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# **Prince William Sound Shrimp Pot Fisheries, 2010–2017**

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**Divisions of Sport Fish and Commercial Fisheries**



## Symbols and Abbreviations

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| Weights and measures (metric)           |        | General                                          |                                             | Mathematics, statistics                                    |                         |
|-----------------------------------------|--------|--------------------------------------------------|---------------------------------------------|------------------------------------------------------------|-------------------------|
| centimeter                              | cm     | Alaska Administrative Code                       | AAC                                         | all standard mathematical signs, symbols and abbreviations |                         |
| deciliter                               | dL     | all commonly accepted abbreviations              | e.g., Mr., Mrs., AM, PM, etc.               | alternate hypothesis                                       | H <sub>A</sub>          |
| gram                                    | g      | all commonly accepted professional titles        | e.g., Dr., Ph.D., R.N., etc.                | base of natural logarithm                                  | <i>e</i>                |
| hectare                                 | ha     |                                                  |                                             | catch per unit effort                                      | CPUE                    |
| kilogram                                | kg     |                                                  |                                             | coefficient of variation                                   | CV                      |
| kilometer                               | km     | at                                               | @                                           | common test statistics                                     | (F, t, $\chi^2$ , etc.) |
| liter                                   | L      |                                                  |                                             | confidence interval                                        | CI                      |
| meter                                   | m      |                                                  |                                             | correlation coefficient                                    |                         |
| milliliter                              | mL     | compass directions:                              |                                             | (multiple)                                                 | R                       |
| millimeter                              | mm     | east                                             | E                                           | correlation coefficient (simple)                           | r                       |
| Weights and measures (English)          |        | north                                            | N                                           | covariance                                                 | cov                     |
|                                         |        | south                                            | S                                           | degree (angular )                                          | °                       |
|                                         |        | west                                             | W                                           | degrees of freedom                                         | df                      |
|                                         |        | copyright                                        | ©                                           | expected value                                             | <i>E</i>                |
|                                         |        | corporate suffixes:                              |                                             | greater than                                               | >                       |
|                                         |        | Company                                          | Co.                                         | greater than or equal to                                   | ≥                       |
|                                         |        | Corporation                                      | Corp.                                       | harvest per unit effort                                    | HPUE                    |
|                                         |        | Incorporated                                     | Inc.                                        | less than                                                  | <                       |
|                                         |        | Limited                                          | Ltd.                                        | less than or equal to                                      | ≤                       |
|                                         |        | District of Columbia                             | D.C.                                        | logarithm (natural)                                        | ln                      |
| et alii (and others)                    | et al. | logarithm (base 10)                              | log                                         |                                                            |                         |
| et cetera (and so forth)                | etc.   | logarithm (specify base)                         | log <sub>2</sub> , etc.                     |                                                            |                         |
| Time and temperature                    |        | exempli gratia                                   | e.g.                                        | minute (angular)                                           | '                       |
|                                         |        | (for example)                                    |                                             | not significant                                            | NS                      |
|                                         |        | Federal Information Code                         | FIC                                         | null hypothesis                                            | H <sub>0</sub>          |
|                                         |        | id est (that is)                                 | i.e.                                        | percent                                                    | %                       |
|                                         |        | latitude or longitude                            | lat or long                                 | probability                                                | P                       |
|                                         |        | monetary symbols                                 |                                             | probability of a type I error                              |                         |
|                                         |        | (U.S.)                                           | \$, ¢                                       | (rejection of the null hypothesis when true)               | $\alpha$                |
|                                         |        | months (tables and figures): first three letters | Jan.,...,Dec                                | probability of a type II error                             |                         |
|                                         |        | registered trademark                             | ®                                           | (acceptance of the null hypothesis when false)             | $\beta$                 |
|                                         |        | trademark                                        | ™                                           | second (angular)                                           | "                       |
| United States                           |        | standard deviation                               | SD                                          |                                                            |                         |
| (adjective)                             | U.S.   | standard error                                   | SE                                          |                                                            |                         |
| United States of America (noun)         | USA    | variance                                         |                                             |                                                            |                         |
| horsepower                              | hp     | U.S.C.                                           | United States Code                          | population sample                                          | Var var                 |
| hydrogen ion activity (negative log of) | pH     | U.S. state                                       | use two-letter abbreviations (e.g., AK, WA) |                                                            |                         |
| parts per million                       | ppm    |                                                  |                                             |                                                            |                         |
| parts per thousand                      | ppt, ‰ |                                                  |                                             |                                                            |                         |
| volts                                   | V      |                                                  |                                             |                                                            |                         |
| watts                                   | W      |                                                  |                                             |                                                            |                         |

***SPECIAL PUBLICATION NO. 18-01***

**PRINCE WILLIAM SOUND SHRIMP POT FISHERIES, 2010–2017**

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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 (department) in the Prince William Sound Management Area (Area E) through the 2017 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 2017 commercial and noncommercial fisheries was 67,421 lb and 91,827 lb, respectively. Total harvest was 159,248 lb or 95% of the 167,000 lb total allowable harvest (TAH). Catch per unit effort (CPUE) in the department index survey has remained stable with an average of 2.19 lb per pot from 2010 to 2017 of all-sized shrimp and 1.51 lb per pot of marketable-sized shrimp ( $\geq 32$  mm carapace length). CPUE in the commercial fishery over the same time period fluctuated because fishing areas were rotated; average CPUE was 2.02 lb per pot in Area 1, 1.64 lb per pot in Area 2, and 1.13 lb per pot in Area 3. Noncommercial fishery CPUE (where effort is measured in pot-days) averaged 1.7 lb per pot-day between 2010 and 2014 and increased to a 2.1 lb per pot-day average between 2015 and 2017. Commercial and noncommercial fisheries combined remained within the TAH between 2010 and 2017 for all years except 2016. Percentage of the TAH harvested has ranged from 60% to 128%. The TAH is set at the lower 90% confidence interval of maximum sustained yield (MSY) and is therefore a conservative estimate of sustainable allowable harvest.

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) commercial, sport, personal use, and subsistence shrimp pot fisheries. The boundaries of the PWS 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 for commercial fisheries is divided into the Inside and Outside Districts (Figure 1). The Inside District is defined as waters enclosed by lines from Point Whitt to Point Bentinck, from Cape Hinchinbrook to Zaikof Point, and from Cape Cleare to Cape Puget. The Outside District, made up of Gulf of Alaska waters 0–3 miles from shore, is further divided into 2 sections: 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 (department) manages shrimp fisheries within the PWS Area; the Division of Commercial Fisheries manages the commercial shrimp fishery and the Division of Sport Fish manages noncommercial shrimp fisheries (sport, personal use, and subsistence). The Alaska Board of Fisheries (board) establishes management regulations, determines reasonable opportunity for subsistence, and the department uses its emergency order (EO) authority to make adjustments to fishing time and area. The board 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*. These pandalid shrimp are protandric hermaphrodites, first maturing as males and, as they get larger, later transitioning to females. Spot shrimp may reach sexual maturity by their third year, and eggs are

typically found on females from October to March. A department tagging study in PWS between 1983 and 1986 indicated that spot shrimp lifespans may range from 7 to 10 years (Kimker et al. 1996). Although spot shrimp are typically caught in greatest concentrations around 60 fathoms, they occur at 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 department 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 retained for personal use or used as bait, must be reported on department fish tickets. Also, regulations specify that only 50% of the harvest may come from a single statistical area (5AAC 31.214).

The noncommercial fishery is allocated 60% of the TAH and in years when the TAH exceeds 110,000 lb, a commercial fishery is opened. However, the noncommercial fishery will still open if the TAH falls below the commercial fishery threshold. Noncommercial harvest is currently monitored through a permit with a catch log, and data are analyzed postseason. Permits record location, effort, and harvest and are used to evaluate fishery dynamics.

Harvests from both commercial and noncommercial PWS shrimp pot fisheries are incorporated into a surplus production model to establish TAH and guideline harvest levels (GHLs) within the fisheries.

Data collected from the commercial and noncommercial PWS shrimp pot fisheries, as well as from department index 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 for continued sustainable management of these fisheries.

## **RESEARCH**

### **STOCK ASSESSMENT**

The PWS shrimp pot survey has changed since its inception. The survey began in 1989 as part of the *Exxon Valdez* oil spill (EVOS) damage assessment process, and the department initiated an annual survey using pot gear to assess oiled 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. The survey transitioned into an abundance index assessment tool starting in 1992; south Chenega and Prince of Wales were added to the survey and fishing depths were standardized to range from 20 to 80 fathoms because survey catch rates dropped precipitously at depths below 80 fathoms in previous surveys (Trowbridge 1994). The survey was also expanded to cover more area: 10 areas are currently surveyed in PWS. The shrimp pots used in the survey are designed to catch all sizes of shrimp in order to evaluate small shrimp and potential recruitment, along with larger more marketable shrimp. These pots do not fit the regulatory guidelines of commercial pot gear and therefore survey catch per unit effort (CPUE) cannot be directly compared with that of the commercial fishery.



In 1992, the annual survey was standardized to a set of 4 strings at each survey site. Each string of standardized gear was made up of 11 pots spaced approximately 10 fathoms apart on a groundline with buoys at each end. 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 (in the nonsubsistence area), to obtain fishery-independent data in this area of high noncommercial (sport and personal use) harvest.

In 2016, the number of pots on each string was reduced from 11 to 5 pots. This allowed the number of strings to be increased to 8 at each survey site, which increased the coverage area. The reduction in number of pots per string should not affect CPUE results because an analysis showed high correlation of CPUE in pots across strings within each survey site.

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

Although a department damage assessment study following the *Exxon Valdez* oil spill concluded that PWS spot shrimp may have declined as a result of overfishing, environmental conditions may have also been instrumental in both the decline and slow recovery of spot shrimp in PWS and other shellfish populations throughout the Gulf of Alaska (Trowbridge 1992; Bechtol 1997). Spot shrimp are a sedentary species and there is no indication that they migrate out of an area after settling, making them particularly susceptible to localized and serial depletion.

CPUE in the department's standardized index survey for spot shrimp declined from 0.71 lb/pot in 1992 to 0.29 lb/pot in 1998 (Table 2). After 1998, survey CPUE demonstrated a slow but steady increase in abundance and biomass to a high of 3.94 lb/pot for all shrimp in 2017, and an average of 2.19 lb/pot over the last 8 years (2010–2017; Figure 3). Similarly, index 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 1.98 lb/pot in 2016, then decreased slightly in 2017. The CPUE of these larger shrimp averaged 1.51 lb/pot over the last 8 years (Table 2; 2010–2017). Although the CPUE for larger shrimp decreased in 2017, the total catch weight was at its highest level seen in the survey: 1,413 lb with 37,722 shrimp caught. Between 2010 and 2016, the average catch was 730 lb and 14,369 shrimp.

Since 2010, CPUE during index surveys in commercial fishery Area 1 has averaged 2.67 lb/pot, CPUE in Area 2 has averaged 2.89 lb/pot with a high of 5.62 lb/pot in 2017 (this includes all sizes of shrimp; Table 3), whereas Area 3 was lower with an average CPUE of 1.12 lb/pot. Area 3, in the southwestern part of PWS, also has the lowest values for CPUE during the commercial fishery.

The shrimp pot survey occurs in October and sex composition results indicate there was a shift toward a higher proportion of females beginning in 2009. From 1994 to 2008, the percentage of females in the survey catch was 9% or less (Table 2). Starting in 2009, the percentage of female shrimp was above 10% in all years except 2015 and 2017, with an average of 94% of the female shrimp having eggs. Concerns over fishery timing prompted department staff to query the PWS

commercial shrimp pot fishery participants after the first 2017 opening (April 15–April 25) and interviewed participants reported observing less than 5% females with eggs.

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 (GHLs) for both commercial and noncommercial spot shrimp fisheries. All of the biological metrics from this survey, which are used to examine the relative abundance and composition of spot shrimp in PWS, indicate that the abundance of spot shrimp has been stable or is increasing (depending on area) and that PWS spot shrimp fisheries are sustainable.

## 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:

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

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:

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

where  $\hat{I}_t$  is an estimated index of relative abundance for year  $t$  and  $q$  is the catchability coefficient. Taking the average of the biomass levels at the start and end of year  $t$  allows catches to be related to 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 index 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:

$$MSY = \frac{rK}{4}. \quad (3)$$

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 from pot gear were first documented in 1960 when approximately 5,000 lb was harvested (Table 4). 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 PWS (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 guideline harvest range (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 (Table 4). Beginning in 1985, the board 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 (Table 4).

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, 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 GHR 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 board lowered the GHR for PWS pot shrimp to 0–100,000 lb. The commercial fishery was closed by EO from 1992 to 1999, and in 2000, the board closed the fishery. The fishery remained closed for a total of 18 years (1992–2009). In 2009, the board adopted a new management plan and in 2010, the PWS commercial fishery opened.

### **CURRENT FISHERY REGULATIONS**

Regulations to manage the PWS commercial shrimp pot fishery guideline harvest level (GHL) were adopted by the board in March of 2009 with additional regulation changes at the 2015 Statewide Dungeness and Miscellaneous Shellfish meeting:

- 1) Shrimp may be taken April 15 through September 15.
- 2) A person may only register 1 vessel to participate in the fishery during a registration year (5 AAC 31.206 [c]).
- 3) No more than 50% of the GHJ may be harvested from any one statistical area (5 AAC 31.214).
- 4) Stringent reporting regulations require all shrimp fishermen to contact the department within 24 hours of leaving to harvest shrimp, and additionally to contact the department before landing to provide all harvest information (5 AAC 31.245).
- 5) Shrimp pots deployed on a longline consisting of more than 5 pots must have a buoy marking each end (5 AAC 31.226 [c]).

Other regulatory elements include the following:

- 6) The estimated total allowable harvest (TAH) must be more than 110,000 lb before a commercial harvest may be opened (5 AAC 31.214).
- 7) The commercial fishery is allocated 40% of the TAH for the GHJ.
- 8) 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).
- 9) The department 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 AAC 31.223). This may change inseason by EO.
- 10) Shrimp pot gear may only be deployed and retrieved between the hours of 8:00 AM and 4:00 PM, unless modified by EO.
- 11) A vessel operator may not have more than the legal limit of pot gear on the vessel or in the water.

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 1 bottom, a vertical height of more than 24 in, more than 4 tunnel eye openings, or a bottom perimeter exceeding 124 in. 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 board 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 department 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, which sets the TAH. This model incorporates survey catch weight and CPUE and all commercial and noncommercial harvest, updated with 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 the department to estimate effort in the

fishery. Following adoption of new regulations establishing the TAH threshold and GHL in 2009, the commercial fishery has been open each year from 2010 to the present (Table 1). Immediately following the registration deadline, the department sets commercial gear limits and initial fishing periods based on the number of vessels registered relative to the GHL, expected CPUE, and likely participation.

Between 2015 and 2017, gear limits have been set for the first fishing period and have not changed throughout the season, although the department has the authority to adjust gear limits inseason. In 2015, gear limits were set at a maximum of 60 pots per vessel with 50 vessels registered for the fishery (Tables 5 and 6); in 2016, gear limits were 30 pots per vessel with 86 vessels registered; and, most recently in 2017, gear limits were 40 pots for the entire season, with 85 vessels registering to fish.

Total fishing time and fishing period lengths vary each season depending on vessels registered and the area open to fishing (Tables 5 and 6). Between 2015 and 2017, total available fishing time ranged from 28 days in Area 1 in 2016 to 146 days of fishing time in 2015 in Area 3, the least productive area (Table 6). Fishing periods ranged from 6 days in Area 1 for the fourth period in 2017 to 113 days in Area 3 during the third period in 2015 (Table 5).

Hours of gear operation (8:00 AM–4:00 PM by regulation) have been consistently relaxed by EO to 8:00 AM–8:00 PM in order to allow fishermen to take advantage of the most favorable tide conditions to operate their gear (Table 5). For the past 3 seasons, these hauling hours have stayed the same, providing managers a consistent reference on CPUE per day. Along with CPUE information, managers have effort information from the pre-trip call-in and data from landing reports, which allows the GHL to be targeted closely.

There are several requirements to participate in the commercial shrimp pot fishery in PWS, including purchasing a permit from the Commercial Fishery Entry Commission (CFEC) and registering for the fishery with the department, which is free but has a deadline of April 1. In this fishery, many vessels are registered that do not participate. Between 2010 and 2017, an average of 53% of the vessels that registered actually participated in the fishery (Table 7). From 2010 to 2017, an average of 147 CFEC permits were issued annually, with an average of 33% of these permits being fished, ranging from 26% (2015) to 50% (2017) in the last 3 seasons. Multiple permits can fish on 1 registered vessel, but the vessel is still limited to the maximum gear allowance.

## **CURRENT FISHERY HARVEST AND EFFORT**

Fishing areas are defined in regulation and have rotated the past 3 seasons (2015–2017) through all 3 areas. The 2017 PWS commercial shrimp pot fishery was prosecuted in Area 2 and the GHL was set at 67,000 lb (Table 1). A total of 67,421 lb of shrimp was harvested by 61 permit holders on 54 vessels from 349 landings and 45,261 pot pulls (Tables 7 and 8); the fishery closed by EO on August 14 (Table 5). Harvest composition was 66,555 lb spot shrimp (98.7%), 783 lb coonstripe shrimp (1.2%), and 83 lb other shrimp (0.1%); Table 6).

The commercial shrimp fishery GHL was achieved in 4 years between 2010 and 2017 (Table 1); the GHL for 2015 and 2107 was 67,000 lb and for 2016 it was 47,061 lb, with commercial harvest ranging from 35% to 103% of the GHL. Commercial harvest has been highest in Area 2 with an average of 62,970 lb for the 3 seasons it has been open in that area (Table 8). Area 1 had an average harvest of 51,774 lb for 3 seasons, whereas Area 3 has only been open 2 seasons

between 2010 and 2016, with the lowest average harvest of 22,350 lb, and the GHL was not achieved in either season fished. CPUE in the fishery has ranged from a low of 1.10 lb/pot in Area 3 (2012) to high of 2.52 lb/pot in Area 1 (2010) (Table 6).

## **NONCOMMERCIAL FISHERY**

### **HISTORY**

Shellfish have played an important role in the diets of the indigenous Chugach and Eyak peoples of Prince William Sound and the Copper River Delta (ADF&G 2008). In March 1999, the board made a positive customary and traditional use finding for shrimp (various species), Dungeness crab, and miscellaneous shellfish in the Prince William Sound Management Area. The noncommercial shrimp pot fishery in PWS was historically composed of sport, personal use, and subsistence fisheries. In 2016, personal use fishing regulations were repealed by the board to simplify regulations by removing regulations that were redundant to sport fishing regulations. Beginning in 2017, the noncommercial shrimp season only consisted of sport and subsistence shrimp pot fisheries in PWS. The sport fishery for shrimp has been documented since 1994 by statewide harvest surveys (SWHS) and intermittently by harvest permits since 2002 (Marston and Brazil 2008). In 1999, the board established a pot limit of 5 pots per vessel in order to maintain a modest noncommercial shrimp fishery in PWS. In 2000, the Anton Anderson Memorial Tunnel opened to vehicle traffic, providing increased access to the PWS port of Whittier. The initial 5-pot limit was retained, and the board delegated authority to the department to modify effort, area, and season to match trends in harvestable surpluses. Data from the SWHS and occasional household surveys 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, the board adopted the *PWS Noncommercial Shrimp Fishery Management Plan* (5 AAC 55.055) that included an allocation of 60% of the harvestable surplus 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 board revisited the shrimp pot fishery management plan and repealed the department's emergency order authority under 5 AAC 75.003 to increase the pot limit. However, this did not limit the department's emergency order authority under AS 16.05.060 to restrict the fishery preseason and inseason as needed for conservation purposes.

### **CURRENT FISHERY REGULATIONS**

A management plan for the PWS noncommercial shrimp pot fishery was adopted by the board 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 TAH for PWS.
- 2) Shrimp may be taken from April 15 to September 15.
- 3) A harvest recording form (permit) is required to participate in the fishery.
  - a. Fishermen must be in possession of a permit at the time of harvest and must record harvest before leaving the fishing area or concealing shrimp.
  - b. The permit can be issued to a household where all household members listed on the permit can fish the permit, or it can be issued to individuals.

- c. Permits must be returned to the department 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.
- 6) The amount reasonably necessary for all subsistence uses of shrimp in the Prince William Sound Area is 9,000–15,000 pounds of usable weight of shrimp.

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). In addition, 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 inches 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 the noncommercial shrimp fisheries to take place. Once the fishery begins, the department does not specifically track or actively manage these fisheries inseason. Effort and harvest in this fishery has ranged from 19,387 pot-days and 9,288 lb in 2002 to 78,083 pot-days in 2010 and 102,785 lb in 2016 (Table 9). However, from 2013 to 2017, effort has remained relatively consistent, averaging 47,278 pot-days, ranging from 45,012 to 48,967 pot-days. Harvest from 2013 to 2017 has also remained relatively consistent with an average harvest of 92,365 lb of shrimp (range: 85,988–102,785; Table 9). In years with potentially low or no harvestable surpluses, the department does have EO authority to close the fishery or reduce the number of pots. In years with potentially high harvestable surpluses, the department does not have the authority to increase the number of pots. In lieu of inseason management, the department uses a harvest record to estimate noncommercial harvest after the fishing season has concluded and uses preseason estimates of harvestable surpluses to guide management decisions.

In 2015, the noncommercial fishery was allocated a GHL of 100,000 lb. Based on historical effort and harvest, no preseason action was necessary to maintain a harvest that would fall near the GHL (Table 9). The noncommercial harvest determined postseason was 7,928 lb below the established GHL. In 2016, the noncommercial GHL level was reduced to the lowest number since 2009 (70,500 lb). Based on historical effort and harvest, it was necessary for the department to reduce the number of pots allowed per permit (and vessel) from 5 to 4 pots in an effort to keep harvest below the GHL. Two emergency orders (EO 2-SHR-6-13-16 and EO 2-SHR-6-14-16; Table 10) were issued in 2016 for the sport and personal use shrimp fisheries that reduced the number of pots allowed. The goal was to reduce effort and harvest; however, harvest exceeded the previous 7-year average (2009–2015) of 98,090 lb even with a 20% reduction in pots, which led to a reduction in effort (pot-days). Despite the lowest effort recorded since 2005, the 2016 noncommercial harvest of shrimp was 102,785 lb, exceeding the GHL by 32,285 lb. In 2016, the CPUE for the noncommercial fishery was the highest recorded. This was the second time since the inception of the management plan in 2009 that the GHL was exceeded but typically the GHL has not been fully utilized.

In 2017, the GHL increased to 100,000 lb, similar to 2013–2015 GHLs (Table 9). However, if harvest and effort trends in 2017 were similar to what was observed in 2016, the established GHL would again be exceeded. To reduce harvest and effort during the 2017 noncommercial

shrimp season, an EO (EO 2-SHR-6-11-17) was issued once again reducing the pot limit to 4 pots per permit and vessel. In 2017, the noncommercial shrimp GHF was not achieved.

## **NONCOMMERCIAL SHRIMP PERMIT**

Noncommercial fisheries in PWS are monitored with a variety of methods that include a postseason mail-out survey of all sport fish license holders<sup>1</sup>, 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, the department 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). In addition, 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 may be similar, harvest may not be recorded by SWHS (e.g., PWS noncommercial shrimp fishery) because those fishing under subsistence regulations are not required to obtain a sport fish license prior to participation in subsistence fisheries; therefore, they may or may not be in the sport fishing license database and may or may not receive a 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). This harvest information from the permit can be submitted online or turned in on a paper copy. 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 2009–2017.

## **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 in PWS shrimp fisheries were required to obtain a permit (Appendix A1) or be named on the permit of another household member. Permits were made available online or at major license vendors in the Anchorage, Seward, Valdez, and Whittier areas. Permits were also issued at department offices in Anchorage, Cordova, Fairbanks, Soldotna, and Homer and at Village Council offices in Tatitlek and Chenega Bay. License vendors and department offices were required to return the top copy of the permit to the

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<sup>1</sup> Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited October 14, 2015). Available from: <http://www.adfg.alaska.gov/sf/sportfishingsurvey/>



department's Division of Sport Fish office 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 gallons of whole shrimp), and location of each set. Permit holders were also required to return their harvest records to Anchorage or Cordova department offices 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 B1) by 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. To reduce the number of mailings and increase the timeliness of reporting, in 2016 and 2017 the nonrespondents that provided a valid email address on their permit also received 2 reminder emails encouraging reporting.

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:

$$\hat{N} = \frac{o}{\hat{p}} + M, \quad (4)$$

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:

$$\hat{p} = \frac{m}{M}, \quad (5)$$

where

$m$  = 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:

$$\hat{V}[\hat{N}] = \left[ \frac{o^2 \hat{V}[\hat{p}]}{\hat{p}^4} \right], \quad (6)$$

where

$$\hat{V}[\hat{p}] = \left( \frac{\hat{p}(1 - \hat{p})}{M - 1} \right). \quad (7)$$

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

$$\hat{N} = N_{cf} + N_{cz} + \hat{N}_{df} + \hat{N}_{dz}, \quad (8)$$

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:

$$\hat{N}_{df} = (\hat{N} - (N_{cf} + N_{cz})) \hat{w}, \quad (9)$$

where

$$\hat{w} = \frac{n_{df}}{n_d}, \quad (10)$$

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:

$$\hat{N}_{dz} = \hat{N} - (N_{cf} + N_{cz} + \hat{N}_{df}). \quad (11)$$

Information from returned permits (effort, harvest, location, and associated dates for each set of pot gear) was entered into a department 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):

$$\hat{H} = H_{cf} + \hat{H}_{df} , \quad (12)$$

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:

$$\hat{H}_{df} = \hat{N}_{df} \bar{h}_{df} , \quad (13)$$

where

$$\bar{h}_{df} = \frac{\left( \sum_{j=1}^{n_{df}} h_{dfj} \right)}{n_{df}}, \quad (14)$$

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:

$$\hat{V}[\hat{H}] = \hat{V}[\hat{H}_{df}] = \hat{N}_{df}^2 \hat{V}[\bar{h}_{df}] + \bar{h}_{df}^2 \hat{V}[\hat{N}_{df}] - \hat{V}[\bar{h}_{df}] \hat{V}[\hat{N}_{df}], \quad (15)$$

where

$$\hat{V}[\hat{N}_{df}] = \hat{V}[\hat{N}] \hat{V}[\hat{w}] = \hat{N}^2 \hat{V}[\hat{w}] + \hat{w}^2 \hat{V}[\hat{N}] - \hat{V}[\hat{w}] \hat{V}[\hat{N}], \quad (16)$$

$$\hat{V}[\hat{w}] = \left( \frac{\hat{w}(1 - \hat{w})}{n_d - 1} \right), \quad (17)$$

$$\hat{V}[\bar{h}_{df}] = \left( 1 - \frac{n_{df}}{\hat{N}_{df}} \right) \frac{s_{df}^2}{n_{df}}, \quad (18)$$

and

$$s_{df}^2 = \frac{\sum_{j=1}^{n_{df}} (h_{dfj} - \bar{h}_{df})^2}{n_{df} - 1}. \quad (19)$$

Shrimp harvest was then converted from gallons of whole shrimp to pounds of shrimp with the conversion factor of 3.89 lb/gal of whole shrimp (Maria Wessel, Division of Commercial Fisheries Biologist, Alaska Department of Fish and Game, Cordova; unpublished data). This conversion factor was determined in 2012 and is substantially higher than estimates previously used in pound-per-gallon estimates. As a result, previously published harvests reported in pounds were underestimated.

In addition to the estimates of total harvest and effort, we calculated the catch per unit effort (CPUE) for selected statistical areas with catch equal to pounds of whole spot shrimp and effort equal to 1 pot soaked for 24 h. 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 average number of PWS shrimp permits issued and reporting fishing from 2015 to 2017 was slightly higher (by 113 permits) than the prior 5-year average (2010–2014; Table 9). From 2015 to 2017, the average harvest (95,561 lb) increased from the prior 5-year average of 75,558 lb (2010–2014) and the average effort (46,380 pot-days) decreased from the prior 5-year average of 56,899 pot-days (2010–2014) (Table 9). Since 2009, the number of permits issued, the number of individuals that turned in harvest reports, and the number that reported successfully harvesting shrimp has remained relatively constant. The number of permits issued in 2015 was 3,033 permits, which was only 132 permits lower than the prior 5-year average (2010–2014; Table 9).

Effort and harvest in 2015 were very similar to 2013 and 2014 (Figure 4). Effort in 2016 and 2017 were the lowest observed since 2009 when permits were reinstated (45,012 and 45,606 pot-days respectively; Figure 4). The low effort in 2016 and 2017 can be attributed to preseason emergency orders that reduced the maximum number of pots allowed to 4 per person, per vessel. Even with the reduced effort, the pounds of shrimp harvested in 2016 (102,785 lb) was one of the largest on record since 2002 (Figure 5). In addition, 2016 was the first year that both PWS shrimp permits and harvest reporting was available online. This may be why 2016 and 2017 had the greatest number of permits issued (3,592 and 3,441, respectively) and some of the highest response rates (90.7% and 92.0%, respectively) recorded since 2002, although similar numbers have been achieved in the past (Table 9).

In 2016, although more permits were issued and response rates were high, only 1,847 fishermen (58.7%) reported harvesting shrimp, which is slightly lower than the 2010–2014 average (Table 9). Conversely, in 2017, the percentage of fishermen reporting harvest (62.5%) was slightly higher than the 2010–2014 average.

The spatial distribution of effort (Table 11) and harvest (Table 12) in the noncommercial fisheries has remained relatively constant since 2002. The PWS statistical areas that support most of the noncommercial effort and harvest 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 a sum of 68% (range: 55–74%) of the total annual reported effort and 53% (range: 48–59%) of the total annual reported harvest, with no detectable trend across years.

The average CPUE within the noncommercial fishery for 2015–2017 was higher than the prior 5-year average (2010–2014; Table 9). This increase in CPUE reflects that even with less time shrimping (pot-days), noncommercial shrimpers are having a greater success catching shrimp compared to prior years. The highest level of CPUE occurred in 2016 (Figure 5). The observed high catches and low effort in the noncommercial fishery contradict the model results that produced the low GHL in 2016.

CPUE in the areas with the most harvest and effort (Whittier and Valdez) have remained consistent since 2009 (Figure 6). In Port Wells and Port Nellie Juan, the CPUE has been more variable. Since permits were reinstated in 2009, Unakwik has continued to have the highest CPUE; however, the noncommercial CPUE decreased in 2010, 2013, and 2016 when

commercial fisheries occurred in this area. Other variations in the CPUE from one area to another are most likely impacted by variability in fisherman efficiency and fishing pressure near major ports.

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## **TABLES**

Table 1.—Prince William Sound total allowable harvests (TAH), guideline harvest levels (GHL), harvests in commercial and noncommercial shrimp pot fisheries, and percentage of total allowable harvest (TAH), 2010–2017.

| Year | TAH (lb) | GHL (lb)           |            | Shrimp harvest (lb)  |            |         | % of<br>TAH | Non-<br>commercial<br>% of GHL | Commercial<br>% of GHL |
|------|----------|--------------------|------------|----------------------|------------|---------|-------------|--------------------------------|------------------------|
|      |          | Non-<br>commercial | Commercial | Non-<br>commercial   | Commercial | Total   |             |                                |                        |
| 2010 | 137,500  | 82,200             | 55,000     | 87,699 <sup>a</sup>  | 45,349     | 133,048 | 97%         | 107%                           | 82%                    |
| 2011 | 131,900  | 79,200             | 52,760     | 59,182 <sup>a</sup>  | 52,694     | 111,876 | 85%         | 75%                            | 100%                   |
| 2012 | 128,100  | 76,860             | 51,240     | 55,765 <sup>a</sup>  | 21,561     | 77,326  | 60%         | 73%                            | 42%                    |
| 2013 | 165,750  | 99,500             | 66,300     | 85,988 <sup>b</sup>  | 61,644     | 147,632 | 89%         | 86%                            | 93%                    |
| 2014 | 166,500  | 100,000            | 66,600     | 89,155 <sup>b</sup>  | 68,464     | 157,619 | 95%         | 89%                            | 103%                   |
| 2015 | 167,000  | 100,000            | 67,000     | 92,072 <sup>b</sup>  | 23,138     | 115,209 | 69%         | 92%                            | 35%                    |
| 2016 | 117,653  | 70,500             | 47,061     | 102,785 <sup>b</sup> | 48,346     | 151,131 | 128%        | 146%                           | 103%                   |
| 2017 | 167,000  | 100,000            | 67,000     | 91,827 <sup>b</sup>  | 67,421     | 159,248 | 95%         | 92%                            | 101%                   |

<sup>a</sup> Calculated with 2.4 lb spot shrimp/gallon conversion.

<sup>b</sup> Calculated with 3.89 lb spot shrimp/gallon conversion.



Table 2.—Prince William Sound spot shrimp survey results, 1992–2017.

| Year                | Number of pots | Catch weight (lb) | CPUE lb/pot all shrimp | CPUE lb/pot >32 mm | Number of shrimp | Percent |        |                   |
|---------------------|----------------|-------------------|------------------------|--------------------|------------------|---------|--------|-------------------|
|                     |                |                   |                        |                    |                  | Male    | Female | Females with eggs |
| 1992                | 349            | 249               | 0.71                   | 0.55               | 5,009            | 88.2    | 11.8   | 96.8              |
| 1993                | 325            | 121               | 0.37                   | 0.27               | 2,434            | 80.6    | 19.4   | 97.7              |
| 1994                | 355            | 145               | 0.41                   | 0.19               | 4,128            | 95.1    | 4.9    | 95.5              |
| 1995                | 350            | 206               | 0.59                   | 0.34               | 5,053            | 95.7    | 4.3    | NA                |
| 1996                | 350            | 182               | 0.52                   | NA                 | 4,618            | 94.9    | 5.1    | NA                |
| 1997                | 345            | 142               | 0.41                   | 0.21               | 3,835            | 94.1    | 5.9    | NA                |
| 1998                | 264            | 76                | 0.29                   | 0.14               | 2,252            | 94.6    | 5.4    | 99.2              |
| 1999 <sup>a</sup>   | 346            | 165               | 0.48                   | 0.22               | 4,392            | 94.3    | 5.7    | 97.8              |
| 2000                | 349            | 245               | 0.70                   | 0.39               | 6,545            | 95.1    | 4.9    | 97.2              |
| 2001                | 351            | 331               | 0.94                   | 0.64               | 7,034            | 92.7    | 7.3    | 99.6              |
| 2002 <sup>b</sup>   | 304            | 377               | 1.24                   | 0.81               | 8,797            | 91      | 9      | 98.5              |
| 2003                | 352            | 398               | 1.13                   | 0.79               | 9,333            | 92      | 8      | 99.7              |
| 2004                | 352            | 502               | 1.43                   | 0.83               | 12,593           | 91.5    | 8.5    | 97.3              |
| 2005                | 349            | 481               | 1.38                   | 0.63               | 14,453           | 95      | 5      | 95.0              |
| 2006                | 346            | 553               | 1.60                   | 0.83               | 14,203           | 91.6    | 8.4    | 91.7              |
| 2007                | 349            | 838               | 2.40                   | 1.06               | 24,152           | 94.2    | 5.8    | 83.7              |
| 2008                | 348            | 893               | 2.56                   | 1.10               | 23,004           | 93.4    | 6.6    | 81.4              |
| 2009                | 351            | 825               | 2.35                   | 1.48               | 17,622           | 86.2    | 13.8   | 88.0              |
| 2010                | 350            | 478               | 1.37                   | 1.11               | 8,585            | 81.8    | 18.2   | 93.5              |
| 2011                | 350            | 687               | 1.96                   | 1.69               | 11,627           | 74.8    | 25.2   | 99.1              |
| 2012                | 392            | 834               | 2.13                   | 1.60               | 15,928           | 84.7    | 15.3   | 90.8              |
| 2013                | 392            | 744               | 1.90                   | 1.37               | 14,453           | 85.7    | 14.3   | 87.1              |
| 2014                | 393            | 752               | 1.91                   | 1.40               | 16,051           | 89.2    | 10.8   | 93.1              |
| 2015                | 395            | 629               | 1.59                   | 1.01               | 14,118           | 91.7    | 8.3    | 98.3              |
| 2016                | 359            | 986               | 2.75                   | 1.98               | 19,821           | 86.8    | 13.2   | 99.6              |
| 2017                | 359            | 1,413             | 3.94                   | 1.92               | 37,722           | 92.8    | 7.2    | 98.6              |
| Avg. CPUE 2010–2017 |                |                   | 2.19                   | 1.51               |                  |         |        |                   |

Note: NA means data are not available.

<sup>a</sup> Sex data interpolated for 452 lost data points.

<sup>b</sup> Sex data interpolated for 192 lost data points.

Table 3.—Catch per unit effort (CPUE) of spot shrimp in 3 management areas in the Prince William Sound shrimp pot survey, 1992–2017.

| Year           | Survey CPUE (lb/pot) <sup>a</sup> |        |        |
|----------------|-----------------------------------|--------|--------|
|                | Area 1                            | Area 2 | Area 3 |
| 1992           | 0.86                              | 0.62   | 0.75   |
| 1993           | 0.69                              | 0.48   | 0.19   |
| 1994           | 0.40                              | 0.41   | 0.41   |
| 1995           | 0.67                              | 0.61   | 0.55   |
| 1996           | 0.58                              | 0.53   | 0.50   |
| 1997           | 0.50                              | 0.40   | 0.40   |
| 1998           | 0.22                              | 0.38   | 0.19   |
| 1999           | 0.22                              | 0.73   | 0.35   |
| 2000           | 0.40                              | 0.77   | 0.73   |
| 2001           | 1.14                              | 1.19   | 0.71   |
| 2002           | 0.77                              | 1.99   | 0.65   |
| 2003           | 0.61                              | 1.75   | 0.80   |
| 2004           | 3.12                              | 1.82   | 0.71   |
| 2005           | 1.66                              | 1.92   | 0.89   |
| 2006           | 2.93                              | 1.84   | 1.08   |
| 2007           | 3.58                              | 3.23   | 1.49   |
| 2008           | 3.46                              | 3.17   | 1.87   |
| 2009           | 2.79                              | 2.67   | 1.75   |
| 2010           | 1.87                              | 1.63   | 0.77   |
| 2011           | 3.67                              | 2.19   | 0.61   |
| 2012           | 2.94                              | 2.32   | 1.12   |
| 2013           | 1.79                              | 2.55   | 1.35   |
| 2014           | 1.98                              | 2.73   | 1.03   |
| 2015           | 1.84                              | 2.48   | 0.46   |
| 2016           | 3.38                              | 3.61   | 1.26   |
| 2017           | 3.87                              | 5.62   | 2.33   |
| Avg. 2010–2017 | 2.67                              | 2.89   | 1.12   |

<sup>a</sup> All size shrimp are included.

Table 4.–Prince William Sound Area commercial shrimp pot fishery harvest and effort, 1960–2009.

| Year      | Vessels | Landings | Harvest (lb)   |            |       | Total   |
|-----------|---------|----------|----------------|------------|-------|---------|
|           |         |          | Spot           | Coonstripe | Other |         |
| 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 |            |       |         |

Table 5.–Prince William Sound commercial shrimp pot fishery emergency orders (EOs) 2015–2017.

| Emergency order    | Effective date | Explanation                                                                                                                                                                      |
|--------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2015 Calendar year |                |                                                                                                                                                                                  |
| 2-SF-E-01-15       | 4/15/15        | Established first commercial fishing period 8:00 AM April 15–8:00 PM April 30, set maximum gear limit at 60 pots per vessel, and set hours of gear operation 8:00 AM to 8:00 PM. |
| 2-SF-E-02-15       | 5/05/15        | Set second commercial fishing period 8:00 AM May 5–8:00 PM May 21.                                                                                                               |
| 2-SF-E-03-15       | 5/26/15        | Set third commercial fishing period 8:00 AM May 26–8:00 PM September 15.                                                                                                         |
| 2016 Calendar year |                |                                                                                                                                                                                  |
| 2-SF-E-02-16       | 4/15/16        | Established first commercial fishing period 8:00 AM April 15–8:00 PM April 21, set maximum gear limit at 30 pots per vessel, and set hours of gear operation 8:00 AM to 8:00 PM. |
| 2-SF-E-03-16       | 4/26/16        | Set second commercial fishing period 8:00 AM April 26–8:00 PM May 5 closes statistical area 476036 to commercial harvest of shrimp 8:00 PM April 29.                             |
| 2-SF-E-04-16       | 5/10/16        | Set third commercial fishing period 8:00 AM May 10–8:00 PM May 26.                                                                                                               |
| 2-SF-E-05-16       | 5/19/16        | Close the commercial shrimp pot season 8:00 PM May 19.                                                                                                                           |
| 2017 Calendar year |                |                                                                                                                                                                                  |
| 2-SF-E-02-17       | 4/15/17        | Established first commercial fishing period 8:00 AM April 15–8:00 PM April 25, 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-03-17       | 5/01/17        | Set second commercial fishing period 8:00 AM May 1–8:00 PM May 11.                                                                                                               |
| 2-SF-E-04-17       | 5/10/17        | Set third commercial fishing period 8:00 AM May 16–8:00 PM May 25.                                                                                                               |
| 2-SF-E-05-17       | 5/19/17        | Set fourth commercial fishing period 8:00 AM May 31–8:00 PM June 5.                                                                                                              |
| 2-SF-E-06-17       | 6/05/17        | Extended fourth commercial fishing period to 8:00 PM June 8.                                                                                                                     |

Table 6.–Prince William Sound commercial shrimp pot fishery guideline harvest levels (GHL), effort, gear limits, harvest, catch per unit effort (CPUE), and available fishing days, 2010–2017.

| Year | Area | GHL (lb) | Effort       |           | Gear limits |       | Shrimp harvest (lb) |            |       |        | CPUE<br>(lb/pot) | Available<br>fishing<br>days |
|------|------|----------|--------------|-----------|-------------|-------|---------------------|------------|-------|--------|------------------|------------------------------|
|      |      |          | Vessel count | Pot lifts | Open        | Close | Spot                | Coonstripe | Other | Total  |                  |                              |
| 2010 | 1    | 55,000   | 75           | 18,025    | 20          | 20    | 45,076              | 263        | 10    | 45,349 | 2.52             | 118                          |
| 2011 | 2    | 52,760   | 45           | 29,580    | 40          | 40    | 51,302              | 1,204      | 44    | 52,550 | 1.78             | 96                           |
| 2012 | 3    | 51,240   | 35           | 19,644    | 50          | 50    | 18,097              | 3,428      | 36    | 21,561 | 1.10             | 93                           |
| 2013 | 1    | 66,300   | 43           | 34,804    | 30          | 50    | 59,376              | 2,266      | 2     | 61,644 | 1.77             | 145                          |
| 2014 | 2    | 66,600   | 32           | 41,027    | 40          | 50    | 64,220              | 4,085      | 158   | 68,464 | 1.67             | 111                          |
| 2015 | 3    | 67,000   | 30           | 20,004    | 60          | 60    | 21,193              | 1,934      | 11    | 23,138 | 1.16             | 146                          |
| 2016 | 1    | 47,061   | 57           | 27,360    | 30          | 30    | 47,822              | 580        | 21    | 48,423 | 1.77             | 28                           |
| 2017 | 2    | 67,000   | 54           | 45,261    | 40          | 40    | 66,555              | 783        | 83    | 67,421 | 1.67             | 41                           |

Table 7.—Number of CFEC permits issued and fished, number of registered vessels, vessels fished, and number of landings in the Prince William Sound commercial shrimp pot fishery by year, 2010–2017.

| Year           | Permits issued | Permits fished | % of permits fished | Registered vessels | Vessels fished | % Vessels fished | Landings |
|----------------|----------------|----------------|---------------------|--------------------|----------------|------------------|----------|
| 2010           | 195            | 82             | 42%                 | 156                | 75             | 48%              | 233      |
| 2011           | 182            | 48             | 26%                 | 91                 | 45             | 50%              | 183      |
| 2012           | 158            | 40             | 25%                 | 83                 | 35             | 42%              | 105      |
| 2013           | 148            | 46             | 31%                 | 89                 | 45             | 51%              | 214      |
| 2014           | 129            | 33             | 26%                 | 65                 | 32             | 49%              | 214      |
| 2015           | 112            | 29             | 26%                 | 56                 | 30             | 54%              | 107      |
| 2016           | 131            | 52             | 40%                 | 86                 | 57             | 66%              | 219      |
| 2017           | 122            | 61             | 50%                 | 85                 | 54             | 64%              | 349      |
| Avg. 2010–2017 | 147            | 49             | 33%                 | 89                 | 47             | 53%              | 203      |

Table 8.–Prince William Sound commercial shrimp pot fishery harvest, pots pulled, and CPUE by area and year.

| Area 1        | 2010   | 2013   | 2016   | Average |
|---------------|--------|--------|--------|---------|
| Harvest (lb)  | 45,349 | 61,644 | 48,329 | 51,774  |
| Pot pulls     | 18,025 | 34,804 | 27,360 | 26,730  |
| CPUE (lb/pot) | 2.52   | 1.77   | 1.77   | 2.02    |
| Area 2        | 2011   | 2014   | 2017   | Average |
| Harvest (lb)  | 52,550 | 68,938 | 67,421 | 62,970  |
| Pot pulls     | 29,580 | 41,670 | 45,261 | 38,837  |
| CPUE (lb/pot) | 1.78   | 1.65   | 1.49   | 1.64    |
| Area 3        | 2012   | 2015   | 2018   | Average |
| Harvest (lb)  | 21,561 | 23,138 | NA     | 22,350  |
| Pot pulls     | 19,644 | 20,004 | NA     | 19,824  |
| CPUE (lb/pot) | 1.10   | 1.16   | NA     | 1.13    |

Table 9.—Number of permits issued, guideline harvest level (GHL), pounds (lb) of whole shrimp and percentage of GHL harvested, pot-days of effort, catch per unit effort (CPUE), pound of harvested whole shrimp, and percentage of GHL harvested by year in the noncommercial Prince William Sound pot shrimp fishery, 2002–2017.

| Noncommercial PWS shrimp permit data |                |               |                |                     |                   |                       |              |         |
|--------------------------------------|----------------|---------------|----------------|---------------------|-------------------|-----------------------|--------------|---------|
| Year                                 | Permits issued | Response rate | Permits fished | % of permits fished | Effort (pot-days) | Catch per unit effort | Harvest (lb) | GHL     |
| 2002                                 | 717            | 84.0%         | 385            | 53.7%               | 19,387            | 0.78                  | 9,288        | —       |
| 2003                                 | 1,061          | 91.0%         | 614            | 57.9%               | 24,094            | 0.94                  | 13,965       | —       |
| 2004                                 | 1,649          | 90.0%         | 902            | 54.7%               | 30,694            | 1.36                  | 25,694       | —       |
| 2005                                 | 2,112          | 90.0%         | 1,202          | 56.9%               | 37,271            | 1.39                  | 31,950       | —       |
| 2006                                 | —              | —             | —              | —                   | —                 | —                     | —            | —       |
| 2007                                 | —              | —             | —              | —                   | —                 | —                     | —            | —       |
| 2008                                 | —              | —             | —              | —                   | —                 | —                     | —            | —       |
| 2009                                 | 2,733          | 89.0%         | 1,719          | 62.9%               | 47,631            | 1.91                  | 56,120       | 57,900  |
| 2010                                 | 3,181          | 90.0%         | 2,007          | 63.1%               | 78,083            | 1.82                  | 87,699       | 82,200  |
| 2011                                 | 3,309          | 88.0%         | 1,972          | 59.6%               | 56,543            | 1.70                  | 59,182       | 79,200  |
| 2012                                 | 3,098          | 87.0%         | 1,829          | 59.0%               | 52,620            | 1.72                  | 55,765       | 76,860  |
| 2013                                 | 3,101          | 89.0%         | 1,895          | 61.1%               | 48,967            | 1.76                  | 85,988       | 99,500  |
| 2014                                 | 3,134          | 86.0%         | 1,903          | 60.7%               | 48,283            | 1.85                  | 89,155       | 100,000 |
| 2015                                 | 3,033          | 86.7%         | 1,847          | 60.9%               | 48,521            | 1.90                  | 92,072       | 100,000 |
| 2016                                 | 3,592          | 90.7%         | 2,107          | 58.7%               | 45,012            | 2.28                  | 102,785      | 70,500  |
| 2017                                 | 3,441          | 92.0%         | 2,149          | 62.5%               | 45,606            | 2.01                  | 91,827       | 100,000 |
| Avg. 2010–2014                       | 3,165          | 88.0%         | 1,921          | 60.7%               | 56,899            | 1.77                  | 75,558       |         |
| Avg. 2015–2017                       | 3,355          | 89.8%         | 2,034          | 60.6%               | 46,380            | 2.1                   | 95,561       |         |

*Note:* Permits were first offered online in 2016. Between 2002 and 2012, the conversion factor for a gallon of shrimp was 2.4 lb. In 2013, this was reevaluated and updated to a conversion factor of 3.89 lb per gallon of shrimp.



Table 10.—Prince William Sound noncommercial shrimp pot fishery emergency orders (EOs) 2015–2017.

| Emergency order                               | Effective date | Explanation                                                                                                                                                                                                                            |
|-----------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2015 Calendar year                            |                |                                                                                                                                                                                                                                        |
| No noncommercial fisheries EOs issued in 2015 |                |                                                                                                                                                                                                                                        |
| 2016 Calendar year                            |                |                                                                                                                                                                                                                                        |
| 2-SHR-6-13-16                                 | 4/15/2016      | Restricts the number of shrimp pots allowed to harvest shrimp in the Prince William Sound sport fishery from 5 pots per person with a maximum of 5 pots per vessel, to 4 pots per person with a maximum of 4 pots per vessel.          |
| 2-SHR-6-14-16                                 | 4/15/2016      | Restricts the number of shrimp pots allowed to harvest shrimp in the Prince William Sound personal use fisheries from 5 pots per person with a maximum of 5 pots per vessel, to 4 pots per person with a maximum of 4 pots per vessel. |
| 2017 Calendar year                            |                |                                                                                                                                                                                                                                        |
| 2-SHR-6-11-17                                 | 4/15/2017      | Restricts the number of shrimp pots allowed to harvest shrimp in the Prince William Sound sport fishery from 5 pots per person with a maximum of 5 pots per vessel, to 4 pots per person with a maximum of 4 pots per vessel.          |

Table 11.—Contribution of major statistical areas to total effort (expanded) in the noncommercial shrimp fishery in Prince William Sound by year, 2002–2005 and 2009–2017.

| Year         | Name (statistical area)       |     |                        |     |                           |    |                                      |    |                                      |     |                              |     | Total pot-<br>days |
|--------------|-------------------------------|-----|------------------------|-----|---------------------------|----|--------------------------------------|----|--------------------------------------|-----|------------------------------|-----|--------------------|
|              | Whittier vicinity<br>(486033) |     | Valdez Arm<br>(466100) |     | S. Port Wells<br>(486034) |    | Unakwik Inlet<br>(476036,<br>476101) |    | Port Nellie Juan<br>(486031, 486003) |     | All other areas <sup>a</sup> |     |                    |
|              | Pot-days                      | %   | Pot-days               | %   | Pot-days                  | %  | Pot-days                             | %  | Pot-days                             | %   | Pot-days                     | %   |                    |
| 2002         | 4,459                         | 23% | 9,694                  | 50% | 1,745                     | 9% | 582                                  | 3% | 1,551                                | 8%  | 1,357                        | 7%  | 19,387             |
| 2003         | 7,710                         | 32% | 8,192                  | 34% | 1,928                     | 8% | 964                                  | 4% | 2,891                                | 12% | 2,409                        | 10% | 24,094             |
| 2004         | 5,832                         | 19% | 14,119                 | 46% | 2,456                     | 8% | 1,535                                | 5% | 3,376                                | 11% | 3,376                        | 11% | 30,694             |
| 2005         | 10,436                        | 28% | 15,281                 | 41% | 2,982                     | 8% | 2,236                                | 6% | 2,236                                | 6%  | 4,100                        | 11% | 37,271             |
| <sup>b</sup> |                               |     |                        |     |                           |    |                                      |    |                                      |     |                              |     |                    |
| 2009         | 13,337                        | 28% | 20,958                 | 44% | 3,334                     | 7% | 2,382                                | 5% | 2,382                                | 5%  | 5,239                        | 11% | 47,631             |
| 2010         | 24,987                        | 32% | 32,795                 | 42% | 5,466                     | 7% | 3,123                                | 4% | 3,123                                | 4%  | 8,589                        | 11% | 78,083             |
| 2011         | 17,528                        | 31% | 22,617                 | 40% | 3,393                     | 6% | 3,393                                | 6% | 3,393                                | 6%  | 6,220                        | 11% | 56,543             |
| 2012         | 21,048                        | 40% | 17,891                 | 34% | 3,683                     | 7% | 3,683                                | 7% | 2,631                                | 5%  | 4,210                        | 8%  | 52,620             |
| 2013         | 15,669                        | 32% | 11,262                 | 23% | 3,428                     | 7% | 2,448                                | 5% | 3,428                                | 7%  | 12,731                       | 26% | 48,967             |
| 2014         | 18,348                        | 38% | 14,002                 | 29% | 3,863                     | 8% | 3,380                                | 7% | 2,414                                | 5%  | 6,277                        | 13% | 48,283             |
| 2015         | 17,953                        | 37% | 15,042                 | 31% | 4,367                     | 9% | 4,367                                | 9% | 2,911                                | 6%  | 4,367                        | 9%  | 48,521             |
| 2016         | 16,204                        | 36% | 11,703                 | 26% | 2,701                     | 6% | 3,601                                | 8% | 3,151                                | 7%  | 7,652                        | 17% | 45,012             |
| 2017         | 16,874                        | 37% | 12,314                 | 27% | 3,648                     | 8% | 3,192                                | 7% | 912                                  | 2%  | 8,665                        | 19% | 45,606             |
| Average      | 14,645                        | 32% | 15,836                 | 36% | 3,307                     | 8% | 2,684                                | 6% | 2,646                                | 6%  | 5,784                        | 13% | 44,824             |

<sup>a</sup> Remaining 24 statistical areas where noncommercial shrimp harvest was reported contributed on average less than 5% each to the total reported shrimp effort on any given year.

<sup>b</sup> Between 2006 and 2008, permits were not required for noncommercial shrimp harvests in PWS. Harvest data for these years are not comparable and not included.

Table 12.—Contribution of major statistical areas to total harvest of whole shrimp in the noncommercial shrimp pot fishery in Prince William Sound, 2002–2005 and 2009–2017.

| Year         | Name (statistical area)       |     |                        |     |                           |     |                                   |     |                                      |     |                              |     | Total<br>Pounds |
|--------------|-------------------------------|-----|------------------------|-----|---------------------------|-----|-----------------------------------|-----|--------------------------------------|-----|------------------------------|-----|-----------------|
|              | Whittier vicinity<br>(486033) |     | Valdez Arm<br>(466100) |     | S. Port Wells<br>(486034) |     | Unakwik Inlet<br>(476036, 476101) |     | Port Nellie Juan<br>(486031, 486003) |     | All other areas <sup>a</sup> |     |                 |
|              | Pounds                        | %   | Pounds                 | %   | Pounds                    | %   | Pounds                            | %   | Pounds                               | %   | Pounds                       | %   |                 |
| 2002         | 1,579                         | 17% | 3,901                  | 42% | 1,115                     | 12% | 650                               | 7%  | 1,115                                | 12% | 836                          | 9%  | 9,288           |
| 2003         | 3,631                         | 26% | 3,771                  | 27% | 1,815                     | 13% | 1,397                             | 10% | 2,234                                | 16% | 1,117                        | 8%  | 13,965          |
| 2004         | 4,882                         | 19% | 9,764                  | 38% | 2,312                     | 9%  | 2,826                             | 11% | 3,597                                | 14% | 2,569                        | 10% | 25,694          |
| 2005         | 8,627                         | 27% | 8,627                  | 27% | 3,195                     | 10% | 5,112                             | 16% | 2,876                                | 9%  | 3,195                        | 10% | 31,950          |
| <sup>b</sup> |                               |     |                        |     |                           |     |                                   |     |                                      |     |                              |     |                 |
| 2009         | 16,836                        | 30% | 14,030                 | 25% | 6,734                     | 12% | 7,296                             | 13% | 4,490                                | 8%  | 6,734                        | 12% | 56,120          |
| 2010         | 29,818                        | 34% | 19,294                 | 22% | 13,155                    | 15% | 7,893                             | 9%  | 7,893                                | 9%  | 9,647                        | 11% | 87,699          |
| 2011         | 20,122                        | 34% | 12,428                 | 21% | 5,918                     | 10% | 8,877                             | 15% | 5,918                                | 10% | 5,918                        | 10% | 59,182          |
| 2012         | 21,748                        | 39% | 9,480                  | 17% | 6,134                     | 11% | 8,922                             | 16% | 4,461                                | 8%  | 4,461                        | 8%  | 55,765          |
| 2013         | 29,236                        | 34% | 12,898                 | 15% | 8,599                     | 10% | 7,739                             | 9%  | 7,739                                | 9%  | 20,637                       | 24% | 85,988          |
| 2014         | 33,879                        | 38% | 14,265                 | 16% | 9,807                     | 11% | 15,156                            | 17% | 5,349                                | 6%  | 10,699                       | 12% | 89,155          |
| 2015         | 31,304                        | 34% | 14,732                 | 16% | 9,207                     | 10% | 21,177                            | 23% | 7,366                                | 8%  | 9,207                        | 10% | 92,072          |
| 2016         | 34,358                        | 35% | 12,762                 | 13% | 10,798                    | 11% | 12,762                            | 13% | 11,780                               | 12% | 16,688                       | 17% | 98,167          |
| 2017         | 32,178                        | 37% | 9,566                  | 11% | 18,263                    | 21% | 8,697                             | 10% | 2,609                                | 3%  | 16,524                       | 19% | 86,968          |
| Average      | 20,631                        | 31% | 11,194                 | 22% | 7,466                     | 12% | 8,346                             | 13% | 5,187                                | 10% | 8,326                        | 12% | 60,924          |

*Note:* Permits were first offered online in 2016. Between 2002 and 2012 the conversion factor for a gallon of shrimp was 2.4 lb. In 2013, this was reevaluated and updated to a conversion factor of 3.89 lb per gallon of shrimp.

<sup>a</sup> Remaining 24 statistical areas where noncommercial shrimp harvest was reported contributed on average less than 5% each to the total reported shrimp harvest on any given year.

<sup>b</sup> For 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.



## **FIGURES**

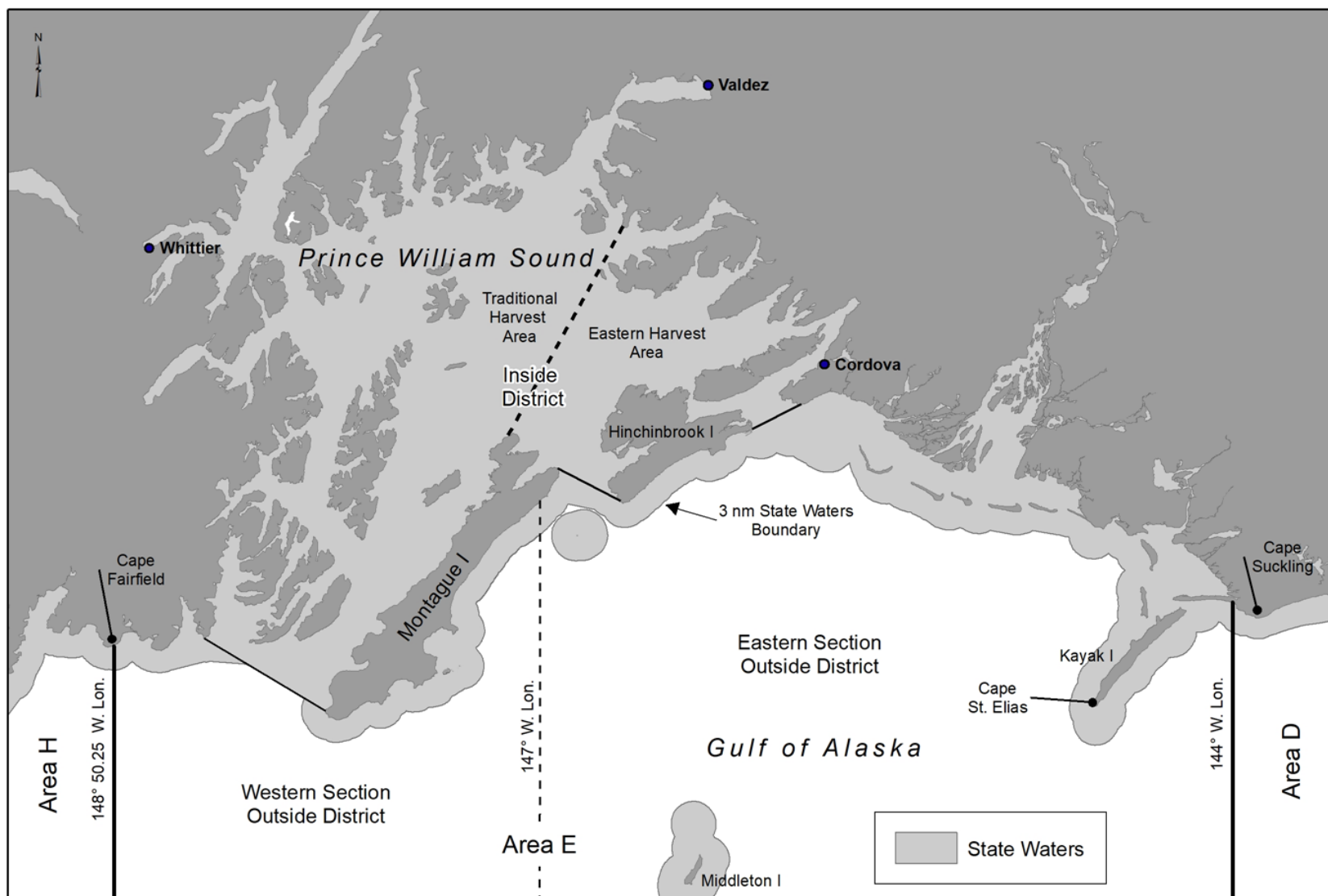


Figure 1.—Prince William Sound shellfish management districts and sections.

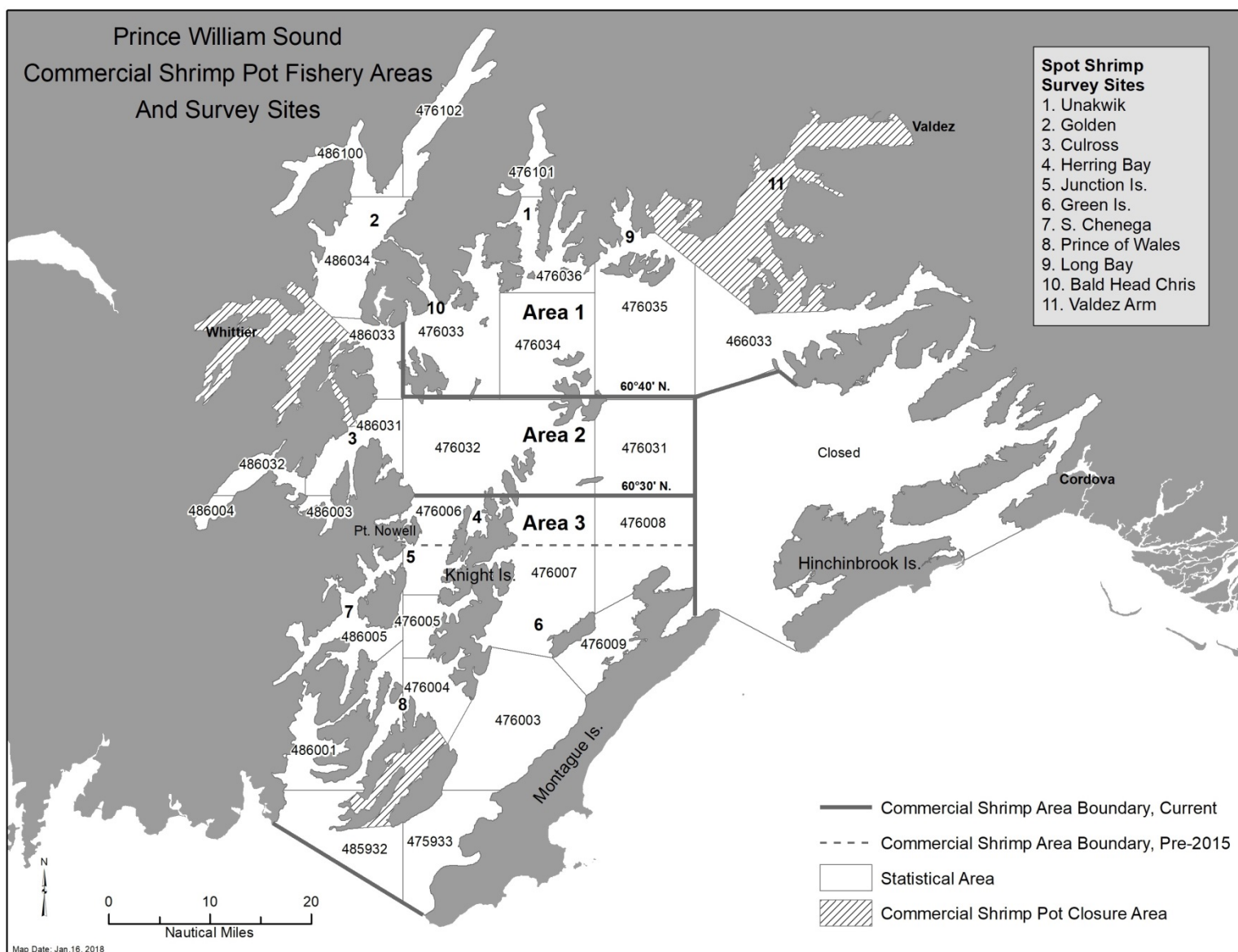


Figure 2.—Prince William Sound commercial management areas and index survey sites for spot shrimp.

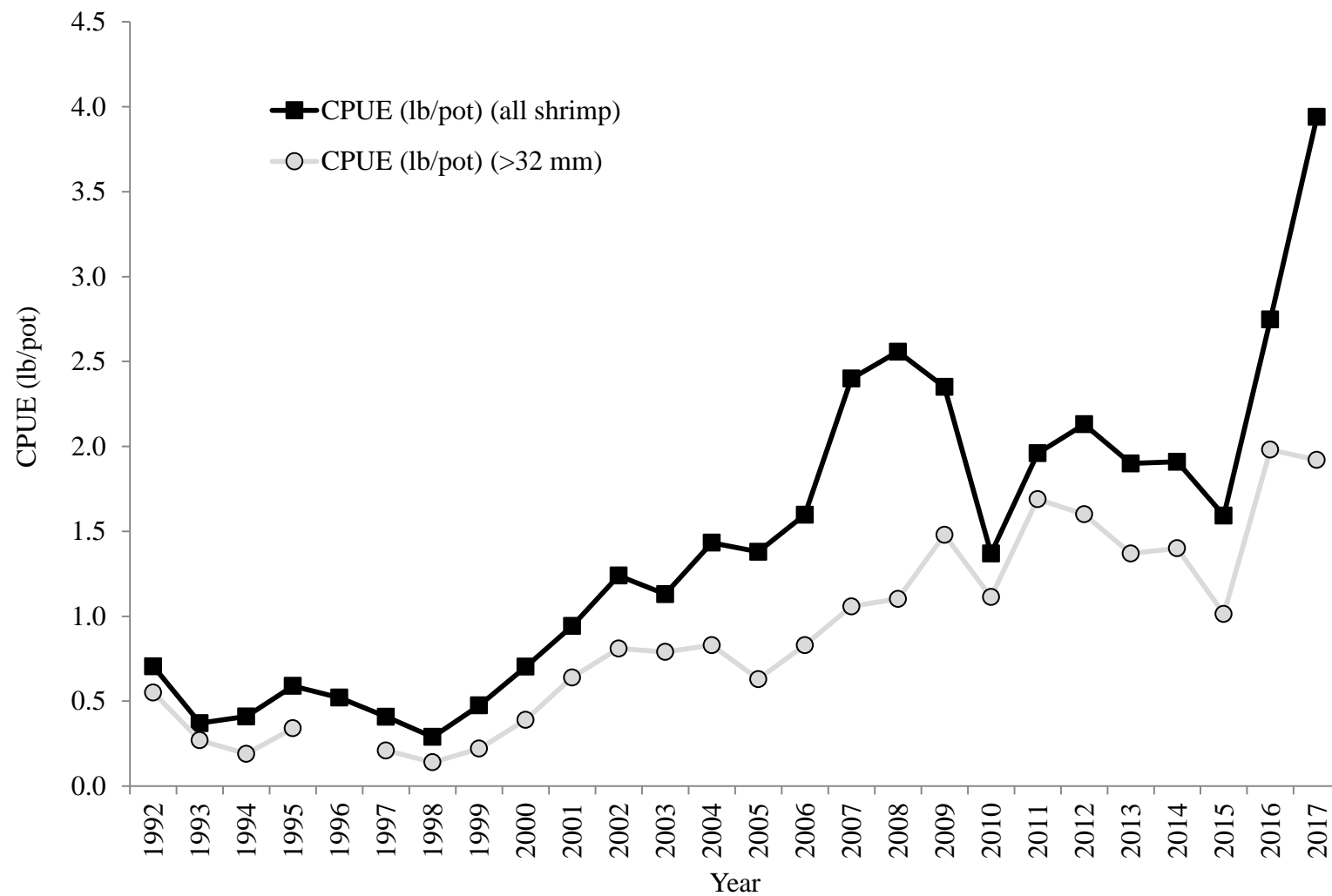


Figure 3.—Prince William Sound spot shrimp survey average catch per unit effort (CPUE) for all spot shrimp and commercially marketable spot shrimp (those equal to or greater than 32 mm in carapace length), 1992–2017.



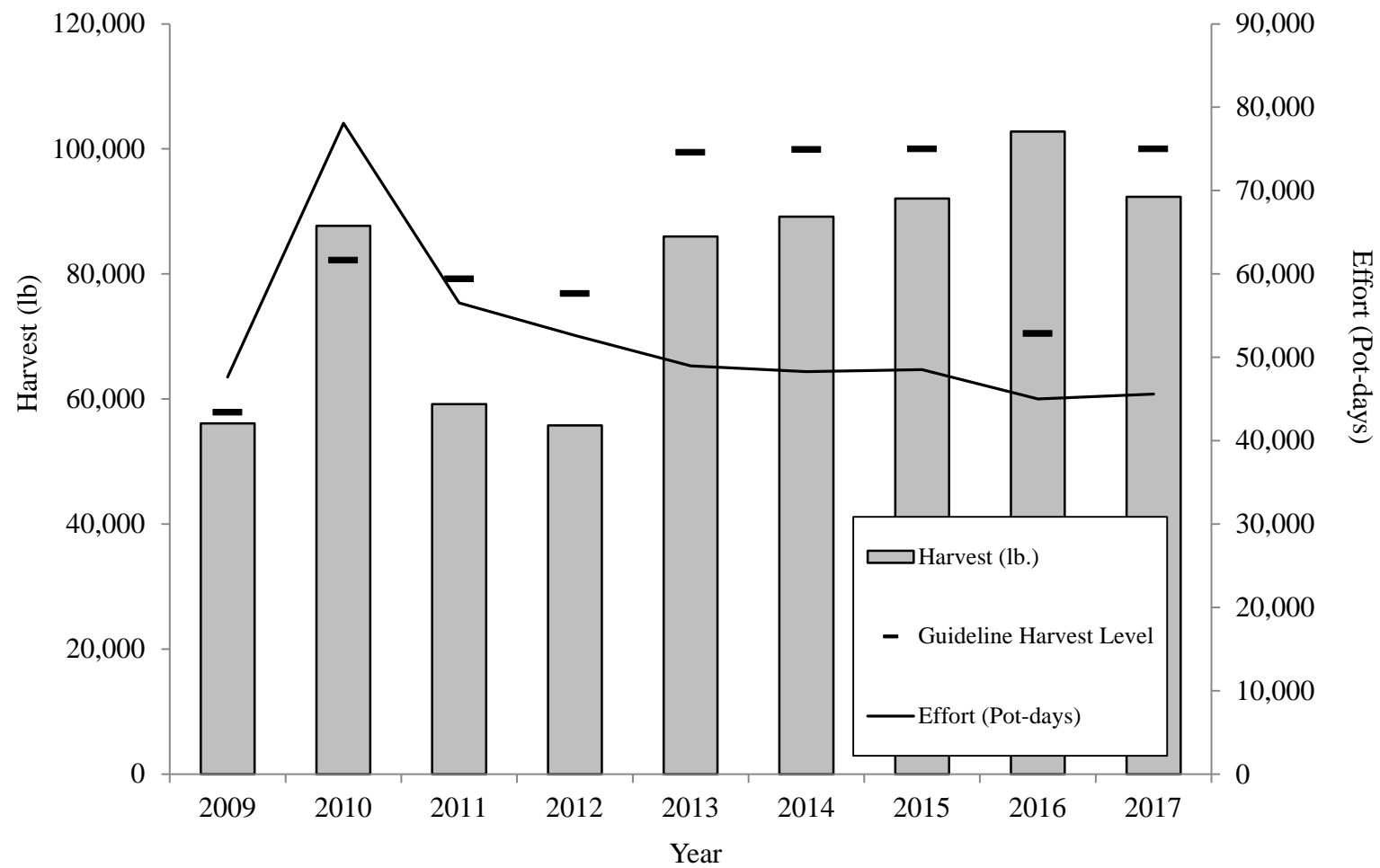


Figure 4.—Guideline harvest level (GHL), effort (pot-days), and harvest (lb) in the noncommercial shrimp fishery in the Prince William Sound Management Area (PWSMA), 2009–2017.

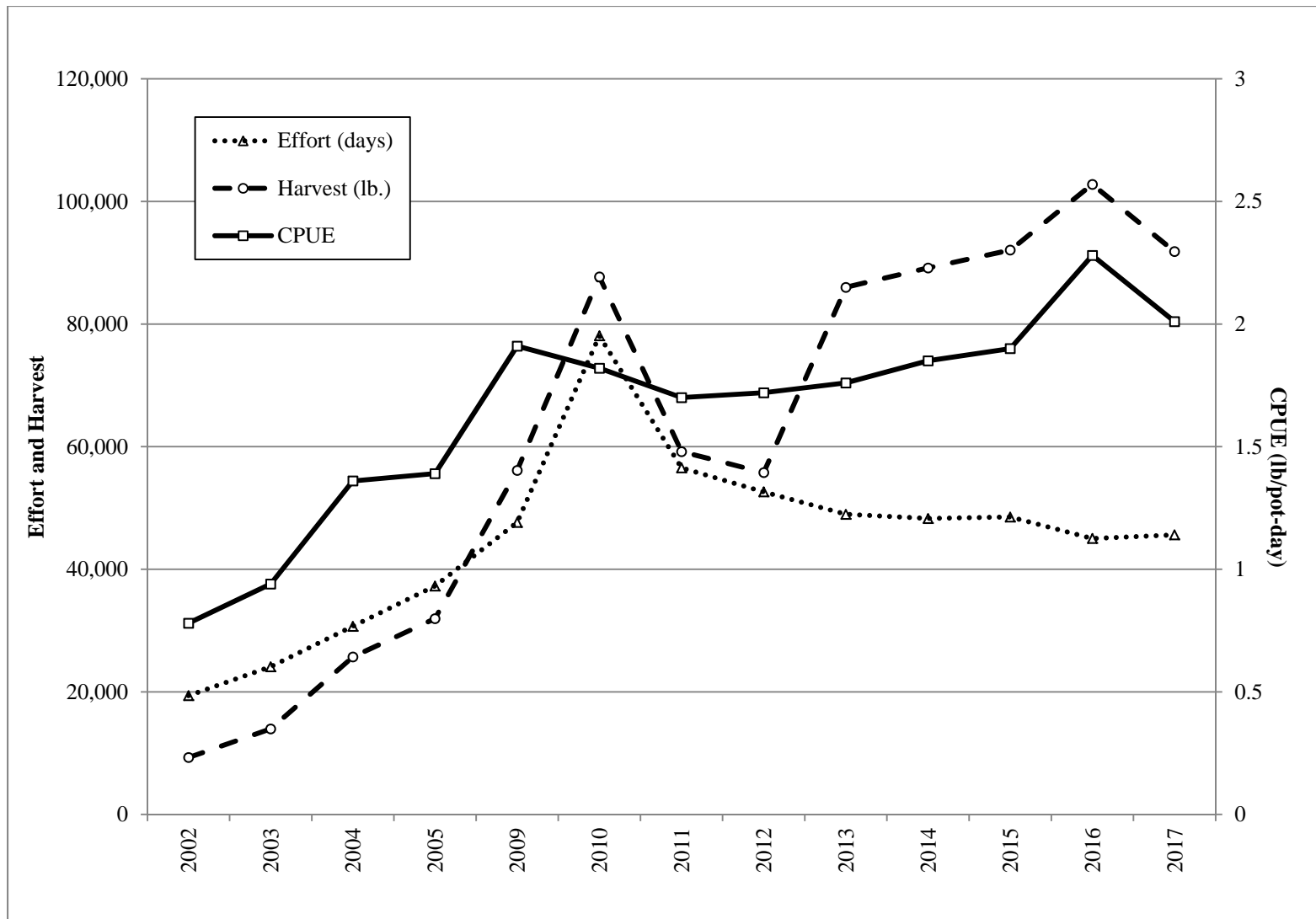


Figure 5.—Total estimated harvest, effort, and catch per unit effort (pounds of whole shrimp caught in 1 pot soaked for 24 hours; CPUE) in the noncommercial pot shrimp fishery of Prince William Sound, 2002–2005, 2009–2017.

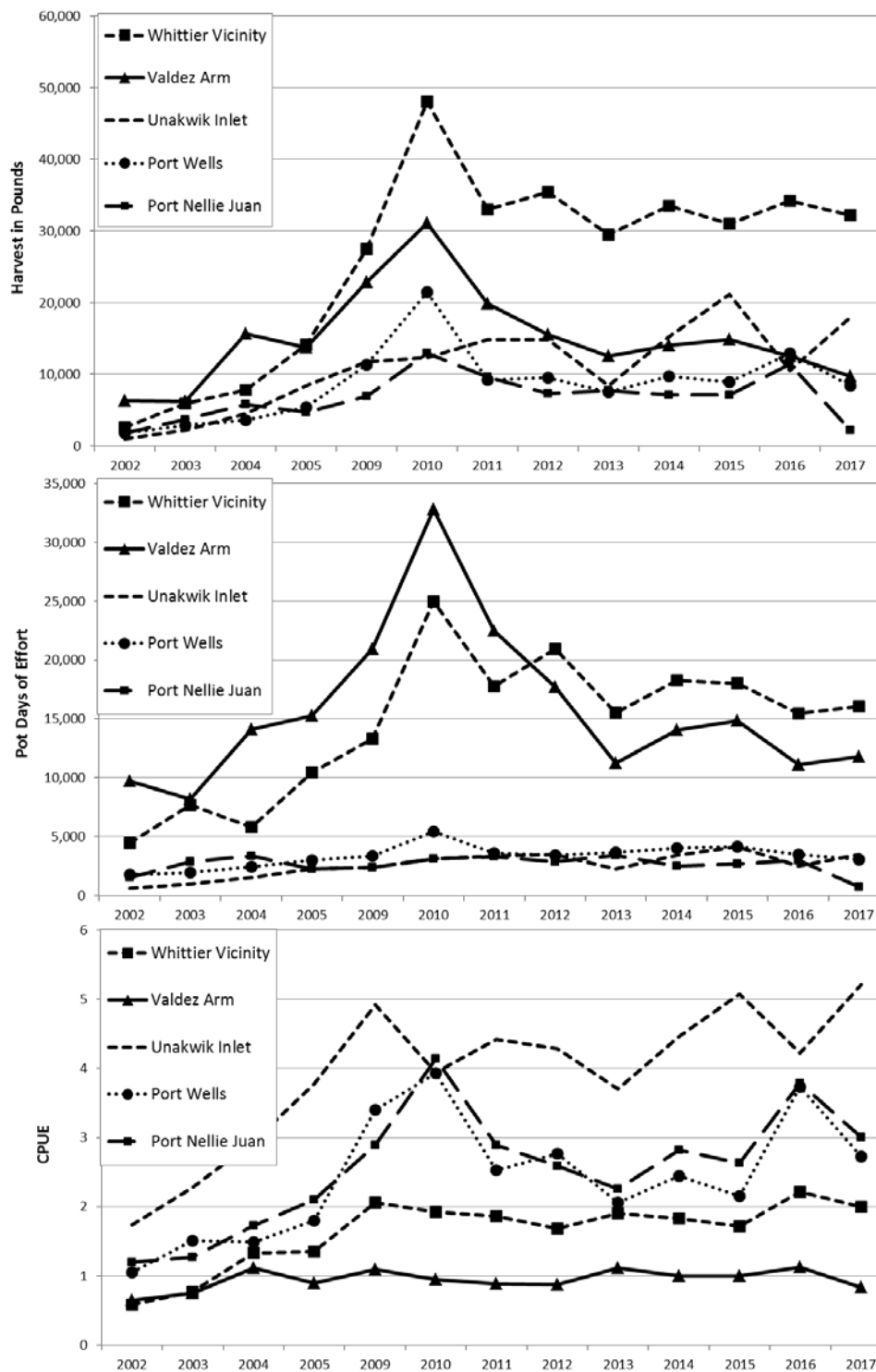


Figure 6.—Harvest, effort, and catch per unit effort (pounds of whole shrimp caught in 1 pot soaked for 24 hours) at the 5 major statistical areas in the noncommercial pot shrimp fishery of Prince William Sound, 2002–2005, 2009–2017.



## **APPENDIX A: SHRIMP PERMIT**

## The logo of the Alaska Department of Fish and Game is a circular emblem. The word "ALASKA" is written in a semi-circle at the top, and "DEPARTMENT OF FISH AND GAME" is written in a semi-circle at the bottom. The center of the logo is divided into three horizontal sections: the top section shows a fish jumping out of the water, the middle section shows a moose standing on a patch of land, and the bottom section shows a fish swimming in the water.

|                                                                                                                    |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  |                                                                                                                                                                                                                   |  |                      |  |
|--------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|----------------------|--|--|--|----------------------|--|--|--|----------------------|--|--|--|--|--|--|--|----------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------|--|
| Last Name                                                                                                          |  |  |  |  |  |  |  |                      |  |  |  | First Name           |  |  |  |                      |  |  |  |  |  |  |  | Initial              |  | <input type="radio"/> Alaska Resident<br><input type="radio"/> Non-Resident                                                                                                                                       |  |                      |  |
| <input type="text"/>                                                                                               |  |  |  |  |  |  |  |                      |  |  |  | <input type="text"/> |  |  |  |                      |  |  |  |  |  |  |  | <input type="text"/> |  |                                                                                                                                                                                                                   |  |                      |  |
| Mailing Address                                                                                                    |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  | Sport Fishing License #                                                                                                                                                                                           |  |                      |  |
| <input type="text"/>                                                                                               |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  | <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> |  |                      |  |
| City                                                                                                               |  |  |  |  |  |  |  | State                |  |  |  | Zip Code             |  |  |  | Phone Number         |  |  |  |  |  |  |  | Driver's License #   |  |                                                                                                                                                                                                                   |  | State                |  |
| <input type="text"/>                                                                                               |  |  |  |  |  |  |  | <input type="text"/> |  |  |  | <input type="text"/> |  |  |  | <input type="text"/> |  |  |  |  |  |  |  | <input type="text"/> |  |                                                                                                                                                                                                                   |  | <input type="text"/> |  |
| E-Mail Address (Optional but highly recommended)                                                                   |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  |                                                                                                                                                                                                                   |  |                      |  |
| <input type="text"/>                                                                                               |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  |                                                                                                                                                                                                                   |  |                      |  |
| Names Of Other Household Members (this permit may only be used by the permit holder or by individuals listed here) |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  |                                                                                                                                                                                                                   |  |                      |  |
| <input type="text"/>                                                                                               |  |  |  |  |  |  |  |                      |  |  |  |                      |  |  |  |                      |  |  |  |  |  |  |  |                      |  |                                                                                                                                                                                                                   |  |                      |  |

- ▶ **You must have this permit with you while taking shrimp** in the waters of Prince William Sound (from Cape Fairfield to Cape Suckling).
- ▶ See the Southcentral Sport Fishing Regulations for complete descriptions of shrimp pot regulations (including marking requirements).
- ▶ If you share pots with a friend or relative, be careful to report each harvest on only ONE permit.
- ▶ By signing this permit you agree to all conditions and terms of this fishery. See back side of permit for additional information.
- ▶ 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.
- ▶ You must submit a report even if you did not fish.
- ▶ **Final report must be completed online or by submitting a hard copy of the permit in person or by mail to the address on the reverse side by October 15th, 2017.**

|                         |      |        |                  |
|-------------------------|------|--------|------------------|
| Permit Holder Signature | Date | Vendor | Vendor Signature |
|                         |      |        |                  |

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. Vendors are responsible for verifying that ALL identifying information on this form is complete.
3. Write in your vendor number and sign your name. Unless optional, DO NOT let applicant leave any blank spaces except sport fishing license field if the applicant is only subsistence shrimping. DO NOT allow people to walk out with vendor copy (copy with these instruction on them) or 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 Anchorage Fish & Game.
5. You (Vendor) keep the top (white) copy to mail back to Anchorage Fish & Game weekly. The permit holder gets the bottom copy.
6. Return your top copies **each week** to Anchorage Fish & 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 -SF  
PRINCE WILLIAM SOUND SHRIMP PERMITS  
333 Raspberry Rd.  
Anchorage, AK 99518-1599

Weekly return of vendor copy 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, 2017.

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

40



# Alaska Department of Fish & Game 2017 Prince William Sound Shrimp Permit


☐ replacement for lost original

Last Name  First Name  Initial   
 Mailing Address  Sport Fishing License #  ◀ sport only  
 City  State  Zip Code  Phone Number  -  -  Driver's License #  State   
 E-Mail Address   
 Names Of Other Household Members (this permit may only be used by the permit holder or by individuals listed here)

**This permit is valid for the period April 15<sup>th</sup> – September 15<sup>th</sup>, 2017**

- ▶ You must have this permit with you while taking shrimp in the waters of Prince William Sound (from Cape Fairfield to Cape Suckling).
- ▶ See the Southcentral Sport Fishing Regulations for complete descriptions of shrimp pot regulations (including marking requirements).
- ▶ If you share pots with a friend or relative, be careful to report each harvest on only ONE permit.
- ▶ By signing this permit you agree to all conditions and terms of this fishery. See back side of permit for additional information.
- ▶ 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.
- ▶ You must submit a report even if you did not fish.
- ▶ Final report must be completed online or by submitting a hard copy of the permit in person or by mail to the address on the reverse side by October 15th, 2017.



Permit Holder Signature  Date  Vendor  Vendor Signature

▶ Was this permit used to set shrimp pots in 2017? ☐ YES ☐ NO

Number of lost shrimp pots:

How to enter for gallons of harvested shrimp:

Example: 0.5 = harvest ½ gallon whole shrimp (shrimp heads on)

| DATE |                      | LOCATION shrimp was harvested from in Prince William Sound | NUMBER OF POTS FISHED | TIME SOAKED          | WHOLE SHRIMP HARVESTED |
|------|----------------------|------------------------------------------------------------|-----------------------|----------------------|------------------------|
| MM   | DD                   | Examples include: specific bay, fjord, canal, arm, etc.    | Pots                  | Hours                | Gallons                |
| 1.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 2.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 3.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 4.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 5.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 6.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 7.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 8.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 9.   | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 10.  | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 11.  | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |
| 12.  | <input type="text"/> | <input type="text"/>                                       | <input type="text"/>  | <input type="text"/> | <input type="text"/>   |

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

-continued-

| Summary of regulations                               | Sport                                                                                 | Subsistence                                                              |
|------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Alaska residency required?                           | No                                                                                    | Yes                                                                      |
| Fishing license required?                            | Yes                                                                                   | No                                                                       |
| Open season?                                         | April 15 - September 15                                                               |                                                                          |
| Bag limit?                                           | none                                                                                  |                                                                          |
| Number of pots allowed?<br>Pot limit reduced in 2017 | Per Emergency Order: <b>Only 4 pots per vessel may be used to take shrimp in 2017</b> |                                                                          |
| Open areas?                                          | All salt waters of PWS                                                                | All salt waters of PWS (except "Valdez non-subsistence area", see below) |
| Can keep crab caught?                                | No                                                                                    |                                                                          |
| Can keep finfish?                                    | 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](http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.nonsub_detail&area=Valdez)

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### Summary Of Shrimp Pot Regulations

- 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.
- 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.
- 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.
- The 7/8-inch requirement does not apply to the tunnels.

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PLACE  
STAMP  
HERE

**IMPORTANT:**  
Report online at <http://fish.alaska.gov/PWS>  
OR mail this permit to Fish and Game by  
October 15th, 2017 even if you did not fish.



STATE OF ALASKA  
DEPARTMENT OF FISH & GAME - SPORT FISH  
PRINCE WILLIAM SOUND SHRIMP PERMITS  
333 RASPBERRY RD  
ANCHORAGE AK 99518-1599

use tape here if mailing – do not staple



use tape here if mailing – do not staple



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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.

### Guide to reporting accurately:

MM/DD = Month and  
Day shrimp gear  
deployed.

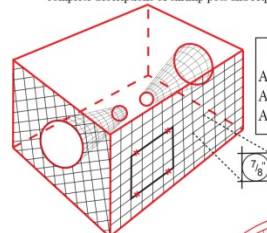
Location = specific  
name of bay, canal,  
arm or fjord in P.W.S.

Time soaked = The hours between when you dropped  
your gear to the time you retrieve or check your gear.

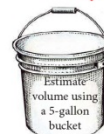
Harvest must be recorded as you are actively shrimping on paper permit. Final reports can be submitted to ADF&G after each trip (online) or at the conclusion of the season (September 15).

use tape here when mailing – do not staple

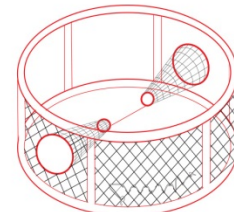
See the most recent Southcentral Sport Fishing Regulations for more complete descriptions of shrimp pots and required escape mechanisms.



Contact Information:  
ADF&G SF info. 267-2218  
ADF&G Cordova 424-3212  
AK Troopers 352-5401



Gallons = Volume of whole  
shrimp (with shrimp heads  
attached).



use tape here when mailing – do not staple



## **APPENDIX B: REMINDER LETTER**

Appendix B1.–Copy of reminder letter sent to nonrespondent permit holders.

---

December 28, 2017

To: «first\_name» «last\_name»  
«address»  
«city», «state» «zipcode»

**From:** Jay Baumer (Area Management Biologist) [jay.baumer@alaska.gov](mailto:jay.baumer@alaska.gov)  
Brittany Blain (Assistant Area Biologist) [brittany.blain@alaska.gov](mailto:brittany.blain@alaska.gov)

**Subject:** 2017 Prince William Sound Area Non-Commercial Shrimp Permits

---

Our records show that you have not returned your **2017 Prince William Sound Shrimp permit**. Even if you think you have returned your permit, it still has not reached us. Please return the original permit, use the Harvest Report on the back of this page, OR enter your harvest data online here: <https://www.adfg.alaska.gov/sf/PU/>. If you enter your data online your permit number is: XXXXXXXX. If you choose to mail it please put this sheet or your original permit in an envelope then seal the envelope, apply postage and mail to the address below.

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. Please turn in your report or enter it online immediately.

**MAIL RESPONSES TO:**  
PWS Shrimp Permit  
Alaska Department of Fish and Game  
Sport Fish Division  
333 Raspberry Road  
Anchorage, AK 99518

Sincerely,

*Jay Baumer*

Jay Baumer, Area Management Biologist  
Anchorage/Prince William Sound/ North Gulf Coast  
Division of Sport Fish

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-continued-



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

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

[illegible]

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

Alaska Department of Fish and Game  
Sport Fish Division  
333 Raspberry Road  
Anchorage, AK 99518  
Re: Permit no. «permitno»

Place  
First  
Class  
Postage  
Here

**PSW Shrimp Permit**  
**Alaska Department of Fish and Game**  
**Sport Fish Division**  
**333 Raspberry Road**  
**Anchorage, AK 99518**