samples taken during 2000, 2002, and 2003 preseason surveys of District 12 and 2000–2003 preseason surveys of District 13.