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Prince William Sound Shrimp Pot Fisheries, 2010–2014

by

Maria Wessel,

Mike Thalhauser,

Kenneth J. Goldman, Ph.D.,

Xinxian Zhang,

Patricia A. Hansen,

Jan Rumble,

and

Chris Russ

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

Symbols and Abbreviations

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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)

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

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By
Maria Wessel
Alaska Department of Fish and Game, Division of Commercial Fisheries, Cordova
and
Mike Thalhauser and Patricia Hansen
Alaska Department of Fish and Game, Division of Sport Fish, Anchorage
and
Kenneth J. Goldman, Jan Rumble, and Chris Russ
Alaska Department of Fish and Game, Division of Commercial Fisheries, Homer
and
Xinxian Zhang
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Maria Wessel,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
401 Railroad Avenue, Cordova, AK 99574, USA

Mike Thalhauser and Patricia A. Hansen
Alaska Department of Fish and Game, Division of Sport Fish,
333 Raspberry Road, Anchorage, AK 99518, USA

Kenneth J. Goldman, Jan Rumble, and Chris Russ
Alaska Department of Fish and Game, Division of Commercial Fisheries,
3298 Douglas Place, Homer, AK 99603, USA

Xinxian Zhang
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518, USA

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ABSTRACT

This report summarizes the most recent fishing seasons and management actions for commercial and noncommercial (personal use, subsistence, and sport fish) shrimp pot fisheries managed by the Alaska Department of Fish and Game (ADF&G) in the Prince William Sound Management Area (Area E) through the 2014 season. Spot shrimp *Pandalus platyceros* is the targeted species in this fishery, although coonstripe shrimp *Pandalus hypsinotus* are harvested to a lesser extent. The shrimp pot fishery season runs from April 15 to September 15 for all commercial and noncommercial fisheries. Harvest in the 2014 commercial and noncommercial fisheries was 68,464 lb and 89,155 lb, respectively. Total harvest was 157,619 lb or 95% of the 166,500 lb total allowable harvest (TAH). Catch per unit effort (CPUE) in the ADF&G index survey has remained stable with an average of 1.97 lb from 2010 to 2014 of all size shrimp and 1.43 lb of marketable size shrimp (≥ 32mm carapace length) per pot hauled. CPUE over the same time period in the commercial fishery has fluctuated because of the rotation of the areas fished and averaged 1.77 lb of shrimp per pot hauled, while CPUE in the noncommercial fisheries has remained stable and averaged 1.77 lb of shrimp per pot day. Although overall shrimp harvests (commercial and noncommercial fisheries combined) exceeded the TAH in 2010 and 2011, harvests in the noncommercial fisheries appear to have stabilized, and total shrimp harvests between 2012 and 2014 have been between 87% and 95% of the TAH. The TAH is set at the lower 90% confidence interval of the MSY and is therefore a conservative estimate of sustainable harvest. A TAH above the 110,000 lb threshold for a 2015 commercial fishery is likely.

Key words: Prince William Sound, Area E, spot shrimp, *Pandalus platyceros*, coonstripe shrimp, *Pandalus hypsinotus*, assessment, management, commercial, noncommercial, Alaska Board of Fisheries.

INTRODUCTION

This report summarizes the most recent fishing seasons and management actions that occurred in the Prince William Sound (PWS) shrimp pot fisheries for commercial, sport, personal use, and subsistence uses. The boundaries of the PWS Management Area (Registration Area E) historically included waters within PWS and territorial waters of Alaska outside of PWS between the longitudes of Cape Fairfield (148°50.25′W long) and Cape Suckling (143°53′ W long; Figure 1). In 2001, the eastern boundary was moved to 144°00′W long, making the regulatory boundaries consistent among all state shellfish and groundfish fisheries.

The PWS area is divided into the Inside and Outside Districts (Figure 1). The Inside District is defined as waters enclosed by lines from Point Whitshed to Point Bentinck, from Cape Hinchinbrook to Zaikof Point, and from Cape Cleare to Cape Puget. The Outside District, made up of the Gulf of Alaska waters 0–3 miles from shore, is further divided into 2 sections, the Western and Eastern. The Western Section includes waters between Cape Fairfield and 147°00′W long, and the Eastern Section includes waters between 147°00′W long and 144°00′W long.

The Alaska Department of Fish and Game (ADF&G) manages shrimp fisheries within the PWS management area; the Division of Commercial Fisheries manages the commercial shrimp fishery and the Division of Sport Fish manages noncommercial shrimp (sport, personal use, and subsistence). The Alaska Board of Fisheries (BOF) establishes management regulations and ADF&G uses its emergency order (EO) authority to make adjustments to fishing time and area. The BOF schedules regular meetings for shellfish on a triennial basis.

There are commercial and noncommercial shrimp pot fisheries that target spot shrimp *Pandalus platyceros* and, to a limited extent, coonstripe shrimp *Pandalus hypsinotus* (Table 1). These pandalid shrimp are protandric hermaphrodites, first maturing as males and as they get larger, transitioning to females. Spot shrimp may reach sexual maturity by their third year, and eggs are typically found on females from October to March. An ADF&G tagging study in PWS between 1983 and 1986 indicated that spot shrimp lifespan may range from 7 to 10 years (Kimker et al.

1996). Although spot shrimp are typically caught in greatest concentrations around 60 fathoms, they range in depths between 2 and 250 fathoms.

The commercial fishery is allocated 40% of the total allowable harvest (TAH) in years when the TAH exceeds 110,000 lb (5 AAC 31.214; Table 1). Commercial shrimp harvests are monitored inseason through ADF&G fish tickets (5 AAC 39.130) with additional information from required inseason reporting on fishing location and effort (5 AAC 31.245). Logbooks are also required for this fishery. Reporting requirements specify that all shrimp retained, including harvest that are retained for personal use or used as bait at sea, must be reported on ADF&G fish tickets. The noncommercial fishery is allocated 60% of the total allowable catch (TAC). Noncommercial harvest is currently monitored through a permit and harvest record form postseason. Permits record location, effort, and harvest and are used to evaluate fishery dynamics and to model future harvestable surplus within the fishery. ADF&G relies on accurate and timely documentation of fisheries mortality and reporting of all harvest removals for fisheries management. Data collected from the commercial and noncommercial PWS shrimp pot fisheries, as well as from ADF&G conducted surveys, provide the information necessary to manage PWS spot shrimp. This report gives background information on spot shrimp fisheries in PWS and summarizes available and relevant information.

RESEARCH

SURVEY

In 1989, as part of the *Exxon Valdez* oil spill (EVOS) damage assessment process, ADF&G initiated an annual survey using pot gear to assess spot shrimp in PWS (Trowbridge 1992, 1994). Variable numbers of pots were set at each survey site during these first 3 years of the survey. Between 1989 and 1991 there were 6 stations set on the survey (Unakwik, Golden, Culross, Herring Bay, Green Island, and north of Chenega [site later referred to as Junction Island]; Figure 2) using 2 depth strata: 20–70 fathoms and 70–120 fathoms. Starting in 1992, south Chenga and Prince of Wales were added to the survey and depths fished were standardized to range from 20 to 80 fathoms; survey catch rates dropped precipitously at depths below 80 fathoms in previous surveys (Trowbridge 1994). In 2009, the Green Island station was eliminated due to regular gear loss from heavy currents and a new survey site was added at Long Bay. In 2012, another new survey site was added at Bald Head Chris to provide better area coverage, and in 2013 an additional survey site was added in the Valdez Arm area, to obtain fishery independent data in this area of high noncommercial harvest. Beginning in 1992, the survey was standardized and 4 strings of 11 pots each were set at each survey site annually (Figure 2). Each string of standardized gear was made up of 11 pots spaced approximately 10 fathoms apart on a groundline with buoys at each end.

Data from the survey, specifically catch per unit of effort (CPUE) and sex ratios, were used to make management decisions in the 1991 fishery and subsequent years when the fishery was closed by EO. Sex ratios are important because spot shrimp are protandrous hermaphrodites, first recruiting to the fishery as males and as they get larger, transitioning to females. The majority of harvest is typically on the larger shrimp, which are females.

Catches in ADF&G's standardized index survey for spot shrimp declined from 0.73 lb/pot in 1992 to 0.29 lb/pot in 1998 (Table 2). After 1998, survey catches demonstrated a slow but steady increase in abundance and biomass from 0.29 lb/pot to a high of 2.56 lb/pot for all shrimp in

2008, and an average of 1.97 lb/pot over the last 5 years (2010–2014). Similarly, survey results for commercially marketable shrimp with a carapace length of 32 mm or greater also increased from 0.14 lb/pot in 1998 to a high of 1.68 lb/pot in 2011. The catch of these larger shrimp averaged 1.43 lb/pot over the last 5 years (2010–2014; Figure 3).

Although the ADF&G damage assessment study following the *Exxon Valdez* oil spill concluded that PWS spot shrimp may have declined as a result of overfishing, environmental conditions were probably instrumental in both the decline and slow recovery of spot shrimp in PWS, in addition to other shellfish populations throughout the Gulf of Alaska (Trowbridge 1992; Bechtol 1997). Spot shrimp are a sedentary species and probably do not migrate out of an area after settling, making them particularly susceptible to serial depletion.

Survey results are currently used to assess the relative abundance of spot shrimp in PWS, and these data, along with survey CPUE and total catch weight, are used in combination with harvests from the commercial and noncommercial fisheries each year to model the harvestable surplus of spot shrimp in PWS. Model results provide the following year's TAH and guideline harvest levels (GHL) for both commercial and noncommercial spot shrimp fisheries.

MODELING POPULATION DYNAMICS

The population dynamics of spot shrimp in PWS is modeled using the Schaefer surplus production model (Haddon 2011). The equation is written as follows:

$$B_{t+1} = B_t + rB_t\left(1 - \frac{B_t}{K}\right) - C_t,$$

where r is an intrinsic rate of population growth, K is a parameter that corresponds to the unfished equilibrium population size, B_{t+1} is the exploitable biomass at the end of year t or the beginning of year t+1, B_t is the exploitable biomass at the start of year t, and C_t is the biomass caught during year t.

Also, an index of relative abundance is generated from the equation:

$$\hat{I}_t = q\frac{\hat{B}_{t+1} + \hat{B}_t}{2},$$

where $\hat{I}_t$ is an estimated index of relative abundance for year t and q is the catchability coefficient. Taking the average of 2 biomass levels relates to using the average biomass at the start and end of year t so that the catches related to the biomass more realistically.

The input data to the model are catches (C_t) and CPUE (observed I_t) from 1981 to present. The CPUE data are from 2 sources: the commercial fisheries (1981 to 1988) and the survey (1989 to present). The CPUE from commercial fisheries is adjusted to the level of the survey CPUE using the ratio of the average of CPUE from 1989 and 1990 to the average of CPUE from 1987 and 1988. The catch data are the total catch weight, which is the summation of catches from the survey and from the commercial and noncommercial fisheries.

The parameters r, K, initial biomass B_0, and q can then be estimated by minimizing the sum of squares error $\sum (I_t - \hat{I}_t)^2$. The maximum sustainable yield (MSY) is obtained from the equation:

$$MSY = \frac{rK}{4}.$$

To determine the uncertainty in the estimate of *MSY*, a bootstrap analysis is conducted by resampling the residuals between estimated CPUE ($\hat{I}_t$) and observed CPUE (I_t); 90% confidence intervals are constructed using at least 1,000 bootstrapping samples. The lower confidence interval (CI) bound is used instead of MSY as the harvestable surplus biomass in order to deal with the uncertainty of MSY and set more conservative, sustainable harvest limits.

COMMERCIAL FISHERY

HISTORY

Commercial shrimp landings were first documented in 1960 when approximately 5,000 lb were harvested (Appendix A). The historical fishery occurred within the Inside District of PWS, primarily in the traditional harvest area, which encompassed the northern and western shores of PWS from Port Valdez to Whittier and the entire southwest portion of the sound (Figure 1). From 1960 to 1977, harvest ranged from 0 in 1961 and 1966, to approximately 25,000 lb in 1974. The shrimp pot fishery expanded rapidly from 1978 to 1982 as local markets were established and the major harvest areas located. Early seasons were open year-round with no harvest restrictions.

From 1982 to 1984, seasons were shortened to April 1 through November 30 and the first GHR of 75,000–145,000 lb was adopted. Despite the shortened season, catch increased to approximately 214,000 lb in 1982 and effort increased to 79 vessels in 1984. Beginning in 1985, the BOF established a split season of March 15 through June 30 and August 15 through December 5, with a GHR of 75,000–100,000 lb each season. An experimental harvest area in Montague Strait with no closed season was also established. The split season was intended to reduce harvests during the egg-bearing periods. Due to incomplete and late catch reporting, coupled with harvest from the experimental fishing area, harvests substantially exceeded the GHR over the next few years. Harvest peaked at approximately 290,600 lb in 1986, and effort increased to 86 vessels in 1987.

Harvest declines beginning in 1988 indicated potential stock conservation problems. The *Exxon Valdez* oil spill on March 24, 1989, complicated prosecution of the 1989 fishery in which 33 vessels harvested 29,315 lb. In 1990, the year-round harvest in the experimental area was discontinued, and this area was included with the traditional harvest area and the spring season was shortened. Also in 1990, a gear limit of 150 pots and mesh size restrictions to allow the escape of undersized shrimp were adopted. In 1991, a limited commercial fishery with a conservative guideline harvest range of 10,000–40,000 lb was closed after 46 days of fishing. The fishery yielded only 17,580 lb taken by 15 vessels in 45 landings. Fishery performance information from the 1991 fishery indicated low shrimp abundance. In 1994 the BOF lowered the GHR for PWS pot shrimp to 0–100,000 lb. The commercial fishery was closed by EO between 1992 and 1999, and in 2000 the BOF closed the fishery until the population rebuilt and

a new management plan was adopted. The fishery remained closed for a total of 18 years (1992–2009).

CURRENT FISHERY REGULATIONS

A new management plan for the PWS commercial shrimp pot fishery was adopted by the BOF in March of 2009 with small revisions to it in 2012. Specific regulations include the following:

1) A harvestable surplus of more than 110,000 lb must exist before a commercial harvest may occur.
2) 40% of the harvestable surplus is allocated to the commercial fishery.
3) The fishery occurs within the Inside District and is rotated on an annual basis between 3 different areas described in 5 AAC 31.210(a) (1), (2), and (3) (Figure 2).
4) ADF&G determines each season the number of shrimp pots that may be operated from a vessel based on total number of registered vessels, estimated catch per unit effort, and magnitude of the guideline harvest level, with the maximum number of allowable pots set at 100.
5) Shrimp pot gear may only be deployed and retrieved between the hours of 8:00 AM and 4:00 PM, unless modified by emergency order.
6) Stringent reporting regulations require all shrimp fishermen to contact ADF&G weekly, and additionally require catcher–sellers and catcher–processors to contact the department before landing, to provide all harvest information.
7) Shrimp pots deployed on a longline consisting of 5 or more pots must have a buoy marking each end.
8) No more than 25% of the guideline harvest level may be harvested from any one statistical area (adopted in 2012).

Statewide commercial shrimp regulations describe buoy marking, maximum tunnel size, and a biodegradable escape mechanism. Area shrimp pot regulations specify that a pot may not have more than one bottom, a vertical height of more than 24 inches, more than 4 tunnel eye openings, or a bottom perimeter exceeding 124 inches. Additionally, a shrimp pot must be entirely covered with net webbing or rigid mesh and at least 2 adjacent sides or 50% of the vertical or near vertical sides must be covered with net webbing or rigid mesh that allows the unaided passage of a seven-eighths inch diameter dowel. Although the PWS Area was originally designated a superexclusive registration area for vessels fishing for shrimp with pot gear, it was redesignated as an exclusive registration area at the 2012 BOF meeting when it was determined that superexclusive was not defined for shrimp fisheries and that exclusive met the same definition. A commissioner's permit is required to fish in the eastern area to allow monitoring of effort and catch with mandatory logbooks and ADF&G contact.

CURRENT FISHERY MANAGEMENT

The opening of the commercial fishery is dependent on the results of the surplus production model, described previously in the research section of this document. This model incorporates survey information and all commercial and noncommercial harvest from the previous year's fishery. This information is available in early February, when an announcement is made regarding whether or not the commercial fishery will occur. If a commercial fishery is to be prosecuted, registrations are then made available at area offices with a deadline of April 1. The registration deadline enables ADF&G to estimate effort in the fishery each season.

Immediately following the registration deadline, ADF&G sets gear limits and initial fishing periods based on the number of vessels registered relative to the GHL, expected CPUE, and likely participation. In 2010, gear limits were set at a maximum of 20 pots per vessel when 155 vessels registered for the fishery (Tables 3 and 4). In subsequent years, fewer vessels registered and even fewer vessels participated, and gear limits have varied accordingly. In 2013, the department began using inseason harvest and effort information to increase or decrease gear limits inseason when appropriate. Between 2010 and 2014, initial fishing periods varied between 4 days and 15 days. Short periods at the beginning of the fishery help to limit effort and harvest until the pace of the fishery is evident and management becomes more predictable. At this point, inseason reporting is sufficient for management goals to be met and the season can remain open to harvest.

Hours of gear operation have been consistently relaxed by EO to between 8:00 AM and 8:00 PM in order to allow fishermen to take advantage of the most favorable tide conditions to operate their gear (Table 3). In 2011, 2013, and 2014, the gear deployment hours were extended to 6:00 AM to 10:00 PM daily late in the season to increase gear efficiency by increasing soak time and allowing fishermen more time to relocate gear.

Stringent reporting requirements have allowed ADF&G to closely monitor harvest and effort. This facilitates meaningful inseason management decisions such as the closing of Copper Bay to commercial harvest during the 2012 season when a decline in CPUE was detected (Table 3).

The PWS pot shrimp fishery has been open for 5 seasons and conducted twice in Area 1 and Area 2, and once in Area 3. Certain trends have become apparent that are meaningful to management. Typically about 50% of the registered vessels participate each season. Effort is always highest during the first few periods of the fishery and then effort declines significantly by June. Area 1 has higher participation than Area 2, which has higher participation than Area 3; this may be due to distances from specific ports. Area 3 has lower catch rates compared to Area 1 and Area 2; a lower abundance is also shown in Area 3.

CURRENT FISHERY HARVEST AND EFFORT

The 2014 PWS commercial shrimp pot fishery was prosecuted in Area 2 and the GHL was set at 66,600 lb. A total of 68,464 lb of shrimp was harvested by 33 permit holders on 32 vessels in 214 landings, and the fishery closed by EO on August 14. Harvest composition was 64,220 lb spot shrimp (93.8%), 4,085 lb coonstripe shrimp (6.0%), and 158 lb sidestripe shrimp *Pandalopsis dispar* (0.2%; Table 4).

Guideline harvest levels in the PWS commercial shrimp pot fishery between 2010 and 2014 have varied between 51,240 lb (2012) and 66,600 lb (2014) (Table 4). The first year of the fishery had the highest vessel participation (75), with all other years having participation between 32 and 45 vessels. The majority of harvest and effort occurred during the first 6 weeks of the fishery with an average of 64% of total harvest (2010–2014) and 66% of total effort occurring by the end of May. Between 82% and 93% of the GHL was taken in the 2 years that the fishery occurred in Area 1 (2010 and 2013).The GHL was achieved in the 2 years the fishery occurred in Area 2 (2011 and 2014). In 2012, when the fishery occurred in Area 3, the season closed on July 15 because of a consistently low CPUE with only 42% of the GHL harvested. This low CPUE and the effort being widely spread geographically suggested that shrimp abundance throughout Area 3 was low compared to Areas 1 and 2. In 2015, the fishery is scheduled to occur in Area 3 again.

NONCOMMERCIAL FISHERY

HISTORY

The noncommercial shrimp pot fishery in PWS is composed of sport, personal use, and subsistence fisheries. The sport fishery for shrimp has been documented since 1994 by statewide harvest surveys (SWHS) and intermittently by harvest permit since 2002 (Marston and Brazil 2008). In 1999, the BOF established pot limits of 5 pots in order to maintain a modest fishery. In 2000, the Anton Anderson Memorial Tunnel opened to vehicle traffic, allowing many additional fishermen access to the PWS port of Whittier. Initial pot limits of 5 pots were set in order to maintain a modest noncommercial (sport, personal use, and subsistence) shrimp fishery in PWS, and authority was given to ADF&G to modify effort, area, and season to match trends in harvestable surpluses. SWHS were used from 2006 to 2008 to estimate noncommercial harvests during a time when no PWS commercial fisheries targeting shrimp were prosecuted. In March 2009, BOF adopted the *PWS Noncommercial Shrimp Fishery Management Plan* (5 AAC 55.055) that, among other things, allocated 60% to noncommercial users. Harvestable surplus is estimated annually prior to the start of the fishing season (April 15) with a surplus production model that requires more timely and precise estimates of noncommercial harvest than are provided by the SWHS. As such, it became necessary to reinstate the noncommercial shrimp permit prior to the start of the 2009 shrimp pot fishery season. In 2012 the BOF revisited the Shrimp Pot Management Plan and among other changes removed ADF&G's authority to modify pot limits (effort), area, or season in order to stabilize the rapidly developing fishery.

CURRENT FISHERY REGULATIONS

A management plan for the PWS noncommercial shrimp pot fishery was adopted by the BOF in March of 2009. Specific regulations include the following:

1) The guideline harvest level for shrimp taken by pot gear in noncommercial fisheries is calculated as 60% of the total allowable harvest for PWS.
2) Shrimp may be taken from April 15 to September 15.
3) A permit/harvest recording form is required to participate in the fishery.
    a. Fishermen must be in possession of permit at the time of harvest and must record harvest before leaving the fishing area or concealing shrimp.
    b. Permits must be returned to ADF&G by October 15.
4) There is no bag, possession, or size limit on shrimp.
5) No more than 5 pots per person and 5 pots per vessel may be used.

Statewide noncommercial shrimp regulations describe buoy marking, maximum tunnel size, and a biodegradable escape mechanism (5 AAC 02.010; 5 AAC 39.145; 5 AAC 75.035; 5 AAC 77.010). Additionally, as per PWS Area regulations, a shrimp pot must be entirely covered with net webbing or rigid mesh and at least 2 vertical adjacent sides or 50% of the vertical or near vertical sides must be covered with net webbing or rigid mesh that allows the unaided passage of a round wooden peg 12 inches long and seven-eighths inch in diameter (5 AAC 55.022.)

CURRENT FISHERY MANAGEMENT

Unlike the commercial shrimp fishery in PWS, there is no threshold of harvestable surplus that must be met in order for noncommercial shrimp fisheries to take place. Once the fishery begins, ADF&G does not specifically track or actively manage these fisheries inseason. Effort and

harvest in this fishery have stabilized so that, barring extremely low harvestable surplus estimates, overexploitation from noncommercial fisheries is not currently a concern. In the case of potentially low or no harvestable surpluses, ADF&G does have EO authority to close the fishery. In lieu of inseason management, ADF&G uses a permit/harvest record to estimate noncommercial harvest after the fishing season has concluded and monitors preseason estimates of harvestable surpluses to guide management decisions.

NONCOMMERCIAL SHRIMP PERMIT

Noncommercial fisheries in the state of Alaska are monitored by ADF&G with a variety of methods that include a postseason mail-out survey of all sport fish license holders (SWHS; e.g., Jennings 2011), onsite creel surveys, and harvest permits that require submittal of a postseason harvest report. The method used to monitor a particular fishery is based, in part, on the ability of the survey method to provide parameter estimates on a time scale and with a quality (precision and accuracy) that matches the needs of management. In general, ADF&G Division of Sport Fish relies on the SWHS to generate estimates of participation, catch, and harvest for most sport fisheries throughout the state. However, because estimates generated by the SWHS are not available to managers until after the following fishing season (e.g., 2013 estimates were not available until November 2014), the timeliness of SWHS estimates can be inadequate if inseason management is necessary or if estimation of the harvest level for one year is dependent on the harvest from the previous year (e.g., surplus production models). Additionally, several fisheries throughout the state allow users to harvest fish resources under personal use, subsistence, or sport fish designation, and although regulations for each user type are similar, harvest may not be recorded by SWHS (e.g., PWS noncommercial shrimp fishery) because subsistence users are not required to obtain a sport fish license prior to participation in these fisheries and therefore do not receive a sport fishing license associated the SWHS.

The PWS noncommercial shrimp permit (hereafter permit) requires all noncommercial users to report the date, location, duration, number of pots, and harvest of shrimp (gal) for each set of pot gear made throughout the fishing season (15 April–15 September). With these data, total effort and harvest is estimated (detailed below) and spatial distribution of effort and harvest is monitored. This report summarizes these data for the years 2002–2005 and 2010–2014.

Objectives

The objectives of the noncommercial PWS shrimp permit are as follows:

1) Estimate effort (pot days of effort) and harvest of shrimp in the PWS management area noncommercial shrimp fishery such that the estimate of total harvest is within 10% of the true value 95% of the time.
2) Monitor the spatial distribution of noncommercial effort and harvest of shrimp in PWS.

Methods

All noncommercial participants (i.e., personal use, subsistence, and sport fish) in PWS shrimp fisheries were required to obtain a permit (Appendix B) or be named on the permit of another household member. Permits were made available at major license vendors in the Anchorage, Seward, Valdez, and Whittier areas. Permits were also issued at ADF&G offices in Anchorage, Cordova, Fairbanks, Soldotna, and Homer and at Village Council offices in Tatitlek and Chenega. License vendors and ADF&G offices were required to return the top copy of the permit

to ADF&G, Division of Sport Fish, in Cordova. This "vendor copy" had the permit holder's name, sport license number (if sport or personal use), and address. The carbonless copy paper used for the permit allowed information from the "vendor copy" to be transferred to the second page (permitee's copy).

Permit holders were required to record on the permit their effort (number of pots and soak time), harvest (in gal of whole shrimp), and location of each set. Permit holders were also required to return their harvest records to Cordova ADF&G office by 15 October each year; permit holders that did so were considered "compliant." Permit holders who failed to return their permits by 7 November ("noncompliant") were mailed a reminder letter (Appendix C) on 15 November. Nonrespondents from the first reminder letter were mailed a second reminder letter in mid-December. Dates for mailing reminder letters allowed adequate time for permit holders to respond prior to subsequent reminder letters being mailed.

Vendors who failed to return their vendor copies were contacted at the end of the season and reminded of their obligation. Although this minimized the number of missing vendor copies, a portion of the vendor copies were not received each year. Permits returned with no corresponding vendor copy (i.e., the vendor did not return the vendor copy, but the permit holder did return the permit; these are hereafter referred to as "orphan permits") were used to estimate the total number of permits issued for that year. Specifically, orphan permits were assumed to have the same response rate as voluntarily returned permits for which a vendor copy was received. This response rate was then used to estimate the total number of orphan permits as follows:

$$\hat{N} = \frac{o}{\hat{p}} + M \,, \tag{1}$$

where

$\hat{N}$ = the total number of household permits issued,

o = the number of permits issued and returned by households before the first reminder letter, but with no vendor card ("orphan permits"), and

$\hat{p}$ = the response rate before the first reminder letter among households with vendor cards.

$\hat{p}$ was calculated as follows:

$$\hat{p} = \frac{m}{M},$$

where

a m = the number of permits with vendor cards, returned before the first reminder letter, and

M = the total number of permits with vendor cards.

Variance was estimated as follows:

$$\hat{V}\left[\hat{N}\right]=\left[\frac{o^2\hat{V}\left[\hat{p}\right]}{\hat{p}^4}\right], \tag{2}$$

where

$$\hat{V}\left[\hat{p}\right]=\left(\frac{\hat{p}(1-\hat{p})}{M-1}\right).$$

The estimated number of permits issued was then divided into 4 groups:

$$\hat{N} = N_{cf} + N_{cz} + \hat{N}_{df} + \hat{N}_{dz}, \tag{3}$$

where

N_{cf} = the number of compliant households who reported fishing,

N_{cz} = the number of compliant households who reported they did not fish,

$\hat{N}_{df}$ = the estimated number of noncompliant households who fished, and

$\hat{N}_{dz}$ = the estimated number of noncompliant households who did not fish.

$\hat{N}_{df}$ was estimated as follows:

$$\hat{N}_{df} = \left(\hat{N} - (N_{cf} + N_{cz})\right)\hat{w},$$

where

$\hat{w} = \frac{n_{df}}{n_d}$, and

n_d = the number of noncompliant households responding to the last reminder, and

n_{df} = the number of noncompliant households who responded to the last reminder and reported fishing.

$\hat{N}_{dz}$ was estimated as follows:

$$\hat{N}_{dz} = \hat{N} - (N_{cf} + N_{cz} + \hat{N}_{df}).$$

Information from returned permits (effort, harvest, location, and associated dates for each set of pot gear) was entered into a database. Occasionally, a permit holder ended up with 2 or more permits if the original permit was lost. Prior to mailing out reminder letters, all but one of the permits for a given individual was marked as "duplicate" in the database. If 2 copies of one permit were received (e.g., the person responded to 2 reminder letters), only the first response was entered into the database. An exception to this was if a person returned a permit, but then got a second permit and went fishing after the first was returned (identifiable because the dates of the harvest information on the second permit were after those on the first permit). In that case, the

record from the second permit was appended to the end of the first permit and the second permit was marked as a duplicate.

After all records were entered into the database, the records were screened for errors. Flagged records were checked by comparing the database information to the original permits. If the database accurately reflected what was written on a permit, then no changes were made. Errors were corrected and only those records that met all checks were placed in "corrected" database tables.

The database was scanned to identify and flag the following:

1) Incorrect areas (outside of PWS).
2) Permit records marked as "not returned" yet containing harvest data or having "true" entered in the "did not fish" field.
3) Permit records marked as duplicates, yet without a final replacement permit associated with them.
4) Permit records marked as duplicates, yet containing harvest or "did not fish" information (see 2 paragraphs above for final disposition of this information).
5) Permit records containing harvest data, or having "true" entered in the "did not fish" field, or marked as having no reported harvest, yet were not recorded as returned.
6) Permit records marked as "returned" but not marked as duplicates, yet containing no harvest data, no record of "true" under the "did not fish" field, nor a record of "no harvest reported."

Harvest and effort were estimated with the following general equation (for simplicity, subscripts denoting parameter of estimation [harvest or effort] are not shown):

$$\hat{H} = H_{cf} + \hat{H}_{df} \ , \tag{4}$$

where

$\hat{H}$ = estimated total harvest or effort,

H_{cf} = harvest or effort reported by compliant households, and

$\hat{H}_{df}$ = estimated harvest by noncompliant households.

$\hat{H}_{df}$ was estimated as follows:

$$\hat{H}_{df} = \hat{N}_{df} \overline{h}_{df} \ ,$$

where

$$\bar{h}_{df} = \frac{\left(\sum_{j=1}^{n_{df}} h_{dfj}\right)}{n_{df}},$$

which is the mean harvest or effort per household for noncompliant households that fished and where

h_{dfj} = reported harvest by household j that responded, was noncompliant and fished, and

n_{df} = the number of noncompliant households responding to the reminder mailings.

Variance was calculated as follows:

$$\hat{V}\left[\hat{H}\right] = \hat{V}\left[\hat{H}_{df}\right] = \hat{N}_{df}^2 \hat{V}\left[\bar{h}_{df}\right] + \bar{h}_{df}^2 \hat{V}\left[\hat{N}_{df}\right] - \hat{V}\left[\bar{h}_{df}\right]\hat{V}\left[\hat{N}_{df}\right], \quad (5)$$

where

$$\hat{V}\left[\hat{N}_{df}\right] = \hat{V}\left[\hat{N}\right]\hat{V}\left[\hat{w}\right] = \hat{N}^2 \hat{V}\left[\hat{w}\right] + \hat{w}^2 \hat{V}\left[\hat{N}\right] - \hat{V}\left[\hat{w}\right]\hat{V}\left[\hat{N}\right], \quad (6)$$

$$\hat{V}\left[\hat{w}\right] = \left(\frac{\hat{w}(1-\hat{w})}{n_d - 1}\right), \quad (7)$$

$$\hat{V}\left[\bar{h}_{df}\right] = \left(1 - \frac{n_{df}}{\hat{N}_{df}}\right)\frac{s_{df}^2}{n_{df}}, \quad (8)$$

and

$$s_{df}^2 = \frac{\sum_{j=1}^{n_{df}} \left(h_{dfj} - \bar{h}_{df}\right)^2}{n_{df} - 1}\ . \quad (9)$$

Shrimp harvest was then converted from gal of whole shrimp to lb of shrimp with the conversion factor of 3.89 lb/gal of whole shrimp (Maria Wessel, Division of Commercial Fisheries Biologist, ADF&G, Cordova; unpublished data). This conversion factor was reevaluated in 2012, and is substantially higher than estimates previously used in lb/gallon estimates. As a result, previously published harvests reported in lb were underestimated. Reported harvests in this report used this new and more reliable conversion factor of 3.89 lb/gal for all years.

In addition to the estimates of total harvest and effort, we calculated the catch per unit effort (CPUE) for selected statistical areas (Appendix C) with catch equal to lb of whole spot shrimp and effort equal to 1 pot soaked for 24 hr. We assumed that the proportional distribution of effort and harvest by nonrespondents was similar to that of respondents. Therefore, to calculate effort and harvest by statistical area, we multiplied the percentage of the total reported effort and harvest for each statistical area by the expanded estimate of total effort and harvest. Temporal

trends in effort, harvest, and CPUE were investigated for those statistical areas that support most of the noncommercial effort and harvest.

CURRENT FISHERY HARVEST AND EFFORT

The number of permits issued has increased from 717 permits issued in 2002, peaking in 2011 at 3,309, and has remained relatively stable since 2010, averaging just over 3,000 permits issued a year over the last 5 years (Table 5). Total effort and harvest concurrently increased each year from 2002 to 2010 and have also since stabilized and even shown some decline from 2011 to 2013 (Table 5). Generally, effort has increased from 19,387 pot days in 2002, peaking in 2010 to over 78,000 pot days, and has since decreased and stabilized, to an average of 49,957 pot days/year from 2012 to 2014. Effort in 2014 was just over 48,000 pot days. The relatively high peak of effort in 2010 is due to a temporary increase in pot limits from 5 pots to 8 pots that year. Total harvest in the noncommercial fishery increased from 19,387 lb in 2002, peaking in 2010 at 142,146 lb and leveling off from 2011 to 2014, where harvest levels have been relatively consistent with an average of 90,363 lb per year (Table 5).

Following the creation of a GHL for Prince William Sound shrimp fisheries in 2009, the noncommercial shrimp harvest exceeded the GHL for the first 4 years by a substantial but unknown amount (Table 5). This harvest above the GHL through 2012 was unknown due to a low estimated conversion factor of pounds of shrimp/gal. The underestimated harvests during those years were associated with the increase in pot limits in 2010. The conversion factor was reevaluated in 2012 based on an ADF&G study, and previous years' harvests were re-estimated based on this new conversion factor of 3.89 lb/gallon of shrimp (Maria Wessel, Commercial Fisheries Biologist, ADF&G, Cordova; unpublished data). Additionally in 2012, the BOF removed ADF&G's authority to modify effort, season, and area in the noncommercial fishery. Subsequently, 2013 and 2014 noncommercial shrimp harvests averaged 86% and 89% of the noncommercial GHL (Table 5).

The spatial distribution of effort (Table 6) and harvest (Table 7) in the noncommercial fisheries has remained relatively constant since 2002. The statistical areas of PWS that support most of the reported noncommercial effort (Table 6) and harvest (Table 7) are the waters nearest Valdez (466100), Whittier (486033), Port Wells (486034), Unakwik Inlet (476036 and 476101), and Port Nellie Juan (486031 and 486003). The Whittier and Valdez statistical areas have supported on average 69% (range = 55%–74%) and 55% (range = 49%–59%) of the total annual reported effort and harvest, respectively, with no detectable trend across years. In general, CPUE within the noncommercial fishery has remained stable since 2009 and reached its peak in 2014 (Figure 4). CPUE in the areas with the most harvest and effort (Whittier and Valdez) have remained consistent since 2009 (Figure 5). In Port Wells and Unakwik, fishery CPUE have been more variable, but have stabilized in general since 2011 (Figure 5). Port Nellie Juan CPUE show very similar trends to total PWS effort and harvest, decreasing consistently but at a diminishing rate since 2010 (Figure 5). It is likely that the observed patterns in fishery CPUE are driven by a combination of shrimp abundance and variability in fisherman efficiency. However, the relative contribution of shrimp abundance and fisherman efficiency towards explaining trends in fishery CPUE cannot be discerned from the permit data.

REFERENCES CITED

Bechtol, W. R. 1997. Changes in forage fish populations in Kachemak Bay, Alaska, 1976-1995. Pages 441-455 [*In*]: Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report 97-01. University of Alaska, Fairbanks.

Haddon, M. 2011. Modelling and quantitative methods in fisheries, second edition. CRC Press, Boca Raton, FL.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2011. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2010. Alaska Department of Fish and Game, Fishery Data Series No. 11-60, Anchorage.

Kimker, A., W. Donaldson, and W. R. Bechtol. 1996. Spot shrimp growth in Unakwik Inlet, Prince William Sound, Alaska. Alaska Fishery Research Bulletin 3(1):1-8.

Marston, B. H., and C. E. Brazil. 2008. Area management report for the recreational fisheries of Prince William Sound, 2007. Alaska Department of Fish and Game, Fishery Management Report No. 08-55, Anchorage.

Trowbridge, C. 1992. Injury to Prince William Sound spot shrimp. Final report for *Exxon Valdez* Oil Spill State/Federal NRDA Subtidal Study No. 5.

Trowbridge, C. 1994. Spot shrimp, *Pandalus platyceros*, surveys in the Prince William Sound Management Area, 1989–1993. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A94-31, Anchorage.

TABLES AND FIGURES

Table 1.–Prince William Sound total allowable harvests (TAH), guideline harvest levels (GHL), and harvests in commercial and noncommercial shrimp pot fisheries, 2010–2014.

		GHL (lb)		Shrimp Harvest (lb)			% of
Year	TAH (lb)	Noncommercial	Commercial	Noncommercial	Commercial	Total	TAH
2010	137,500	82,500	55,000	142,146	45,349	187,495	139
2011	131,900	79,140	52,760	95,924	52,694	148,618	113
2012	128,100	76,860	51,240	90,385	21,561	111,946	87
2013	165,750	99,450	66,300	85,988	61,644	147,631	89
2014	166,500	99,900	66,600	89,155	68,464	157,619	95

Table 2.–Prince William Sound spot shrimp survey results, 1992–2014.

	Number of	Catch	Average	Number of	Percent		
Year	Pots	Weight (lb)	lb/Pot	Shrimp	Male	Female	Egg Bearing
1992	349	249	0.71	5009	88.2	11.8	11.4
1993	325	121	0.37	2434	80.6	19.4	19
1994	355	145	0.41	4128	95.1	4.9	4.7
1995	350	206	0.59	5053	95.7	4.3	3.9
1996	350	182	0.52	4618	94.9	5.1	NA
1997	345	142	0.41	3835	94.1	5.9	5.6
1998	264	76	0.29	2252	94.6	5.4	5.3
1999 [a]	346	165	0.48	4392	94.3	5.7	5.6
2000	349	245	0.7	6545	95.1	4.9	4.7
2001	351	331	0.94	7034	92.7	7.3	7.3
2002 [b]	304	377	1.24	8797	91	9	8.9
2003	352	398	1.13	9333	92	8	8
2004	352	502	1.43	12,593	91.5	8.5	8.3
2005	349	481	1.38	14,453	95	5	4.7
2006	346	553	1.6	14,203	91.6	8.4	7.7
2007	349	838	2.4	24,152	94.2	5.8	4.8
2008	348	893	2.56	23,004	93.4	6.6	5.4
2009	351	825	2.35	17,622	86.2	13.8	12.1
2010	350	478	1.37	8,585	81.8	18.2	17
2011	350	687	1.96	11,627	74.8	25.2	24.9
2012	392	834	2.13	15,928	84.7	15.3	13.9
2013	392	744	1.9	14,453	85.7	14.3	12.5
2014	393	752	1.91	16,051	89.2	10.8	10.1

Note: NA = Data not available.

[a] Sex data interpolated for 452 lost data points.

[b] Sex data interpolated for 192 lost data points.

Table 3.–Prince William Sound shrimp pot fishery emergency orders (EOs) 2010–2014.

Emergency order	Effective date	Explanation
		2014 Calendar Year
2-SF-E-01-14	4/15/14	Established first commercial fishing period 8:00 AM April 15 – 8:00 PM April 24, set maximum gear limit at 40 pots per vessel, and set hours of gear operation 8:00 AM to 8:00 PM
2-SF-E-02-14	4/29/14	Set second commercial fishing period 8:00 AM April 29 – 8:00 PM May 8 and increased gear limit to 50 pots per vessel
2-SF-E-03-14	5/13/14	Set third commercial fishing period 8:00 AM May 13 – 8:00 PM May 22.
2-SF-E-04-14	5/27/14	Set fourth commercial fishing period 8:00 AM May 27 – 8:00 PM September 15 unless closed earlier by EO, and closed statistical area 486034 at 8:00 PM June 9.
2-SF-E-06-14	6/14/14	Extended hours of gear operation to 6:00 AM to 10:00 PM daily.
2-SF-E-08-14	8/14/14	Closed commercial shrimp pot fishery for the 2014 season.
		2013 Calendar Year
2-SF-E-01-13	4/15/13	Established first three commercial fishing periods 8:00 AM April 15 – 8:00 PM April 18, 8:00 AM April 22 – 8:00 PM April 25, and 8:00 AM April 29 – 8:00 PM May 2, set the maximum gear limit at 30 pots per vessel, and closed statistical area 476036 to commercial harvest after 8:00 PM April 18.
2-SF-E-02-13	4/29/13	Increased the maximum gear limit to 40 pots, opened statistical area 476036 to commercial harvest, and set a fourth commercial fishing period beginning May 6 2013 – 8:00 PM September 15 unless closed earlier by EO.
2-SF-E-03-13	5/6/13	Closed statistical area 476036 to commercial harvest.
2-SF-E-04-13	6/12/13	Increased the maximum gear limit to 50 pots and extended the hours of gear operation to between 6:00 AM and 10:00 PM
2-SF-E-07-13	8/26/13	Closed statistical area 476101 for the 2013 season.
		2012 Calendar Year
2-SF-E-01-12	4/15/12	Established first fishing period 8:00 AM April 15 – 8:00 PM April 29, established hours of gear operation between 8:00 AM and 8:00 PM, and set the maximum gear limit at 50 pots per vessel.
2-SF-E-02-12	4/29/12	Extended the first fishing period from 8:00 PM April 29 – 8:00 PM September 15 unless closed earlier by EO.
2-SF-E-04-12	6/14/12	Closed the waters of Copper Bay to commercial harvest.
2-SF-E-05-12	7/15/12	Closed the commercial shrimp pot fishery for the 2012 season.
		2011 Calendar Year
2-SF-E-01-11	4/15/11	Established first fishing period 8:00 AM April 15 – 8:00 PM April 19, set maximum gear limit at 40 pots per vessel, and set hours of gear operation 8:00 AM to 8:00 PM
2-SF-E-02-11	4/23/11	Established second commercial fishing period for 8:00 AM April 23 – 8:00 PM April 29.
2-SF-E-03-11	5/4/11	Established third commercial fishing period for 8:00 AM May 4 – 8:00 PM May 18.
2-SF-E-04-11	5/22/11	Established fourth commercial fishing period for 8:00 AM May 22 – 8:00 PM June 19.
2-SF-E-05-11	6/19/11	Extended fourth commercial fishing period indefinitely.
2-SF-E-07-11	7/2/11	Extended hours of gear deployment from 6:00 AM to 10:00 PM daily.
2-SF-E-08-11	7/29/11	Closed Prince William Sound commercial shrimp pot fishery for the 2011 season.

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Table 3.−Page 2 of 2.

Emergency Order	Effective Date	Explanation
		2010 Calendar Year
2-SF-E-01-10	4/15/10	Increased subsistence pot limit to eight per person with a maximum of eight per vessel.
2-SF-E-02-10	4/15/10	Increased personal use pot limit to eight per person with a maximum of eight per vessel.
2-SHR-6-03-10	4/15/10	Increased sport pot limit to eight per person with a maximum of eight per vessel.
2-SF-E-03-10	4/15/10	Established commercial fishing period 8:00 AM April 15 – 4:00 PM April 18 and set maximum gear limit at 20 pots per vessel.
2-SF-E-04-10	4/24/10	Established second commercial fishing period 8:00 AM April 24 – 8:00 PM April 29and extended hours of gear operation from 8:00 AM to 8:00 PM
2-SF-E-05-10	5/1/10	Established third commercial fishing period 8:00 AM May 1– 8:00 PM May 7.
2-SF-E-06-10	5/7/10	Extended third commercial fishing period 8:00 PM May 7 – 8:00 PM May 14.
2-SF-E-07-10	5/14/10	Extended third commercial fishing period 8:00 PM May 14 – 8:00 PM May 21.
2-SF-E-08-10	5/21/10	Extended third commercial fishing period 8:00 PM May 21 – 8:00 PM June 4.
2-SF-E-10-10	6/4/10	Extended third commercial fishing period 8:00 PM June 4 – 8:00 PM September 15 unless closed earlier by EO

Table 4.–Prince William Sound commercial shrimp pot fishery guideline harvest levels (GHL), effort, gear limits, harvest, and catch per unit effort (CPUE), 2010–2014.

			Effort		Gear limits		Shrimp harvest (lb)				CPUE
Year	Area	GHL (lb)	Vessel count	Pot lifts	Open	Close	Spot	Coonstripe	Other	Total	(lb/pot)
2010	1	55,000	75	18,025	20	20	45,076	263	10	45,349	2.52
2011	2	52,760	45	29,580	40	40	51,302	1,204	44	52,550	1.78
2012	3	51,240	35	19,644	50	50	18,097	3,428	36	21,561	1.10
2013	1	66,300	43	34,804	30	50	59,376	2,266	2	61,644	1.77
2014	2	66,600	32	41,027	40	50	64,220	4,085	158	68,464	1.67

Table 5.–Number of permits issued, reporting rate, total pot days of effort, total harvest of whole spot shrimp, catch per unit effort (CPUE), and the total number of lost pots by year in the noncommercial pot shrimp fishery, Prince William Sound.

			Estimates using conversion factor known at the time [a]		Estimates using current conversion factor (3.89lb./gal) [a]			
Year	Permits issued	GHL [a]	Harvest (lb) [a]	% of GHL (known) [a]	Effort (pot days)	CPUE	Harvest (lb)	% of GHL
2002	717		9,288[b]		19,387	0.78	15,054	
2003	1,061		13,965 [b]		24,094	0.94	22,635	
2004	1,649		25,694 [b]		30,694	1.36	41,645	
2005	2,112		31,950 [b]		37,271	1.39	51,785	
2009	2,733	57,900 [b]	56,120 [b]	97%[b]	47,631	1.91	90,961	
2010	3,181	82,200 [b]	87,699 [b]	107% [b]	78,083	1.82	142,146	
2011	3,309	79,200 [b]	59,182 [b]	75% [b]	56,543	1.70	95,924	
2012	3,098	76,860 [b]	55,765	73% [b]	52,620	1.72	90,385	
2013	3,101	99,500	85,988	86%	48,967	1.76	85,988	86%
2014	3,134	100,000	89,155	89%	48,283	1.85	89,155	89%
5 year average	3,165	87,552	75,558 [b]	86%	56,899	1.77	100,720	NA
Average (2012–2014)	3,111	92,120	76,969 [b]	83%	49,957	1.77	88,509	88% [c]

Note: For the years 2006–2008, permits were not required for noncommercial shrimp harvests in PWS. Harvest data for these years are not comparable and therefore are not included here. CPUE is catch per unit of effort and GHL is guideline harvest level.

[a] From 2002 to 2012, a conversion factor of 2.4lb/gallon of shrimp was used to estimate harvest in pounds. In late 2012, this conversion factor was re-evaluated and set at 3.89 lb/gallon based on ADF&G study (Maria Wessel, Commercial Fisheries Biologist, ADF&G, Cordova; unpublished data.)

[b] These numbers were produced with incorrect conversion factor of 2.4 lb/gallon.

[c] Represents the 2 years since the previous BOF meeting (2013 and 2014) under current regulations and where the updated conversion factor of 3.89 gal/lb were used.

Table 6.–Contribution of selected statistical areas to total effort expended in the noncommercial shrimp fishery in Prince William Sound by year.

	2002		2003		2004		2005	
Name / Statistical Area	Pot Days	%	Pot Days	%	Pot Days	%	Pot Days	%
Whittier Vicinity / 486033	4,459	23%	7,710	32%	5,832	19%	10,436	28%
Valdez Arm / 466100	9,694	50%	8,192	34%	14,119	46%	15,281	41%
S. Port Wells / 486034	1,745	9%	1,928	8%	2,456	8%	2,982	8%
Unakwik Inlet / 476036, 476101	582	3%	964	4%	1,535	5%	2,236	6%
Port Nellie Juan 486031, 486003	1,551	8%	2,891	12%	3,376	11%	2,236	6%
All other areas [a]	1,357	7%	2,409	10%	3,376	11%	4,100	11%
Total	19,387		24,094		30,694		37,271	

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	2009		2010		2011		2012		2013		2014	
Name / Statistical Area	Pot Days	%	Pot Days	%	Pot Days	%	Pot Days	%	Pot Days	%	Pot Days	%
Whittier Vicinity / 486033	13,337	28%	24,987	32%	17,770	31%	20,956	40%	15,521	32%	18,348	38%
Valdez Arm / 466100	20,958	44%	32,795	42%	22,475	40%	17,713	34%	11,264	23%	14,002	29%
S. Port Wells / 486034	3,334	7%	5,466	7%	3,630	6%	3,434	7%	3,667	7%	3,863	8%
Unakwik Inlet / 476036, 476101	2,382	5%	3,123	4%	3,354	6%	3,467	7%	2,267	5%	3,380	7%
Port Nellie Juan 486031, 486003	2,382	5%	3,123	4%	3,317	6%	2,841	5%	3,425	7%	2,414	5%
All other areas [a]	5,239	11%	8,589	11%	5,997	11%	4,209	8%	12,823	26%	6,277	13%
Total	47,631		78,083		56,543		52,620		48,967		48,283	

Note: For the years 2006–2008, permits were not required for noncommercial shrimp harvests in PWS. Harvest data for these years are not comparable and therefore are not included here

[a] Each of the remaining 24 statistical areas where noncommercial shrimp harvest was reported contributed on average less than 5% to the total reported shrimp effort on any given year.

Table 7.–Contribution of selected statistical areas to total harvest of whole shrimp in the noncommercial fishery in Prince William Sound by year.

	2002		2003		2004		2005	
Name / Statistical Area	lb	%	lb	%	lb	%	lb	%
Whittier Vicinity / 486033	2,627	17%	5,908	26%	7,790	19%	14,134	27%
Valdez Arm / 466100	6,302	42%	6,181	27%	15,697	38%	13,765	27%
S. Port Wells / 486034	1,835	12%	2,908	13%	3,658	9%	5,376	10%
Unakwik Inlet / 476036, 476101	1,012	7%	2,199	10%	4,522	11%	8,453	16%
Port Nellie Juan 486031, 486003	1,850	12%	3,676	16%	5,838	14%	4,694	9%
All other areas [a]	1,428	9%	1,763	8%	4,140	10%	5,363	10%
Total	15,054		22,635		41,645		51,785	

-continued-

Table 7.–Page 2 of 2.

	2009		2010		2011		2012		2013		2014	
Name / Statistical Area	lb	%	lb	%	lb	%	lb	%	lb	%	lb	%
Whittier Vicinity / 486033	27,459	30%	48,071	34%	33,036	34%	35,410	39%	29,552	34%	33,879	38%
Valdez Arm / 466100	22,856	25%	31,101	22%	19,836	21%	15,588	17%	12,495	15%	14,265	16%
S. Port Wells / 486034	11,325	12%	21,515	15%	9,197	10%	9,493	11%	8,402	10%	9,807	11%
Unakwik Inlet / 476036, 476101	11,719	13%	12,307	9%	14,842	15%	14,856	16%	7,574	9%	15,156	17%
Port Nellie Juan 486031, 486003	6,879	8%	12,917	9%	9,591	10%	7,375	8%	7,741	9%	5,349	6%
All other areas [a]	10,723	12%	16,235	11%	9,422	10%	7,663	8%	20,224	24%	10,699	12%
Total	90,961		142,146		95,924		90,385		85,988		89,155	

Note: For the years 2006–2008, permits were not required for noncommercial shrimp harvests in PWS. Harvest data for these years are not comparable and therefore are not included here

[a] Each of the remaining 24 statistical areas where noncommercial shrimp harvest was reported contributed on average less than 5% to the total reported shrimp harvest on any given year.

Figure 1.–Prince William Sound shellfish management districts and sections.

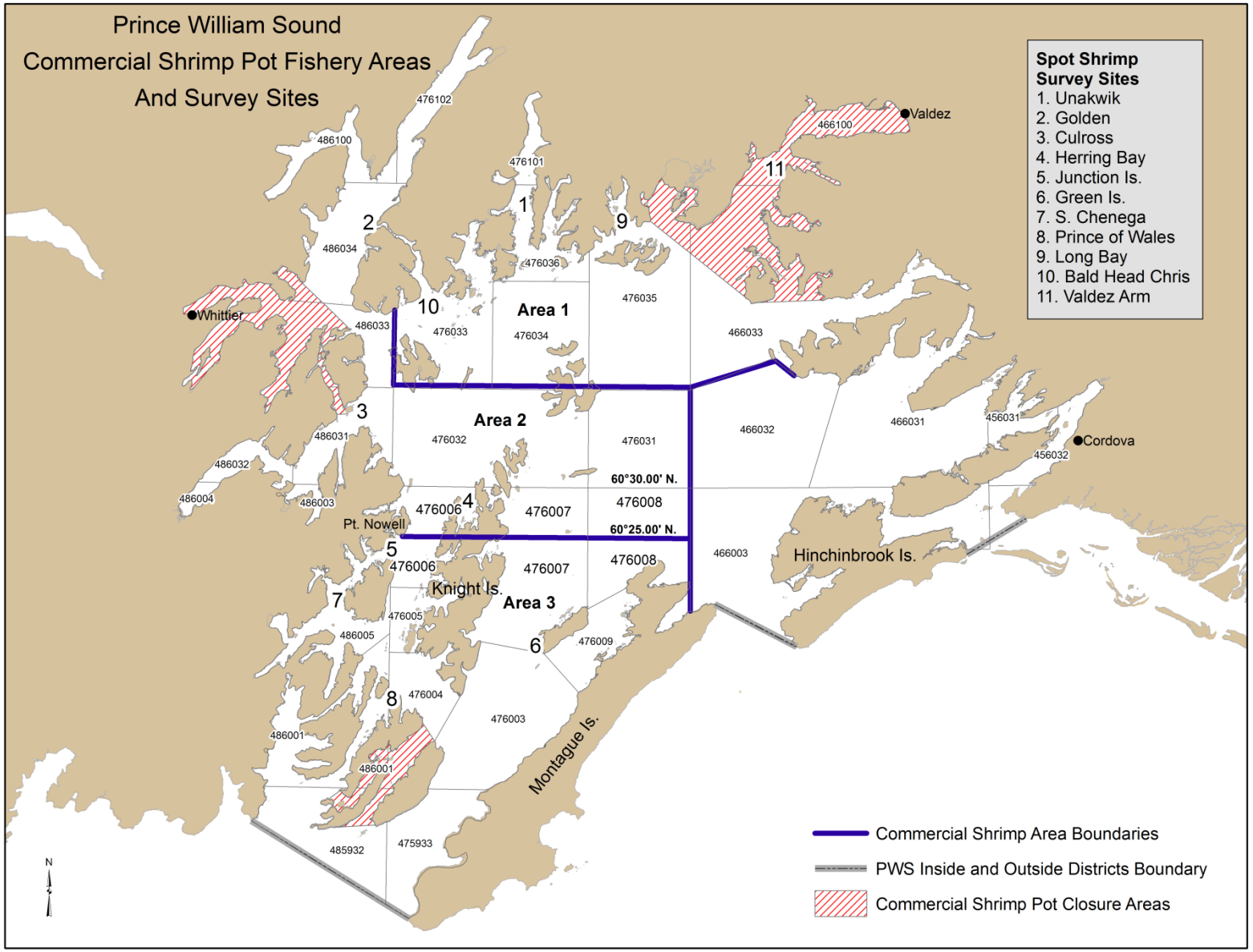

Figure 2.–Prince William Sound management areas and index survey sites for spot shrimp.

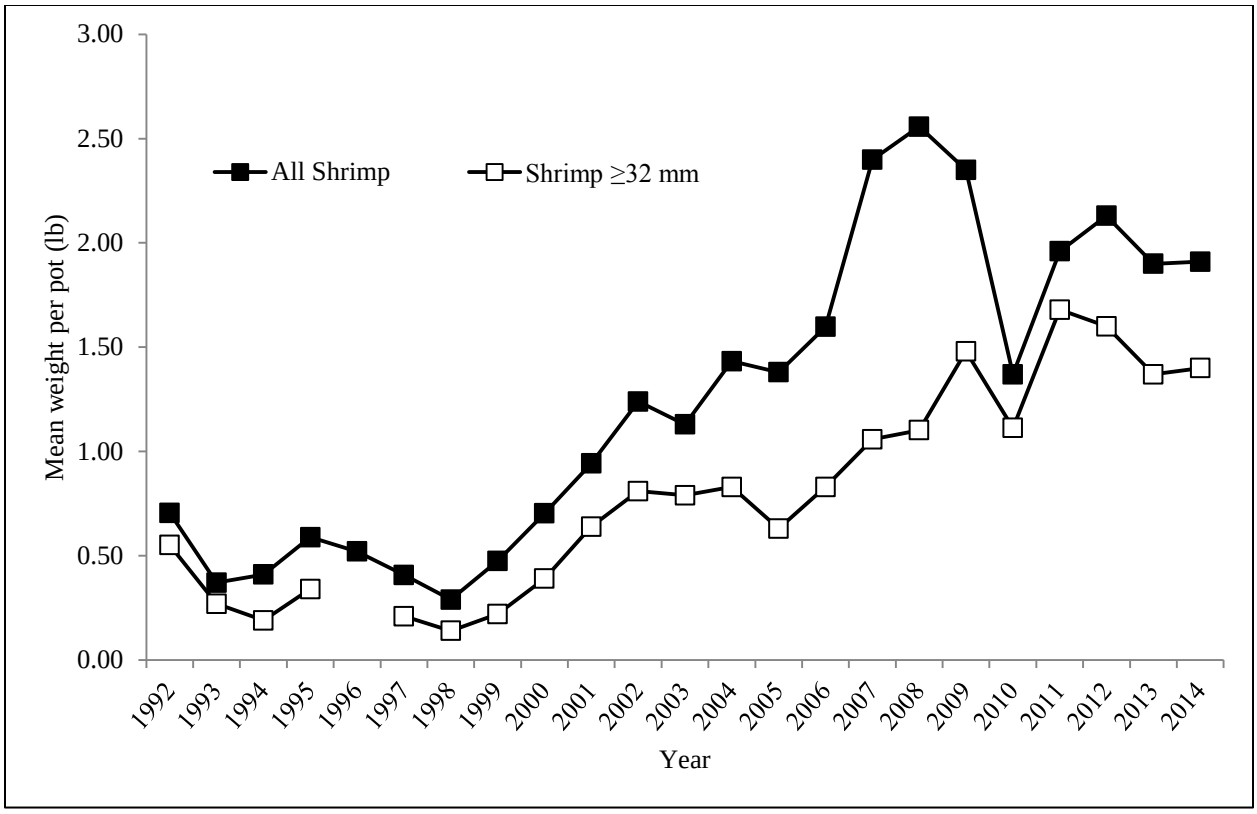

Figure 3.–Prince William Sound spot shrimp survey mean (average) weight of all spot shrimp and commercially marketable spot shrimp per pot (those equal to or greater than 32 mm in carapace length).

Note: Data for spot shrimp 32 mm and greater not available for 1996.

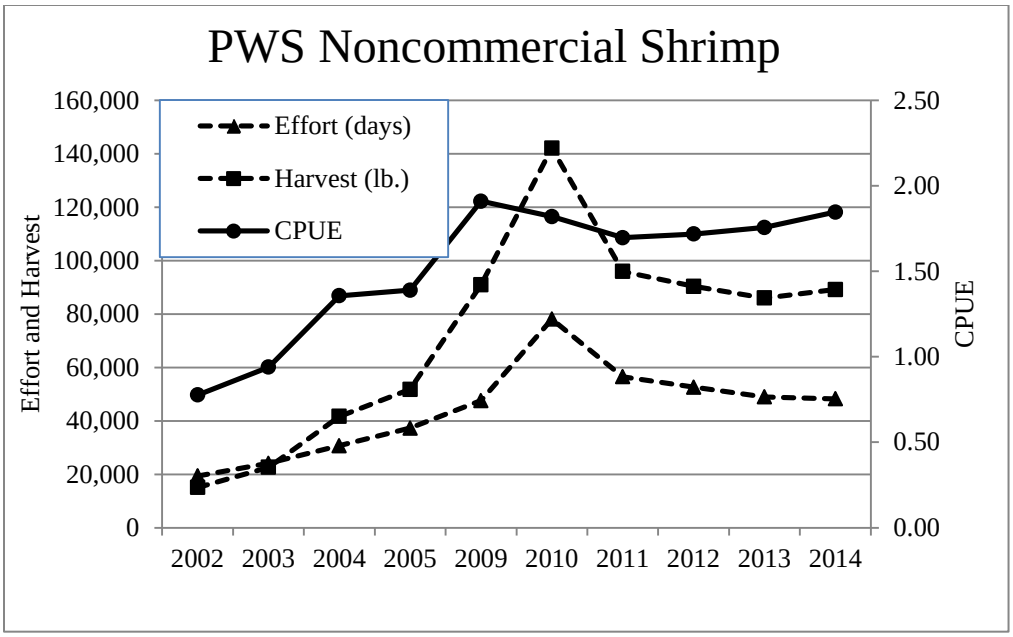

Figure 4.–Total estimated harvest, effort, and catch per unit effort (lb of whole shrimp caught in 1 pot soaked for 24 hr; CPUE) in the noncommercial pot shrimp fishery of Prince William Sound.

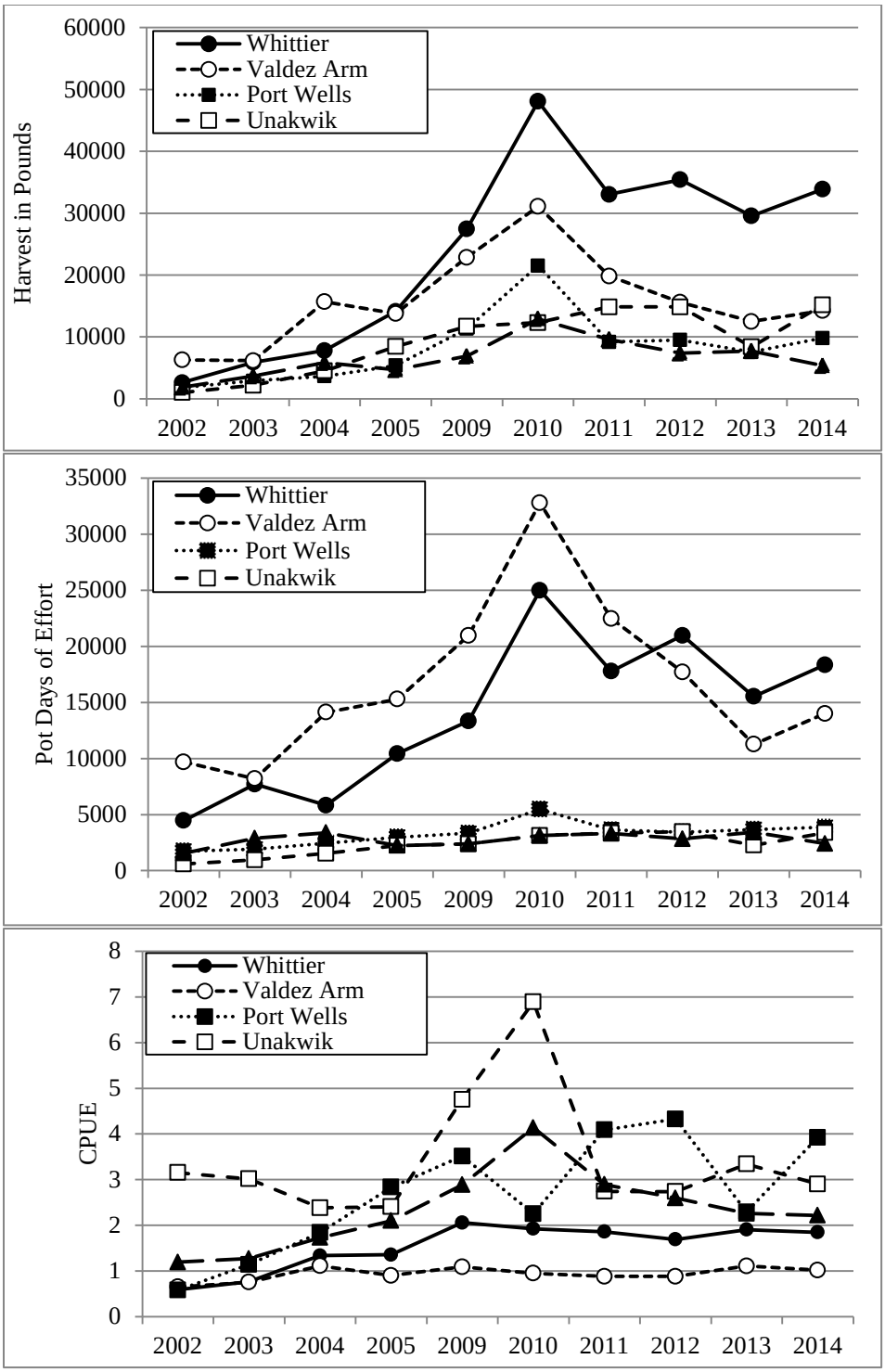

Figure 5.–Harvest, effort, and catch per unit effort (lb of whole shrimp caught in 1 pot soaked for 24 hr; CPUE) at the 5 statistical areas that support the majority of effort and harvest in the noncommercial pot shrimp fishery of Prince William Sound.

APPENDIX A: PRINCE WILLIAM SOUND COMMERCIAL SHRIMP POT FISHERY HARVEST 1960–1991

Appendix A.–Prince William Sound commercial shrimp pot fishery effort and harvest, 1960–1991.

Year	Vessels	Landings	Weight (lb) [a]			
			Spot	Coonstripe	Other	Total
1960						4,988
1961						–
1962						3,576
1963						1,101
1964						4,248
1965						4,356
1966						–
1967						749
1968						6,866
1969						5,146
1970						19,776
1971						13,073
1972						6,949
1973						6,370
1974						24,978
1975						4,150
1976						2,410
1977						7,516
1978	9	17				15,466
1979	17	98				52,208
1980	23	155	84,787	5,174	67	90,028
1981	51	509	153,017	20,055	465	173,537
1982	57	397	205,746	7,250	784	213,781
1983	71	646	198,719	14,119	583	213,420
1984	79	513	198,729	7,911	640	207,280
1985	78	528	271,928	3,919	860	276,707
1986	80	540	286,105	3,715	812	290,632
1987	86	498	265,707	3,795	151	269,653
1988	76	433	191,630	764	48	192,442
1989	33	69	28,884	431	0	29,315
1990	23	59	36,378	358	0	36,737
1991	15	45	17,302	278	0	17,580
1992-2009			Fishery Closed			

[a] Catches converted from tail weight to whole weight using a conversion factor of 2.0.

APPENDIX B: SHRIMP PERMIT

Appendix B.–Copy of noncommercial shrimp permit.

Alaska Department of Fish & Game

00000

2014 Prince William Sound Shrimp Permit

☐ replacement for lost original

Last Name | First Name | Initial

◯ Alaska Resident
◯ Non-Resident

Mailing Address | Sport Fishing License # (sport and personal use only)

City | State | Zip Code | Phone Number | Driver's License # | State

Names Of Other Household Members

This permit is valid for the period April 15th - September 15th, 2014

- **You must have this permit with you while taking shrimp** in the waters of Prince William Sound (from Cape Fairfield to Cape Suckling).
- Your first initial, last name, address and the name or Coast Guard number of the vessel used to operate the pots must be marked on a keg or buoy attached to your pots. Adding your phone number to buoys is also recommended.
- This permit may be used by all household members named on it. A household member may also obtain his or her own permit. If multiple members of household harvest shrimp on the same day please make sure to report the total household harvest on only ONE of the permits.
- If you share pots with a friend or relative, be careful to report each harvest on only ONE permit.
- Harvest information must be recorded in ink below prior to leaving the fishing site or concealing the shrimp from view.
  Please continue on another piece of paper if you need more lines to report your harvest.
- Submit your hard copy permit by mail using the pre-addressed form on reverse, OR scan it and e-mail to:

  dfg.pws.shrimp@alaska.gov

- **Your copy of this permit must be returned by October 15th, 2014 even if you did not fish.**

Permit Holder Signature | Date | Vendor | Vendor Signature

VENDOR INSTRUCTIONS

Issuing a permit:

1. The applicant should fill out the top portion of the permit, including the names of other household members who will fish with this permit. Review the information for legibility and accuracy. Verify that the applicant has signed the permit and written today's date.
2. Write in your vendor number and sign your name.
3. Vendors are responsible for verifying that ALL identifying information on this form is complete. Unless optional, DO NOT let applicant leave any blank spaces. DO NOT allow people to walk out with blank permits.
4. If you mess up a permit, **do not throw it out**. Simply write "VOID" on the permit and add it to your stack for return to Cordova Fish & Game.
5. You keep the top (white) copy to mail back to us weekly. The permit holder gets the bottom copy.
6. Return your top copies **each week** to Cordova Fish and Game in the envelopes provided. If you run out of envelopes, send all issued permits and voided permit forms to:

   STATE OF ALASKA
   DEPARTMENT OF FISH & GAME
   PRINCE WILLIAM SOUND SHRIMP PERMITS
   PO BOX 669
   CORDOVA, AK 99574-0669

   Weekly return of your copies is CRITICAL!

7. All vendor copies of issued permits and any remaining unissued or voided permit forms must be returned after the fishery closes or by October 15th, 2014.

Questions? Call the Anchorage Sport Fish Information Center at (907) 267-2218.

-continued-

Alaska Department of Fish & Game

00000

2014 Prince William Sound Shrimp Permit

☐ replacement for lost original

Last Name | First Name | Initial

◯ Alaska Resident
◯ Non-Resident

Mailing Address | Sport Fishing License #

sport and personal use only

City | State | Zip Code | Phone Number | Driver's License # | State

Names Of Other Household Members

This permit is valid for the period April 15th - September 15th, 2014

- **You must have this permit with you while taking shrimp** in the waters of Prince William Sound (from Cape Fairfield to Cape Suckling).
- Your first initial, last name, address and the name or Coast Guard number of the vessel used to operate the pots must be marked on a keg or buoy attached to your pots. Adding your phone number to buoys is also recommended.
- This permit may be used by all household members named on it. A household member may also obtain his or her own permit. If multiple members of household harvest shrimp on the same day please make sure to report the total household harvest on only ONE of the permits.
- If you share pots with a friend or relative, be careful to report each harvest on only ONE permit.
- Harvest information must be recorded in ink below prior to leaving the fishing site or concealing the shrimp from view.
  Please continue on another piece of paper if you need more lines to report your harvest.
- Submit your hard copy permit by mail using the pre-addressed form on reverse, OR scan it and e-mail to:

  dfg.pws.shrimp@alaska.gov

- **Your copy of this permit must be returned by October 15th, 2014 even if you did not fish.**

Permit Holder Signature | Date | Vendor | Vendor Signature

Was this permit used to set shrimp pots in 2014? ◯ YES ◯ NO **Number of lost shrimp pots:**

	DATE		LOCATION FISHED	NUMBER OF POTS FISHED	TIME SOAKED	WHOLE SHRIMP HARVESTED
	MM	DD	Bay or Headland	Pots	Hours	Gallons
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						

Report each day you shrimped and record your harvest, even if you did not catch anything.

-continued-

use tape here: do not staple

PLACE FIRST-CLASS POSTAGE HERE

IMPORTANT:
Return this permit to Fish and Game by October 15th, 2014 even if you did not fish.

use tape here: do not staple

use tape here: do not staple

STATE OF ALASKA
DEPARTMENT OF FISH & GAME
PRINCE WILLIAM SOUND SHRIMP PERMITS
P O BOX 669
CORDOVA, AK 99574-0669

fold here

Summary of regulations	Sport	Personal Use	Subsistence
Alaska residency required?	No	Yes	Yes
Fishing license required?	Yes	Yes	No
Open season?	April 15 - September 15		
Bag limit?	none		
Number of pots allowed?	Maximum 5 pots per person, with a maximum of 5 pots per vessel		
Open areas?	All salt waters of PWS	All salt waters of PWS	All salt waters of PWS (except "Valdez non-subsistence area", see below)
Can keep finfish?	No		
Can keep crab?	No		
Can keep octopus?	Yes		
Can buy, sell or trade shrimp?	No		

The Alaska Board of Fisheries has defined an area of Prince William Sound that is within the Valdez city limits as "non-subsistence" (described in 5 AAC 24.100 as of March 1993). See map online:

http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.nonsub_detail&area=Valdez

Summary Of Shrimp Pot Regulations

1. Each keg or buoy must have the name of the fisher (first initial, last name) the address, and the name or AK number of the boat used to fish the pots. Phone numbers are also recommended.
2. Two vertical sides of all shrimp pots must be entirely made of webbing big enough to allow a 7/8-inch round wooden dowel to go through without stretching or otherwise deforming the opening. The two vertical sides must touch each other. The webbing on these two sides cannot be covered by anything. The other two sides, as well as the top and bottom, can be composed of any material. The 7/8-inch size allows undersized and juvenile shrimp to escape.
3. A pot with no definable sides, such as a round pot, must have 50% of its vertical surface area covered with the 7/8-inch webbing. The other 50% of the vertical sides, as well as the top and bottom, may be composed of any material.
4. The 7/8-inch requirement does not apply to the tunnels.

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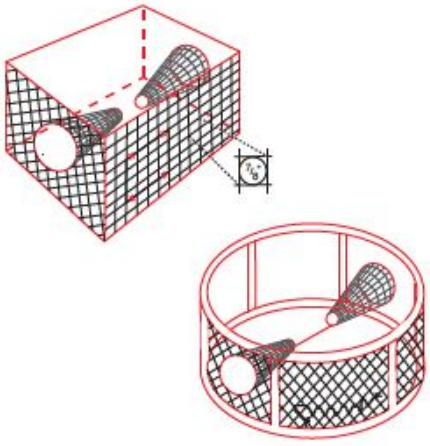
Escape Mechanisms

Rigid mesh pots: Each pot must have an opening at least four (4) inches square with its lower edge within six (6) inches of and parallel to the bottom of the pot. This opening may be covered with a single panel secured with no more than four (4) single loops of 100% untreated cotton twine no larger than 30-thread. Each single loop of cotton twine may contain only one knot. Cotton twine fastenings may not be looped or laced along the edges of the opening. The panel must be attached in such a manner that when the cotton twine degrades the panel will drop away leaving the opening fully exposed.

Net mesh pots and pots with no definable sides: Each pot must have an opening at least six (6) inches long on one sidewall. The opening must be within six (6) inches from the bottom of the pot. The opening must be parallel to the bottom of the pot. To lace the opening together, you must use 100% untreated cotton twine no larger than 30-thread. Knots may be used only at each end of the opening, not in the middle. The twine cannot be tied to or looped around the web bars.

If a pot is lost, the 100% cotton twine will degrade and allow shrimp to escape.

- See the most recent Southcentral Sport Fishing Regulations for more complete descriptions of shrimp pots and required escape mechanisms.



APPENDIX C: REMINDER LETTER

Appendix C.–Copy of reminder letter sent to nonrespondent permit holders.

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
Division of Sport Fish

Bill Walker, GOVERNOR

PO Box 669
Cordova, AK 99574
PHONE: (907) 424-3213

January 6, 2015

To: John Doe
12345 E 21st St
Anchorage, K 99212-6408

From: Mike Thalhauser, Area Biologist, Anch/NGC/PWS, Division of Sport Fish
email: mike.thalhauser@alaska.gov

Subject: 2014 Prince William Sound Area Non-Commercial Shrimp Permits

Our records show that you have not returned your ***2014 Prince William Sound Shrimp permit****. Even if you think you have returned your permit, it has not reached us. Please return the original permit or use the Harvest Report on the back of this page – you can fold the page so that our address on the back is showing and then tape it.*

Note that you must return the permit even if you did not fish – be sure to check the "Did Not Fish" box on the Harvest Report if this is the case. Failure to return your permit may result in denial of your shellfish harvest privileges in the future.

MAIL RESPONSES TO:
PWS Shrimp Permit
Alaska Department of Fish and Game
Sport Fish Division
PO Box 669
Cordova, AK 99574

Sincerely,

Mike Thalhauser

Mike Thalhauser, Area Management Biologist
Prince William Sound
Division of Sport Fish

-continued-

1022 - 1 **Prince William Sound 2014**
Report of Shrimp Harvest

Check this box if you **Did Not Fish** this seaso ☐ **Number of Lost Pots:** ☐

Record all days that you check your pots, even if no shrimp are taken.

Month	Day	Location Bay or Headland	# of Pots	Time Soaked	Gallons of Whole Shrimp

If you need more lines, please continue on another page.
Fold here to mail back

Alaska Department of Fish and Game
Sport Fish Division
PO Box 669
Cordova, AK 99574
Re: Permit no. 1022

Place First Class Postage Here

PWS Shrimp Permit
Alaska Department of Fish and Game
Sport Fish Division
PO Box 669
Cordova, AK 99574

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