

# Report to the Alaska Board of Fisheries

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## **DRAFT: McDonald Lake Sockeye Salmon Stock Status and Action Plan, 2018**

**By**

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January 2018

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the *Système International d'Unités* (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

|                                       |                    |  |   |   |                         |
|---------------------------------------|--------------------|--|---|---|-------------------------|
| <b>Weights and measures (metric)</b>  |                    | <b>General</b>                                   |   | <b>Mathematics, statistics</b>                                    |                         |
| centimeter                            | cm                 | Alaska Administrative Code                       | AAC   | <i>all standard mathematical signs, symbols and abbreviations</i> |                         |
| deciliter                             | dL                 | all commonly accepted abbreviations              | e.g., Mr., Mrs., AM, PM, etc.               | alternate hypothesis  | $H_A$                   |
| gram                                  | g                  | all commonly accepted professional titles        | e.g., Dr., Ph.D., R.N., etc.                | base of natural logarithm   | $e$                     |
| hectare                               | ha                 | at   | @   | catch per unit effort   | CPUE                    |
| kilogram                              | kg                 | compass directions:                              |   | coefficient of variation  | CV                      |
| kilometer                             | km                 | east   | E   | common test statistics  | (F, t, $\chi^2$ , etc.) |
| liter                                 | L                  | north  | N   | confidence interval   | CI                      |
| meter                                 | m                  | south  | S   | correlation coefficient   |                         |
| milliliter                            | mL                 | west   | W   | (multiple)  | R                       |
| millimeter                            | mm                 | copyright  | ©   | correlation coefficient   |                         |
|                                       |                    | corporate suffixes:                              |   | (simple)  | r                       |
| <b>Weights and measures (English)</b> |                    | Company  | Co.   | covariance  | cov                     |
| cubic feet per second                 | ft <sup>3</sup> /s | Corporation                                      | Corp.                                       | degree (angular)  | °                       |
| foot                                  | ft                 | Incorporated                                     | Inc.  | degrees of freedom  | df                      |
| gallon                                | gal                | Limited  | Ltd.  | expected value  | $E$                     |
| inch                                  | in                 | District of Columbia                             | D.C.  | greater than  | >                       |
| mile                                  | mi                 | et alii (and others)                             | et al.                                      | greater than or equal to  | ≥                       |
| nautical mile                         | nmi                | et cetera (and so forth)                         | etc.  | harvest per unit effort   | HPUE                    |
| ounce                                 | oz                 | exempli gratia                                   |   | less than   | <                       |
| pound                                 | lb                 | (for example)                                    | e.g.  | less than or equal to   | ≤                       |
| quart                                 | qt                 | Federal Information Code                         | FIC   | logarithm (natural)   | ln                      |
| yard                                  | yd                 | id est (that is)                                 | i.e.  | logarithm (base 10)   | log                     |
|                                       |                    | latitude or longitude                            | lat. or long.                               | logarithm (specify base)  | log <sub>2</sub> , etc. |
| <b>Time and temperature</b>           |                    | monetary symbols                                 |   | minute (angular)  | '                       |
| day                                   | d                  | (U.S.)   | \$, ¢                                       | not significant   | NS                      |
| degrees Celsius                       | °C                 | months (tables and figures): first three letters | Jan, ..., Dec                               | null hypothesis   | $H_0$                   |
| degrees Fahrenheit                    | °F                 | registered trademark                             | ®   | percent   | %                       |
| degrees kelvin                        | K                  | trademark  | ™   | probability   | P                       |
| hour                                  | h                  | United States                                    | U.S.  | probability of a type I error                                     |                         |
| minute                                | min                | (adjective)                                      | U.S.  | (rejection of the null hypothesis when true)                      | $\alpha$                |
| second                                | s                  | United States of America (noun)                  | USA   | probability of a type II error                                    |                         |
|                                       |                    | U.S.C.   | United States Code                          | (acceptance of the null hypothesis when false)                    | $\beta$                 |
| <b>Physics and chemistry</b>          |                    | U.S. state                                       | use two-letter abbreviations (e.g., AK, WA) | second (angular)  | "                       |
| all atomic symbols                    |                    |  |   | standard deviation  | SD                      |
| alternating current                   | AC                 |  |   | standard error  | SE                      |
| ampere                                | A                  |  |   | variance  |                         |
| calorie                               | cal                |  |   | population  | Var                     |
| direct current                        | DC                 |  |   | sample  | var                     |
| hertz                                 | Hz                 |  |   |   |                         |
| horsepower                            | hp                 |  |   |   |                         |
| hydrogen ion activity                 | pH                 |  |   |   |                         |
| (negative log of)                     |                    |  |   |   |                         |
| parts per million                     | ppm                |  |   |   |                         |
| parts per thousand                    | ppt, ‰             |  |   |   |                         |
| volts                                 | V                  |  |   |   |                         |
| watts                                 | W                  |  |   |   |                         |

***REPORT TO THE ALASKA BOARD OF FISHERIES***

**DRAFT MCDONALD LAKE SOCKEYE SALMON STOCK STATUS AND  
ACTION PLAN, 2018**

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## ABSTRACT

In response to guidelines established in the *Policy for Management of Sustainable Fisheries* (5 AAC 39.22), the Alaska Department of Fish and Game recommended that McDonald Lake sockeye salmon (*Oncorhynchus nerka*) be designated as a “stock of management concern.” A “management concern” is defined as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG [sustainable escapement goal], BEG [biological escapement goal], OEG [optimum escapement goal], or other specified management objectives for the fishery.” Escapement of McDonald Lake sockeye salmon has fallen below the lower bound of the current sustainable escapement goal range in 4 of the past 5 consecutive years, 2013–2017. McDonald Lake sockeye salmon are harvested primarily in commercial net fisheries, as identified by past stock composition information and current genetic stock identification analyses. This action plan report provides stock assessment information and presents options for reducing harvest of McDonald Lake sockeye salmon in commercial, personal use, and sport fisheries.

Key words: McDonald Lake, sockeye salmon, *Oncorhynchus nerka*, stock of concern, action plan, commercial harvest, sustainable salmon fisheries policy, Alaska Board of Fisheries, Southeast Alaska.

## INTRODUCTION

The *Policy for Management of Sustainable Salmon Fisheries* (5 AAC 39.222) directs the Alaska Department of Fish and Game (department) to provide the Alaska Board of Fisheries (board) with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation during regularly-scheduled board meetings. In October 2017, the department recommended that the board designate McDonald Lake sockeye salmon as a stock of management concern at the regulatory board meeting for the Southeast and Yakutat Management Area in January 2018<sup>1</sup>. This recommendation was based on guidelines established in the sustainable salmon policy. The policy states that a “management concern means a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG [sustainable escapement goal], BEG [biological escapement goal], OEG [optimal escapement goal], or other specific management objectives for the fishery...” Chronic inability is further defined in the policy as “...the continuing or anticipated inability to meet escapement thresholds over a 4 to 5 year period, which is approximately the generation time of most salmon species.”

This action plan report provides the department’s assessment of McDonald Lake sockeye salmon (*Oncorhynchus nerka*) as a stock of management concern, summarizes historical assessments of annual run sizes, and describes the existing regulations and emergency order (EO) authority that the department follows to manage the McDonald Lake sockeye salmon run. The plan lists potential management actions for the commercial, personal use, and sport fisheries, and outlines research projects for this stock. Criteria that must be met for future removal of the stock of concern designation are also outlined. The action plan will be presented to the board and public as a final review draft at the 2018 Southeast and Yakutat board meeting. Immediately following the meeting, the department will finalize this report and include descriptions of any management measures or recommendations from the board related to McDonald Lake sockeye salmon. The final action plan will be published in the Regional Informational Report series in early 2018.

McDonald Lake, located on the Southeast Alaska (SEAK) mainland, approximately 40 miles north of Ketchikan (Figure 1), supports one of the largest sockeye salmon runs in southern SEAK. Like most major SEAK sockeye salmon systems, the McDonald Lake run has a history

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<sup>1</sup> Unpublished memorandum from S. Kelley and T. Brookover, ADF&G, to Board of Fisheries, 29 September 2017.



of commercial exploitation and hatchery operation during the late 19th and early 20th centuries (Roppel 1982). Total run size was thought to exceed 100,000 fish in 1909 and 1911, and more than 200,000 fish in 1910 (Johnson et al. 2005). Subsequently, little was known about the run until 1981, when 129,653 sockeye salmon were counted at a weir operated near the outlet of the lake.

McDonald Lake was the target of a long-term lake fertilization enhancement project initiated in 1982 and continued through 2004 (Johnson et al. 2005). McDonald Lake sockeye salmon runs were strong during much of the enhancement period, and escapements averaged more than 100,000 fish through 2000. The stock was actively managed during the 1990s, and fish that were expected to be in excess of the escapement goal were harvested in a terminal purse seine fishery in upper West Behm Canal. The McDonald Lake stock has also supported the largest personal-use fishery in southern SEAK at Yes Bay, including a maximum reported harvest of more than 10,000 fish in 1994. In addition, McDonald Lake sockeye salmon were used as a brood source for enhancement projects at a number of other sites in southern SEAK (Johnson et al. 2005).

The McDonald Lake sockeye salmon run underwent a decline in recruitment starting in the late 1990s and escapements fell below the current sustainable escapement goal range of 55,000–120,000 sockeye salmon in 4 out of 5 consecutive years from 2004 to 2008 (Figure 2). The decline in recruitment and subsequent escapements occurred during the lake fertilization period (Figure 3). The McDonald Lake run was designated a stock of management concern at the 2009 Southeast and Yakutat board meeting and an action plan was developed to reduce harvest on the run (Bergmann et al. 2009). Management measures in the action plan were focused on areas and times when the stock is most prevalent in the commercial drift gillnet and purse seine fisheries closest to McDonald Lake. The escapement goal was met for 3 consecutive years from 2010 to 2012 and the stock of concern designation was removed; however, recent escapements fell below the sustainable escapement goal range in 4 out of 5 consecutive years from 2013 to 2017 (Figure 2).

## **STOCK ASSESSMENT BACKGROUND**

### **ESCAPEMENT**

McDonald Lake sockeye salmon escapements are estimated from standardized foot survey counts at Hatchery Creek, the primary spawning tributary. Sockeye salmon enter the system from early July to early September (mid-point of weir counts occurred between 6 and 15 August), and spawn from late August to mid-October; peak spawning activity typically occurs in mid-September. Foot surveys are conducted annually on approximately 10 September, 20 September, and 28 September to capture the peak of spawning abundance. Surveys cover the entire 1.5 km-length of the creek accessible to sockeye salmon. Stream characteristics, including shallow depth over nearly the entire survey length, relatively narrow stream width, and contrasting pale granite substrate provide excellent conditions for counting fish. The peak annual survey count is multiplied by an expansion factor of 4.85 to estimate total escapement. The expansion factor was based on comparison of peak foot survey counts to 6 years of population estimates from weir counts (1980, 1983, and 1984) and mark–recapture studies (2005–2007) (Heinl et al. 2009).

## HARVEST

### Commercial Fisheries

During their return migration, adult McDonald Lake sockeye salmon move through offshore waters along the west coast of Prince of Wales Island and into inside waters from the north through Sumner Strait and from the south through Dixon Entrance, then through Clarence Strait and adjacent bodies of water to West Behm Canal and on to McDonald Lake (Figure 1). As a result, McDonald Lake sockeye salmon contribute to every commercial net fishery in southern SEAK (Districts 1–8) from early July to late August. Comprehensive information regarding harvest is limited because most of these fisheries are distant from McDonald Lake and because they are conducted on mixed stocks and do not specifically target McDonald Lake sockeye salmon. This is particularly true of purse seine fisheries, which are largely managed to harvest pink salmon (*O. gorbuscha*; Clark et al. 2006).

Information regarding the commercial harvest has been obtained from various projects conducted intermittently since the early 1980s:

- 1) 1982–1983: U.S.-Canada marine tagging studies provided general information on migration routes and areas where McDonald Lake sockeye salmon were harvested (Hoffman et al. 1983, 1984).
- 2) 1985 and 1989–1991: coded wire tagging studies provided information on harvest rate and distribution (Johnson et al. 2005).
- 3) 2007–2009: genetic stock identification (GSI) studies (Gilk-Baumer et al. 2013) provided information regarding harvest in commercial fisheries specifically identified in the 2009 McDonald Lake action plan (Bergmann et al. 2009).
- 4) 2011–2012: otolith sampling studies provided general information on harvest distribution and timing (Brunette et al. 2015).
- 5) 2014–present: U.S.-Canada GSI information has provided the best information to date on harvest rate and harvest distribution and timing (ADF&G Gene Conservation Laboratory, unpublished data).

**Commercial Harvest Rate:** Commercial harvest rates on McDonald Lake sockeye salmon in distant mixed stocked fisheries have been estimated in 7 years. Harvest rates in 1985, 1989, and 1990 averaged 41% (range: 32–48%) based on total harvests estimated from coded wire tag recoveries (Johnson et al. 2005). Harvest rates during 2014–2017 averaged 47% (range: 26–63%) based on total harvests estimated from U.S.-Canada GSI information (Appendix E). These estimates represent minimum values since not all fisheries were sampled in all years, thus harvest rates were probably slightly higher than estimated. Harvest rates from 1991 to 2001 were substantially higher due to additional harvest of McDonald Lake sockeye salmon in terminal commercial purse seine fisheries conducted in upper West Behm Canal. In these years, the department conducted test fisheries in West Behm Canal to determine run strength, then opened terminal fisheries to harvest sockeye salmon in excess of escapement needs (Johnson et al. 2005). Total harvest rate in years when terminal fisheries were conducted averaged 61% (range: 47–84%) and terminal harvests averaged 60,000 fish (Figure 2), including maximum harvests of 142,000 fish (1993) and 210,000 fish (1996). Terminal commercial fisheries have not been conducted since 2004.

**Commercial Harvest Distribution:** Comprehensive information regarding the distribution of McDonald Lake sockeye salmon throughout all southern SEAK commercial mixed stock

fisheries is available for 8 years, based on coded wire tag recoveries in 1985 and 1989–1991, and GSI information, 2014–present. Additional information is available for specific areas in other years, but not the entire region. The largest harvests of McDonald Lake sockeye salmon generally occurred in the District 4 purse seine fishery off the west coast of Prince of Wales Island, the District 1 and 2 purse seine fisheries in Clarence Strait, and the District 6 drift gillnet fishery in Sumner and Clarence straits (Figure 1). During 1985 and 1989–1991, an average 18% of coded-wire-tagged McDonald Lake sockeye salmon were recovered in the District 4 purse seine fishery, 18% in the District 1 purse seine fishery, 13% in the District 2 purse seine fishery, and 37% in the District 6 drift gillnet fishery (Appendix A; Johnson et al. 2005). During 2014–2017, an average 36% of the McDonald Lake sockeye salmon harvest occurred in the District 4 purse seine fishery, 19% in the District 1 purse seine fishery, 6% in the District 2 purse seine fishery, and 30% in the District 6 drift gillnet fishery (Appendix E; ADF&G Gene Conservation Laboratory, unpublished data). Otolith sampling data obtained during 2011–2012 generally showed a similar harvest distribution, though estimates were imprecise (Appendix I; Brunette et al. 2015).

**Commercial Harvest Timing:** Management measures in the 2009 McDonald Lake action plan were based on inferences about overall run timing and the distribution and timing of coded-wire-tagged McDonald Lake sockeye salmon in the commercial harvest (Johnson et al. 2005; Bergmann et al. 2009). In 1989 and 1990, approximately 90% of coded wire tag recoveries in the District 6 drift gillnet fishery occurred during a 5-week period from statistical week (SW) 28 to 32 (approximately early July to mid-August; see Table 1 for average SW dates). Management measures therefore were focused primarily on reducing the harvest of McDonald Lake sockeye salmon during a 3-week period (SWs 29–31) in the District 6 drift gillnet fishery, adjacent District 2, 5, 6 and 7 purse seine fisheries, and the District 1 purse seine fishery (Table 2; Figure 4). Studies conducted since the 2009 action plan was developed have largely corroborated the utility of those management measures for reducing the harvest of McDonald Lake sockeye salmon, and further suggest that restrictions may be more effective if shifted or extended into later SWs.

**2007–2009:** The department conducted a GSI project to determine if area and timing measures stipulated in the 2009 action plan were appropriate (Gilk-Baumer et al. 2013). Sockeye salmon tissue samples were collected and analyzed from commercial drift gillnet harvests in subdistricts 106-30 (Clarence Strait) and 106-41 (Sumner Strait) and purse seine harvests in subdistricts 101-29 (Gravina Island shoreline) and 107-10 (Ernest Sound).

- In the Subdistrict 106-41 drift gillnet fishery, McDonald Lake fish comprised 16–32% of the weekly sockeye salmon harvest during SWs 29–34 (Appendix B).
- In the Subdistrict 106-30 drift gillnet fishery, McDonald Lake fish comprised 21–57% of the weekly sockeye salmon harvest during SWs 30–34 (Appendix C).
- In the Subdistrict 101-29 purse seine fishery, McDonald Lake fish comprised 11–31% of the weekly sockeye salmon harvest during SWs 30–33 (Appendix D).
- In the Subdistrict 107-10 purse seine fishery, McDonald Lake fish comprised 30–60% of the sockeye salmon harvest when the fishery was open during SWs 31–34 (Appendix D).

**2011–2012:** The department conducted otolith sampling of commercial harvests for McDonald Lake sockeye salmon that were thermal marked by Southern Southeast Regional Aquaculture Association (Brunette et al. 2015; see Brood Source and Lake Stocking section, page 6).

- Thermal marked fish were most prevalent in drift gillnet subdistricts 106-41 and 106-30 and combined purse seine subdistricts 101-25/29.
- Peak harvests of thermal marked fish occurred in the combined subdistrict 101-25/29 purse seine fishery during SWs 31–32.
- Peak harvests of thermal marked fish occurred in the Subdistrict 106-41 drift gillnet fishery during SWs 32–33 in 2011, and SW 30 in 2012.
- Peak harvests of thermal marked fish occurred in the Subdistrict 106-30 drift gillnet fishery during SWs 31–33 in 2011, and SWs 30–32 in 2012.

**2014–2017:** Since 2014, the proportions of McDonald Lake fish in sockeye salmon harvests in southern SEAK commercial fisheries have been identified in conjunction with U.S.-Canada GSI studies (ADF&G Gene Conservation Laboratory, unpublished data).

- In the Subdistrict 106-41 drift gillnet fishery, McDonald Lake fish comprised 10–22% of the weekly sockeye salmon harvest from SW 28 (2014), 29 (2017) or 30 (2015, 2016) through SWs 32–34 (Appendix F).
- In the Subdistrict 106-30 drift gillnet fishery, McDonald Lake fish comprised 12–32% of the weekly sockeye salmon harvest from SW 29 (2014, 2017) or 30 (2015, 2016) through SWs 33–34 (Appendix G).
- Run timing in the districts 1 and 2 purse seine fisheries was more difficult to determine than in the drift gillnet fisheries, because estimates were applied to the entire district harvest (rather than by subdistrict) and SWs were often combined for analysis. In general, run timing of McDonald Lake sockeye salmon appeared to be slightly earlier in 2014 and 2017 than it was in 2015 and 2016 when peak contributions occurred during SWs 31–32 or later (Appendix H).

### **Personal Use Fishery**

McDonald Lake sockeye salmon are harvested in a personal use fishery immediately in front of the McDonald Lake outlet stream (Wolverine Creek) at Yes Bay, in upper West Behm Canal (Figure 5). Fish are primarily harvested with gillnet gear in saltwater, but limited numbers are also harvested with dip nets in Wolverine Creek. Personal use harvest has been monitored through permits issued annually since 1985. From 1985 to 1999, personal use fishermen were required to return permits with a record of their harvest. In 2000, permit requirements were changed in an effort to improve reporting; fishermen are required to report harvest from the previous year before being issued a new permit. Reported annual personal use harvest from 1985 to 2005 averaged approximately 5,600 sockeye salmon (range: 1,185–10,000 fish), and an average 273 permits were fished (Figure 6). Since 2006, the reported annual personal use harvest averaged approximately 1,300 sockeye salmon (range: 310–1,756 fish), and an average 112 permits were fished. Reported harvest may underestimate true harvest, particularly prior to 2000; however, the annual personal use harvest represents a very small portion (<3%) of the total McDonald Lake run. There is no subsistence fishery on McDonald Lake sockeye salmon, as the lake is located in the Ketchikan nonsubsistence area per 5 AAC 99.015 (1).

### **Sport Fisheries**

Sport fishing effort and harvest of McDonald Lake sockeye salmon is presumed to be very low. The Alaska Statewide Sport Fish Harvest Survey is designed to estimate sport fishing effort and harvest by location (Romberg 2016). Estimates of the McDonald Lake sockeye salmon sport

harvest are not available, however, due to the low number of respondents that report angling effort in the McDonald Lake and Yes Bay areas. In the greater Ketchikan area, which encompasses all of District 1, the recent 5-year average annual sport harvest of sockeye salmon (as estimated from the statewide harvest survey) is approximately 90 fish in freshwater and 1,700 fish in saltwater. There are no guided freshwater activities that target McDonald Lake sockeye salmon. Saltwater charter logbook data for the Ketchikan area indicates the average annual sockeye salmon harvest is 190 fish, suggesting that the saltwater harvest of sockeye salmon in the Ketchikan area is predominately non-charter (resident or unguided nonresident). Even if all the sockeye salmon harvested in the Ketchikan area were assumed to be McDonald Lake fish, the estimated sport harvest would account for a small fraction (3% of the recent 5-year average) of the total McDonald Lake run.

## **ENHANCEMENT**

### **Lake Fertilization**

A lake fertilization enhancement project was conducted at McDonald Lake from 1982 to 2004. The addition of fertilizer (nutrients) is intended to increase the food supply (zooplankton) of juvenile sockeye salmon, which will result in more and larger sockeye smolt and, in turn, more adult sockeye salmon (Burkett et al. 1989). The project was initiated following baseline studies of lake productivity conducted from December 1979 through 1981 (Koenings et al. 1982; Burkett et al. 1989; Olson 1989; Johnson et al. 2005). A variable amount of liquid fertilizer (nitrogen to phosphorous atomic ratio of 27:7) was applied to McDonald Lake each year based on the estimated late fall or early spring phosphorous concentration in the lake. A variety of limnological and fisheries sampling and assessment information was collected in association with the enhancement project, including smolt size and age (1981–1988), rearing fry abundance, lake physical characteristics (light and temperature), lake chemistry (phosphorus and nitrogen concentration), and primary (chlorophyll *a* concentration) and secondary (zooplankton density and biomass) production (Johnson et al. 2005).

The effects of the lake fertilization project are difficult to assess, because only 2 years (1980–1981) of lake productivity baseline data were collected prior to initiation of the project, and because the sockeye salmon run declined through the later years of the project. Early assessments concluded that natural variation in lake productivity measures masked effects that lake fertilization may have had on productivity (Olson 1989). No significant changes were observed in sockeye salmon fry growth rates, smolt sizes, or age composition, and only limited increase in overall zooplankton production was documented through 1987 (Burkett et al. 1989). The sockeye salmon escapements were strong before the lake was fertilized; e.g., escapements during 1981–1985 averaged 94,000 fish (Figure 3). It was thought that sockeye salmon production may have been artificially maintained at an elevated level because sockeye salmon runs continued to be very strong during much of the enhancement period; however, strong production due to unrelated environmental factors (e.g., favorable marine conditions) could not be ruled out (Burkett et al. 1989). Poor recruitment starting in the late 1990s resulted in a downward trend in escapement (Figure 3), and escapements in 2002 (42,000 fish) and 2004 (29,000 fish) were below the escapement goal range. The fertilization project was terminated because escapements declined steadily during the enhancement period and because small fry populations produced by poor escapements did not warrant continued nutrient enhancement.

## **Brood Source and Lake Stocking**

Lake stocking at McDonald Lake was limited to 5 years. McDonald Lake fry were back-planted into McDonald Lake in 1989 (3.5 million fish) and 1990 (1.0 million fish) (Johnson et al. 2005). More recently, Southern Southeast Regional Aquaculture Association (SSRAA) conducted a “Sentinel Stock” project to stock thermal marked McDonald Lake sockeye salmon smolt in the lake (Brunette et al. 2015). The primary purpose of this project was to provide marked fish that could be tracked through commercial fisheries when they returned as adults and provide improved information regarding the distribution and timing of McDonald Lake sockeye salmon in the commercial harvest. Sockeye salmon eggs were collected annually at the lake for 3 years, 2007–2009. Fish were thermal marked and reared at Burnett Inlet Hatchery, and full-term smolt were released at McDonald Lake in 2009 (276,000 fish), 2010 (160,000 fish), and 2011 (323,000 fish). Smolt were held in net pens for 24 hours to imprint at the mouth of Hatchery Creek prior to release and were expected to immediately migrate to saltwater with wild fish. Adult returns from this project were mixed: thermal marked fish accounted for approximately 18.8% of the escapement in 2012 (10,700 fish), but only 4.5% in 2011 (5,100 fish), 5.3% in 2013 (820 fish), and 0.5% in 2014 (220 fish) (Brunette et al. 2015).

The McDonald Lake sockeye salmon run has also been used as a brood source for enhancement projects at various locations in southern SEAK by the department, the U.S. Forest Service, and SSRAA. Sockeye salmon eggs were collected annually from 1988 to 1995 and fry were stocked at Virginia Lake (1989–1996), Margaret Lake (1990–1994), and Shrimp Bay (1992–1994). Those projects met with poor success (Edmundson et al. 1991; Cartwright et al. 1998; Piston 2004; Johnson et al. 2005). McDonald Lake sockeye salmon eggs were also collected from 1999 to 2003 and used as a brood source for a SSRAA sockeye salmon enhancement program at Burnett Inlet Hatchery and Neck Lake (Johnson et al. 2005); that program was discontinued after 2010.

## **ESCAPEMENT GOAL EVALUATION**

### **ESCAPEMENT GOAL HISTORY**

The McDonald Lake sockeye salmon run has been managed for 4 escapement goals since the late 1980s. The first escapement goal, set at 85,000 fish in 1989, was based on the euphotic volume habitat model of Koenings and Burkett (1987), which related physical water features of McDonald Lake to the carrying capacity of other sockeye salmon lakes throughout Alaska (Burkett et al. 1989; Geiger et al. 2004). In 1993, the escapement goal was changed to a range of 65,000–85,000 fish, based on an undocumented Ricker stock-recruit analysis; the goal was considered a biological escapement goal in 2003 (Geiger et al. 2004). In 2005, the goal was revised to a sustainable escapement goal range of 70,000–100,000 fish, based on a simple brood-year yield analysis (Johnson et al. 2005). The goal was considered a sustainable escapement goal due to uncertainty in estimated harvest and escapement.

The current sustainable escapement goal range of 55,000–120,000 sockeye salmon was established in 2009 (Eggers et al. 2009). The goal was based on a Ricker stock-recruit analysis of the 1980–2001 brood years, improved escapement estimates (Heinl et al. 2009), and assumed average commercial harvest rate of 41% in known mixed stock harvest areas, adjusted for additional harvest in terminal purse seine and personal use fisheries in West Behm Canal. The escapement goal represents the range of spawners predicted to provide 90% of maximum

sustained yield. The goal was defined as a sustainable escapement goal due to limited information on commercial harvest rates and because McDonald Lake was fertilized over most of the stock-recruit data set. The effect of lake fertilization on productivity is not clear, however, due to a lack of pre-fertilization baseline data and because the sockeye salmon run declined substantially during the lake fertilization period (Figure 3). It should also be noted that sockeye salmon production was at a high level regionwide during the 1980–2001 period upon which the McDonald Lake escapement goal was established.

## **SPAWNER DATA AND ESCAPEMENT GOAL ANALYSIS**

McDonald Lake sockeye salmon brood tables have been updated following the methods used to establish the current escapement goal (Eggers et al. 2009). Ricker stock-recruit analysis of the updated data set produced a slightly higher estimate of  $S_{MSY}$ , the escapement that provides maximum sustained yield:  $S_{MSY} = 90,000$  spawners for brood years 1980–2011 compared to  $S_{MSY} = 84,000$  spawners for brood years 1980–2001 (Eggers et al. 2009). The updated estimate of  $S_{MSY}$ , though larger, falls well within the current sustainable escapement goal range of 55,000–120,000 sockeye salmon. The probability that escapements within the current sustainable escapement goal range will provide greater than 80% of maximum sustained yield is estimated to be 70–90%. The probability of reducing yield (“over fishing”) to less than 80% of maximum sustained yield at the lower bound of the escapement goal is estimated to be 30% and increases steeply at escapements below 55,000 fish (e.g., approximately 40% at 50,000 fish and 53% at 45,000 fish). Results based on this analysis suggest no change is warranted to the current McDonald Lake sustainable escapement goal range.

## **ESCAPEMENT GOAL RECOMMENDATION**

The department reviews salmon escapement goals every 3 years in preparation for Southeast and Yakutat board meetings as outlined in the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223). No changes to the current McDonald Lake sockeye salmon escapement goal were recommended following escapement goal reviews prior to board meetings in 2012 (Heinl et al. 2011), 2015 (Heinl et al. 2014), or 2018 (Heinl et al. *In press*). McDonald Lake stock assessment information and escapement goal analysis will be reviewed again prior to the 2021 Southeast and Yakutat board meeting.

## **STOCK OF CONCERN RECOMMENDATION**

McDonald Lake sockeye salmon escapements have fallen below the lower bound of the sustainable escapement goal range of 55,000–120,000 fish in 4 out of 5 consecutive years from 2013 to 2017 (Figure 2). In October 2017, the department recommended that the board designate McDonald Lake sockeye salmon as a stock of management concern at the regulatory board meeting for the Southeast and Yakutat Management Area in January 2018.

## **OUTLOOK**

The department does not develop a formal preseason forecast for McDonald Lake sockeye salmon; however, the 2018 run is expected to be below average based on weak parent-year escapement. Five-year old fish, primarily age 1.3, account for an average 65% of McDonald Lake sockeye salmon returns. Age-1.3 fish in the 2018 run will have been produced by the 2013 escapement of 15,400 fish, which was among the smallest recorded since 1980 (Figure 2). The

estimated sockeye salmon fry population at McDonald Lake in 2014 (240,000 fish), largely produced by the 2013 escapement, was also among the smallest recorded (Figure 7).

## **HABITAT ASSESSMENT**

Habitat in the McDonald Lake watershed is considered pristine, and there are no habitat related concerns identified for this stock. Virtually no logging has occurred in the drainage, aside from limited timber removal and other habitat alterations that may have taken place in the early 1900s in association with operation of the federal hatchery at the head of the lake.

## **FISHERY MANAGEMENT OVERVIEW AND BACKGROUND**

### **COMMERCIAL FISHERIES OVERVIEW**

All commercial salmon net fisheries conducted in southern SEAK harvest mixed stocks of salmon, except in the most terminal harvest locations. In addition, commercial purse seine fisheries are managed primarily to harvest pink salmon (Clark et al. 2006). While there are exceptions, such as directed fisheries on fall-run chum salmon (*O. keta*) or on hatchery stocks, inseason management of the purse seine fishery is based on pink salmon escapement levels, harvest levels, and fishing effort. Pink salmon accounted for an average 87% (22.7 million fish) of the annual salmon harvest in traditional commercial net fisheries in southern SEAK (Districts 1–8), followed by chum salmon at 8% (2.1 million fish), sockeye salmon at 3% (740,000 fish), and coho salmon (*O. kisutch*) at 2% (448,000 fish) (Table 3). Unless otherwise noted, all harvest data presented here and in the sections below pertain to the 20-year period 1997–2016.

#### **District 1 Purse Seine Fishery**

District 1 encompasses Revillagigedo Channel, portions of East and West Behm Canal, and the eastern portion of southern Clarence Strait. The southern section of District 1 opens on the first Sunday in July to target early-run pink salmon. After initial openings in lower District 1 to harvest pink salmon traveling through southern Clarence Strait and Revillagigedo Channel, the fishing area is expanded north to include the Gravina Island shoreline. The Gravina Island shore is managed conservatively to allow pink salmon moving into West Behm Canal. In most years, the entire shoreline of Gravina Island is open by the third week in August. Sockeye salmon account for an average of 2% (67,500 fish) of the total purse seine salmon harvest in District 1 (Table 3). An average 45% (28,000 fish) of the sockeye salmon harvest in this district (not including terminal West Behm Canal fisheries) occurs on the Gravina Island shoreline (Subdistrict 101-29), the closest portion of District 1 to West Behm Canal (and McDonald Lake).

#### **District 2 Purse Seine Fishery**

District 2 encompasses the waters of Clarence Strait along the southeastern shore of Prince of Wales Island south of Narrow Point, and the western shore of the Cleveland Peninsula between Lemesurier and Camaano points. The southern section of District 2 opens on the first Sunday in July. The northern portions of District 2 may open as early as SW 30 (late July) in years of high pink salmon abundance. Sockeye salmon account for an average 1% (40,000 fish) of the total purse seine salmon harvest in District 2 (Table 3). Subdistrict 102-80 is located directly south of the drift gillnet fishery in Subdistrict 106-30, where McDonald Lake sockeye salmon are known to be harvested. The department has managed this area conservatively during past years to ensure



McDonald Lake sockeye salmon conserved in Districts 5, 6, and 7 to the north are passed through the northernmost area of District 2. An average 7% (2,885 fish) of the sockeye salmon harvest in this district occurred in Subdistrict 102-80 in years when it was fished (15 of 20 years, 1997–2016).

#### **District 4 Purse Seine Fishery**

District 4 encompasses the waters west of the offshore islands located east of Prince of Wales Island from Cape Muzon north to Cape Lynch. Sockeye salmon account for an average 6% (352,000 fish) of the total purse seine salmon harvest in District 4. The majority (70–80%) of those sockeye salmon are Canadian fish bound primarily for the Skeena and Nass rivers. Pacific Salmon Treaty provisions currently limit the total District 4 sockeye salmon harvest prior to SW 31 (approximately the last week in July) to 2.45% of the annual allowable catch of the combined Nass and Skeena river sockeye salmon runs. While the intent of the Treaty is to pass Canadian sockeye salmon, it also has the effect of passing other early-run salmon through the district.

#### **District 5 Purse Seine Fishery**

District 5 encompasses the waters of western Sumner Strait. Purse seine fisheries occur either inside the major bays or in the more exposed waters along the eastern side of the district between Cape Pole and Point Baker. District 5 purse seine fisheries normally open during the first or second week in August and are often confined inside bays to harvest pink and chum salmon. Occasionally, the area just south of the District 6 drift gillnet area is opened and when that occurs the percentage of sockeye salmon is slightly higher. That shoreline area (Subdistrict 105-41) from Point Baker south to Ruins Point has been opened prior to SW 32, one year since 1997. In 2003, that area was open in SW 31 (beginning around 24–30 July). The small sockeye salmon harvests in this fishery have not been sampled for stock identification, but stock composition is probably very similar to the composition of harvests in the adjacent drift gillnet fishery in Sumner Strait (Subdistrict 106-41). Restrictions, during what is expected to be the peak timing of the McDonald sockeye salmon run through the fishery (SWs 29–31), have not been necessary because poor pink salmon runs in that area have not warranted opening the area prior to SW 32 since 2003.

#### **District 6 Purse Seine Fishery**

District 6 is divided into 4 sections. Purse seine fisheries are limited to Sections 6-C and 6-D. Section 6-D includes most of the waters of northern Clarence Strait and the southern portion of Stikine Strait. Section 6-C is a small diamond shaped area adjacent to Screen Island and Lincoln Rock. Section 6-C together with the adjacent Screen Island shoreline of Section 6-D are the only waters in SEAK that, at times, may be fished simultaneously by the purse seine and drift gillnet fleets.

The District 6 purse seine fishery normally opens during the first or second week in August. Openings occur in 3 general areas of the district. The earliest fisheries often occur along the western shoreline of Etolin Island in 2 of those areas, including the Quiet Harbor to Screen Island shoreline and the area off the mouths of Mosman/Burnett/McHenry Inlets and the western side of Onslow Island. The third area is the Ratz Harbor shoreline, which usually opens between the second and third week in August. The sockeye salmon harvests in this fishery have not been sampled for stock identification, but stock composition is probably similar to the composition of harvests in the adjacent drift gillnet fishery in Clarence Strait (Subdistrict 106-30). The Screen

Island shoreline has been opened once during SW 30 and 3 times during SW 31 in the past 20 years. The Mosman/Burnett/McHenry/Onslow area has been opened once during SW 30 and 8 times during SW 31 during the past 20 years. The Ratz Harbor shoreline has only been opened twice during SW 31.

### **District 7 Purse Seine Fishery**

District 7 encompasses the waters of Ernest Sound, Bradfield Canal, Zimovia Strait, and Eastern Passage. Purse seine fisheries occur primarily in Ernest Sound. District 7 is divided into early- and middle-run pink salmon stocks in the northern portion (Section 7-A), which is known as the Anan fishery, and late-run stocks in lower Ernest Sound (Section 7-B). Until recently, the area was primarily a pink salmon harvesting area. Beginning in 1997, enhanced chum salmon entered the district in large enough numbers to attract additional purse seiners to the area.

District 7 purse seine fisheries normally open the first Sunday in July in Section 7-A (Anan). Openings occur most consistently during SWs 28 and 29, and by SWs 31 and 32, Section 7-A is open about one out of every 4 years. Harvests of sockeye salmon in this fishery are small, so it is usually difficult to obtain samples; however, the stocks are probably similar to those harvested in the adjacent drift gillnet fishery in Clarence Strait.

Purse seine fisheries in Section 7-B (lower Ernest Sound) normally start between SWs 30 and 32. Section 7-B was opened once during SW 29, 3 times during SW 30, and eleven times during SW 31 since 1997. Since 2005, when Section 7-B has been open in SW 31, the area open has generally been restricted to the upper portion of the area.

### **District 6 Drift Gillnet Fishery**

The District 6 drift gillnet fishery takes place in Section 6-A in Sumner Strait, and 6-B, 6-C, and a portion of 6-D in Clarence Strait. Management of District 6 is based on sockeye salmon abundance from early June to the end of July, pink salmon abundance throughout August, and coho salmon abundance from September through the end of the season. Although these salmon stocks largely dictate the management decisions for weekly openings, fishermen also target summer coho and chum salmon as well as fall chum salmon during the season. The District 6 fishery is managed (along with the District 8 drift gillnet fishery) by Pacific Salmon Treaty provisions to harvest 50% of the total allowable catch of the transboundary Stikine River sockeye salmon run. Preseason forecasts of the Stikine River sockeye salmon run guide the initial openings, but management is based on inseason information by the end of June or early July. The sockeye salmon harvest in District 6 is typically dominated by Stikine River sockeye salmon until early July, at which point other sockeye salmon stocks, including local island stocks, represent the majority of the harvest.

## **PAST COMMERCIAL FISHERY MANAGEMENT ACTIONS**

Management measures to reduce harvest of McDonald Lake sockeye salmon may result in foregone harvest of other healthy stocks because McDonald Lake fish are harvested incidentally in all of the commercial net fisheries in southern SEAK (Districts 1–8) and migratory timing broadly overlaps with other sockeye, pink, and chum salmon runs (Bergmann et al. 2009). Management of the McDonald Lake sockeye salmon run is further complicated by lack of inseason stock assessment information with which to gauge run strength and take effective inseason action to reduce harvest. Sockeye salmon do not enter the McDonald Lake system until well after sockeye salmon harvests have peaked in the commercial fisheries. Management

measures to date, therefore, were focused on area and time when the stock is known to be most prevalent in the fisheries closest to McDonald Lake, as outlined in the Harvest section (pages 2–5).

Management actions in southern SEAK fisheries to conserve McDonald Lake sockeye salmon have occurred in varying degrees since 2006. Management measures implemented during 2006–2008 included restrictions in the commercial net fisheries in Sumner and upper Clarence straits, in Districts 1, 2, 5, 6, and 7, during a 4-week period from mid-July to early August (SWs 29–32). Those measures (Table 2; Figure 4) were incorporated into the McDonald Lake action plan instituted by the board in 2009 (Bergmann et al. 2009) and carried out through 2011 when the stock of concern designation was removed.

From 2012 through 2016, possible management actions were outlined in the annual purse seine and drift gillnet management plans. These actions were similar to those outlined in the 2009 McDonald Lake action plan. Actions were not always required due to pink and sockeye salmon run timing or abundance, which made implementation of actions unnecessary either entirely or in part. In 2017, set management actions were outlined in the in 2017 drift gillnet and purse seine management plans and followed during the season; however, despite a significant drop in the 2017 harvest rate compared to 2014–2016 (Appendix E), the lower bound of the escapement goal was not achieved.

## **PAST PERSONAL USE FISHERY MANAGEMENT ACTIONS**

Sockeye salmon personal use fishing limits have varied since harvest permits were first issued for McDonald Lake sockeye salmon. The first documented permit was issued in 1968. The largest Yes Bay sockeye salmon possession limits were set in 1987, following several years of robust runs and a growing interest from local users. The daily possession limit was 50 fish per person or 75 fish per household with no annual limit (Table 4). In 1993 the daily possession limit was reduced to 25 fish per person or 50 fish per household. Those limits were maintained until 2002, when permits were changed to combine the individual with the household possession limit, which was then set to 40 fish (Table 3). In 2005, the possession limit was reduced to 25 fish. An annual limit was implemented for the first time in 2007, following poor escapements to McDonald Lake, and the daily and annual possession limit was set at 20 fish. The season was also shortened from 1 June–30 August to 1 July–30 August. Following removal of the stock of concern designation in 2012, the daily and annual possession limit was raised to 30 fish.

## **PAST SPORT FISHERY MANAGEMENT ACTIONS**

Sport fishing effort and harvest of McDonald Lake sockeye salmon is presumed to be very low (see Harvest section, page 5). The current freshwater bag limit for sockeye salmon, including the McDonald Lake drainage, is 6 fish, 12 in possession. Sport fisheries are subject to inseason action under EO authority, but no management actions to reduce sport harvest of McDonald Lake sockeye salmon have been taken to date.

# **ACTION PLAN MANAGEMENT OPTIONS FOR ADDRESSING STOCK OF CONCERN**

## **ACTION PLAN GOAL**

The action plan goal is to rebuild the McDonald Lake sockeye salmon run to levels that consistently achieve the sustainable escapement goal range. The plan includes measures to reduce commercial harvests of McDonald Lake sockeye salmon in the commercial drift gillnet and purse seine fisheries in closest proximity to McDonald Lake and during the time McDonald Lake fish are most prevalent in those fisheries. The plan provides flexibility with respect to information (e.g., harvest distribution and timing) used in managing fisheries to conserve McDonald Lake sockeye salmon.

## **ACTION PLAN ALTERNATIVES**

### **Action #1: Commercial Fisheries**

**Objective: Reduce commercial harvest of McDonald Lake sockeye salmon.**

#### **Option A. Status quo (2013–2016).**

**Specific Action to Implement the Objective:** Use EO authority to manage commercial fisheries based on pink salmon abundance. Management actions to reduce harvest of McDonald Lake sockeye salmon would be implemented during SWs 29–31 in the Districts 1, 5, 6, and 7 purse seine fisheries and the District 6 drift gillnet fishery and during SWs 29–32 in the District 2 purse seine fishery. Management measures could include time and area restrictions. Specific actions will depend on expected run strength of McDonald Lake sockeye salmon, general observations of sockeye salmon abundance and harvests, and expected or realized levels of fishing effort.

**Benefits:** The status quo would allow commercial net fisheries to proceed based on historical fishing patterns. Management actions would be more restrictive during periods of low sockeye salmon abundance and less restrictive during periods of high sockeye salmon abundance. As a result, there may be less economic loss than with management actions that are set regardless of inseason sockeye salmon abundance.

**Detriments:** The department can determine trends in total sockeye salmon abundance inseason, but cannot accurately determine the abundance of McDonald Lake sockeye salmon due to lack of inseason assessment programs to determine stock-specific abundance. If commercial harvest of McDonald Lake sockeye salmon is the major factor contributing to recent poor escapements, then escapements may not improve if prescriptive management measures are not implemented.

#### **Option B. Reinstate the 2009 McDonald Lake action plan.**

**Specific Action to Implement the Objective:** Use EO authority to implement the 2009 McDonald Lake action plan (Table 2) to reduce fishing time and area in the districts 1, 2, 5, 6, and 7 purse seine fisheries and reduce time in the District 6 drift gillnet fishery. These actions will be implemented annually during SWs 29–31, and extended to SW 32 in the District 2 purse seine fishery, to reduce harvest of McDonald Lake sockeye salmon.

**Benefits:** Management actions implemented by the board in 2009 were accepted by the fishing industry, though the actions reduced fishing opportunity. The McDonald Lake sockeye salmon escapement goal was achieved during years the action plan was implemented.

**Detriments:** Recent GSI information suggests conservation measures in the 2009 McDonald Lake action plan may need to be expanded or shifted later into the season to be most effective in reducing harvest of McDonald Lake sockeye salmon. Fishing opportunity will be reduced.

### **Option C. Implement modified 2009 McDonald Lake action plan.**

**Specific Action to Implement the Objective:** Management actions outlined in the 2009 McDonald Lake action plan will be modified to account for harvest information collected since 2007 (Gilk-Baumer et al. 2013; Brunette et al. 2015; ADF&G Gene Conservation Laboratory, unpublished data). Openings would be reduced in Districts 1, 2, 5, 6, and 7 during SWs 29–32 to allow more McDonald Lake sockeye salmon to pass through the fisheries when these fish are most prevalent in those fisheries. Changes from the 2009 McDonald Lake action plan are **shown in bold**:

- 1) District 1 purse seine—The purse seine fishery on the **entire western shore of Gravina Island** (Subdistrict 101-29) will be closed during SWs 29–30 (only closed north of the latitude of Cone Point in the 2009 McDonald Lake action plan). In SW 31, the area north of the latitude of Cone Point will be closed and **will remain closed during SW 32**.
- 2) District 2 purse seine—No change from 2009 action plan. The purse seine fishery in Subdistrict 102-80 on the western shore of the Cleveland Peninsula (within 3 nautical miles of the shoreline) will be closed during SWs 29–32.
- 3) District 5 purse seine—No change from 2009 action plan. The purse seine fishery in Subdistrict 105-41 along northwestern Prince of Wales Island between Point Baker and the Barrier Islands will be closed during SWs 29–31.
- 4) District 6 purse seine—The purse seine fishery in Subdistrict 106-30 along western Etolin Island between Point Stanhope and the latitude of Round Point will be closed during SWs 29–31, and **the area between Point Stanhope and the latitude of Steamer Point will remain closed in SW 32**. The purse seine fishery in Subdistrict 106-10 along eastern Prince of Wales Island between Luck Point and Narrow Point will be closed during SWs 29–31 and **will remain closed in SW 32**.
- 5) District 7 purse seine—The purse seine fishery in Section 7-B (Subdistrict 107-10) will be closed during SWs 29–31 and **will remain closed in SW 32**. If pink salmon runs are strong, the northern portion of section 7-B north of Union Point may be open during SWs 31 and 32.
- 6) District 6 drift gillnet—In the 2009 McDonald Lake action plan, the District 6 drift gillnet fishery was open for a maximum of 2 days during SWs 29–31. The plan will be modified to **include SW 32** and have a **maximum of three days in SW 29 and SW 32**. The plan will continue to include a maximum of 2 days in SWs 30–31. Specific fishing time in SWs 29 and 32 will be dependent on expected or observed fishing effort. Specific area closures in this fishery are not anticipated; however, ongoing stock composition data

may highlight certain time and area where McDonald Lake sockeye salmon are more susceptible to harvest, and modifications to these conservation measures would proceed accordingly.

**Benefits:** Changing management actions based on recent GSI information may prove to be more effective in conserving McDonald Lake sockeye salmon.

**Detriments:** Fishing opportunity will be reduced. Recent stock composition information may only represent a recent trend in McDonald Lake sockeye salmon run timing and actions based on newer information may be too conservative. Additional area restrictions in District 1 may not have the desired effect as the purse seine fleet will move into other districts in the Ketchikan management area where McDonald Lake sockeye salmon could be present, resulting in no real reduction in harvest.

## **Action #2: Personal Use Fishery**

**Objective: Reduce personal use harvest of McDonald Lake sockeye salmon.**

### **Option A. Status quo.**

**Specific Action to Implement the Object:** No change to annual personal use limit of 30 sockeye salmon per household.

**Benefits:** Maintaining personal use limits would keep personal use fishing effort on McDonald Lake sockeye salmon at Yes Bay and away from other much smaller sockeye salmon systems in the Ketchikan Management Area.

**Detriments:** The personal use fishery at Yes Bay specifically targets McDonald Lake salmon. The personal use harvest may be too large to allow for adequate sockeye salmon escapement at McDonald Lake. In addition, the personal use fishery may not share the conservation burden with other fisheries; however, the reported personal use harvest averaged <3% of the total McDonald Lake sockeye salmon run from 2012 to 2016 (see Harvest section, page 5).

### **Option B. Reduce harvest limits.**

**Specific Action to Implement the Object:** Take action to reduce the annual harvest limit on the personal use permit to 20 sockeye salmon per household.

**Benefits:** The harvest limit will be reduced by 33% to allow more sockeye salmon to reach McDonald Lake. Reducing the harvest limit will also limit participation, further reducing harvest.

**Detriments:** Significant costs are incurred by participants to travel by boat from Ketchikan to Yes Bay to participate in this fishery. Some may not consider 20 sockeye salmon to be worth the cost and effort, and effort may shift to other smaller sockeye salmon stocks in the area. The reported personal use harvest averaged <3% of the total McDonald Lake sockeye salmon run from 2012 to 2016 (see Harvest section, page 5).

## **Action #3: Sport Fishery**

**Objective: Reduce sport harvest of McDonald Lake sockeye salmon.**

### **Option A. Status quo.**

**Specific Action to Implement the Object:** Use EO authority to reduce sport harvest of McDonald Lake sockeye salmon by implementing restrictions or closures inseason. No restrictions are being considered at this time because sport effort and harvest is very low.

**Benefits:** This option would provide the department with the flexibility to maintain sport fishing opportunity if the McDonald Lake sockeye salmon run rebuilds prior to the next board meeting.

**Detriments:** If restrictions were implemented, this option will likely not decrease harvest of McDonald Lake sockeye salmon by a measurable amount because the sport harvest is already very low (see Harvest section, page 5).

**Option B. Close sport fishing for sockeye salmon at McDonald Lake and saltwater areas in Yes Bay.**

**Specific Action to Implement the Object:** Take board action to close the McDonald Lake drainage and the saltwater area adjacent to the mouth of the outlet stream in Yes Bay to sport fishing for sockeye salmon.

**Benefits:** Closing the freshwater drainage and saltwater staging area to the retention of sockeye salmon may increase the sockeye salmon escapement by a small number of fish.

**Detriments:** This option will likely not decrease harvest of McDonald Lake sockeye salmon by a measurable amount because the sport harvest is already very low (see Harvest section, page 5). It would eliminate the small amount of sport fishing opportunity provided by this fishery.

## **CONDITIONS FOR REDUCING MANAGEMENT RESTRICTIONS OR DELISTING STOCK OF CONCERN**

Criteria for removing the stock of concern designation or reducing management restrictions include:

- 1) If the lower bound of the escapement goal is met or exceeded in 3 consecutive years or is met or exceeded in 4 of 6 consecutive years, the department will recommend removing the McDonald Lake sockeye salmon run as a stock of management concern at the first Southeast and Yakutat board meeting after this condition is met.
- 2) Management measures could be relaxed in specific areas if updated stock composition and harvest data indicate areas where restrictions are no longer needed to ensure the escapement goal is met.
- 3) In the event that 2 consecutive years of escapements are near the upper bound of the escapement goal range or above the range, some management restrictions may be relaxed or set aside using EO authority.

Stock status, action plan performance (including information on harvest rate, distribution, and timing in commercial fisheries), and escapement goal review will be updated in a report to the board at the 2021 Southeast and Yakutat meeting.

# 2018 ALASKA BOARD OF FISHERIES REGULATORY PROPOSALS AFFECTING MCDONALD LAKE SOCKEYE SALMON

The following proposals before the board at the 2018 Southeast and Yakutat Board of Fisheries meeting potentially affect commercial fisheries in which McDonald Lake sockeye salmon are harvested. In addition, adoption of an action plan to reduce harvest of Unuk River king salmon (*O. tshawytscha*) in commercial net fisheries may also result in reduced harvest of McDonald Lake sockeye salmon.

- Proposal 153: Repeal the District 1 pink salmon management plan.
- Proposal 154: Establish a management plan for pink salmon in lower Clarence Strait (proposal would reestablish a drift gillnet fishery in District 2).
- Proposal 169: Open Section 6-D the second Sunday of June to commercial fishing for salmon with drift gillnet gear.
- Adoption of Unuk River king salmon action plan.

## RESEARCH PLAN

Funding for McDonald Lake stock assessment was greatly reduced by state budget cuts in 2015 (removed video escapement assessment project). Stock assessment information essential for escapement goal review and evaluation of action plan performance will continue to be collected.

### Current Research Projects

1. Escapement estimates. Standardized multiple foot survey counts will be conducted annually at McDonald Lake to estimate the sockeye salmon escapement. Surveys will be conducted on approximately 10 September, 20 September, and 28 September. The annual peak survey count will be multiplied by an expansion factor (4.85) to estimate total escapement (Heinl et al. 2009). Scale samples will be collected on the spawning grounds to estimate age composition of the run.
2. Fry population estimates. A fall (October) hydroacoustic survey will be conducted annually at McDonald Lake to estimate the sockeye salmon fry rearing population.
3. Commercial harvest estimates. The commercial harvest will be estimated annually in conjunction with U.S.-Canada GSI studies. This information will provide much needed long-term assessment of harvest rates, distribution, and timing in southern SEAK commercial fisheries.

### Future Research Projects

1. Improved escapement estimates. Current escapement estimates are based on expanded peak foot survey counts conducted on the spawning grounds. Additional years of mark-recapture studies could be conducted at McDonald Lake to compare total population estimates to peak survey counts with the goal of improving the current expansion factor. Conducting adult escapement work at the outlet to McDonald Lake has proven to be problematic over the last several decades, but a mark-recapture program where fish are marked throughout the run at the mouth of Hatchery Creek (the primary spawning tributary) and recovered upstream would have a high probability of success. However, it is unlikely that additional years of data would dramatically alter the current expansion



factor and the project itself could cause additional stress and mortality on McDonald Lake sockeye salmon immediately prior to spawning.

There would potentially be some benefit in counting the escapement at the outlet of McDonald Lake to provide timelier inseason information regarding abundance, but maintaining picket and net weirs in what appear to be the most suitable locations has proven to be problematic in the past. In addition, peak movements of sockeye salmon into McDonald Lake typically occur in August, after the Action Plan measures have been implemented. Even a perfect weir program at the outlet of the lake may not provide useful inseason information for managing fisheries, and may come at a very high cost. The current program of estimating escapement through an expanded peak count provides adequate escapement information at low cost and no harm to the sockeye salmon population.

2. Detailed harvest estimates. Although the current harvest information obtained through U.S.-Canada GSI studies is a vast improvement over anything previously available, additional funding would allow for a more detailed examination of specific subdistricts where managers may want additional harvest location information. Although the majority of the harvest in Districts 1–8 is covered under current sampling plans, additional area not currently covered (e.g., District 7 purse seine), could be sampled with more funding. Reasonable estimates of harvest in those areas can currently be made by applying stock composition from adjacent fisheries. Thus, additional sampling would not likely provide dramatic improvements to current estimates of harvest rate and harvest distribution, but may be useful for fine-tuning management actions in southern SEAK net fisheries.

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## **TABLES**

Table 1.—Average opening and closing dates for ADF&G statistical weeks 25–36. Statistical weeks begin on Sunday at 12:01 a.m. and end the following Saturday at midnight, and are numbered sequentially starting from the first week of the calendar year.

| Statistical Week | Opening Date | Closing Date | Statistical Week | Opening Date | Closing Date |
|------------------|--------------|--------------|------------------|--------------|--------------|
| 25               | 14 June      | 20 June      | 31               | 26 July      | 1 August     |
| 26               | 21 June      | 27 June      | 32               | 2 August     | 8 August     |
| 27               | 28 June      | 4 July       | 33               | 9 August     | 15 August    |
| 28               | 5 July       | 11 July      | 34               | 16 August    | 22 August    |
| 29               | 12 July      | 18 July      | 35               | 23 August    | 29 August    |
| 30               | 19 July      | 25 July      | 36               | 30 August    | 5 September  |

Table 2.—Commercial fisheries management measures outlined in the 2009 McDonald Lake action plan (Bergmann et al. 2009) and implemented through 2011.

| Area       | Gear          | Period <sup>a</sup>          | Year        |  |
|------------|---------------|------------------------------|-------------|--|
|            |               |                              | Implemented | Restriction  |
| District 6 | Drift gillnet | Statistical weeks (SW) 29–31 | 2007–2011   | Open for a maximum of 2 days.  |
| District 1 | Purse seine   | SWs 29–31                    | 2007–2011   | Western shore of Gravina Island (in Subdistrict 101-29) closed north of the latitude of Cone Point.  |
| District 2 | Purse seine   | SWs 29–32                    | 2009–2011   | Western shore of the Cleveland Peninsula (Subdistrict 102-80) closed within 3 nautical miles of the shoreline.   |
| District 5 | Purse seine   | SWs 29–31                    | 2009–2011   | Northwest corner of Prince of Wales Island (in Subdistrict 105-41) closed between Point Baker and the Barrier Islands.   |
| District 6 | Purse seine   | SWs 29–31                    | 2009–2011   | West side of Etolin Island closed between Point Stanhope and the latitude of Round Point (Subdistrict 106-30), and east side of Prince of Wales Island closed between Luck Point and Narrow Point (Subdistrict 106-10).  |
| District 7 | Purse seine   | SWs 29–31                    | 2009–2011   | Section 7-B closed (Subdistrict 107-10). If pink salmon runs are extremely strong, the northern portion of section 7-B, north of Union Point may be open during SW 31. If this occurs, restrictions may occur in that area south of Union Point into SW 32 to reduce the overall interception of sockeye salmon. |

<sup>a</sup> Statistical weeks 29–31 are approximately mid-July to early August.

Table 3.—Average annual harvest in numbers fish and average percentage of harvest by gear, district, and species in southern SEAK commercial salmon net fisheries, 1997–2016.

| <b>Gear</b>   | <b>District</b> | <b>Pink<br/>Salmon</b> | <b>Chum<br/>Salmon</b> | <b>Sockeye<br/>Salmon</b> | <b>Coho<br/>Salmon</b> | <b>Chinook<br/>Salmon</b> | <b>Total</b> |
|---------------|-----------------|------------------------|------------------------|---------------------------|------------------------|---------------------------|--------------|
| Drift Gillnet | 101             | 444,799                | 275,714                | 86,915                    | 53,262                 | 1,449                     | 862,140      |
| Drift Gillnet | 106             | 353,084                | 202,657                | 100,524                   | 154,478                | 1,696                     | 812,439      |
| Drift Gillnet | 108             | 44,282                 | 113,363                | 42,872                    | 26,224                 | 8,182                     | 234,922      |
| Drift Gillnet | Total           | 842,165                | 591,734                | 230,310                   | 233,964                | 11,326                    | 1,909,500    |
| Purse Seine   | 101             | 5,228,062              | 341,184                | 67,459                    | 36,664                 | 741                       | 5,674,110    |
| Purse Seine   | 102             | 3,904,059              | 571,448                | 40,167                    | 51,978                 | 874                       | 4,568,526    |
| Purse Seine   | 103             | 4,042,274              | 119,416                | 25,786                    | 29,269                 | 437                       | 4,217,182    |
| Purse Seine   | 104             | 5,687,543              | 233,107                | 351,816                   | 74,486                 | 6,607                     | 6,353,558    |
| Purse Seine   | 105             | 565,326                | 16,584                 | 3,078                     | 2,466                  | 18                        | 587,471      |
| Purse Seine   | 106             | 1,048,134              | 18,205                 | 8,183                     | 12,205                 | 21                        | 1,086,750    |
| Purse Seine   | 107             | 1,460,268              | 188,248                | 13,577                    | 7,467                  | 389                       | 1,669,949    |
| Purse Seine   | Total           | 21,935,666             | 1,488,191              | 510,065                   | 214,536                | 9,087                     | 24,157,545   |
| SSEAK         | Total           | 22,725,424             | 2,079,015              | 739,966                   | 447,890                | 20,413                    | 26,012,708   |
| Drift Gillnet | 101             | 50%                    | 33%                    | 10%                       | 6%                     | 0%                        | 100%         |
| Drift Gillnet | 106             | 41%                    | 26%                    | 13%                       | 21%                    | 0%                        | 100%         |
| Drift Gillnet | 108             | 21%                    | 43%                    | 18%                       | 16%                    | 3%                        | 100%         |
| Drift Gillnet | Total           | 43%                    | 32%                    | 12%                       | 13%                    | 1%                        | 100%         |
| Purse Seine   | 101             | 89%                    | 9%                     | 2%                        | 1%                     | 0%                        | 100%         |
| Purse Seine   | 102             | 81%                    | 17%                    | 1%                        | 1%                     | 0%                        | 100%         |
| Purse Seine   | 103             | 94%                    | 4%                     | 1%                        | 1%                     | 0%                        | 100%         |
| Purse Seine   | 104             | 87%                    | 5%                     | 6%                        | 1%                     | 0%                        | 100%         |
| Purse Seine   | 105             | 89%                    | 10%                    | 1%                        | 1%                     | 0%                        | 100%         |
| Purse Seine   | 106             | 94%                    | 3%                     | 2%                        | 2%                     | 0%                        | 100%         |
| Purse Seine   | 107             | 82%                    | 17%                    | 1%                        | 0%                     | 0%                        | 100%         |
| Purse Seine   | Total           | 88%                    | 8%                     | 3%                        | 1%                     | 0%                        | 100%         |
| SSEAK         | Total           | 87%                    | 8%                     | 3%                        | 2%                     | 0%                        | 100%         |

Table 4.—History of personal use sockeye salmon fishery limits in Yes Bay.

| <b>Year</b> | <b>Individual<br/>Limit</b> | <b>Household<br/>Limit</b> | <b>Annual<br/>Limit</b> | <b>Notes</b>  |
|-------------|-----------------------------|----------------------------|-------------------------|---|
| 1974        | ---                         | 10                         | None                    | Beach Seine, gillnet, and dipnet gear allowed.                |
| 1981        | 10                          | 50                         | None                    | Weir operated on system 1981–1984; large escapements counted. |
| 1984        | 10                          | 20                         | None                    |   |
| 1987        | 50                          | 75                         | None                    | Season established 1 June–30 August.                          |
| 1993        | 25                          | 50                         | None                    | Set gillnet allowed at Yes Bay.                               |
| 2002        | NA                          | 40                         | None                    | Individual limit combined with household limit.               |
| 2005        | NA                          | 25                         | None                    |   |
| 2007        | NA                          | 20                         | 20                      | Season changed to 1 July–30 August.                           |
| 2017        | NA                          | 30                         | 30                      |   |

## **FIGURES**



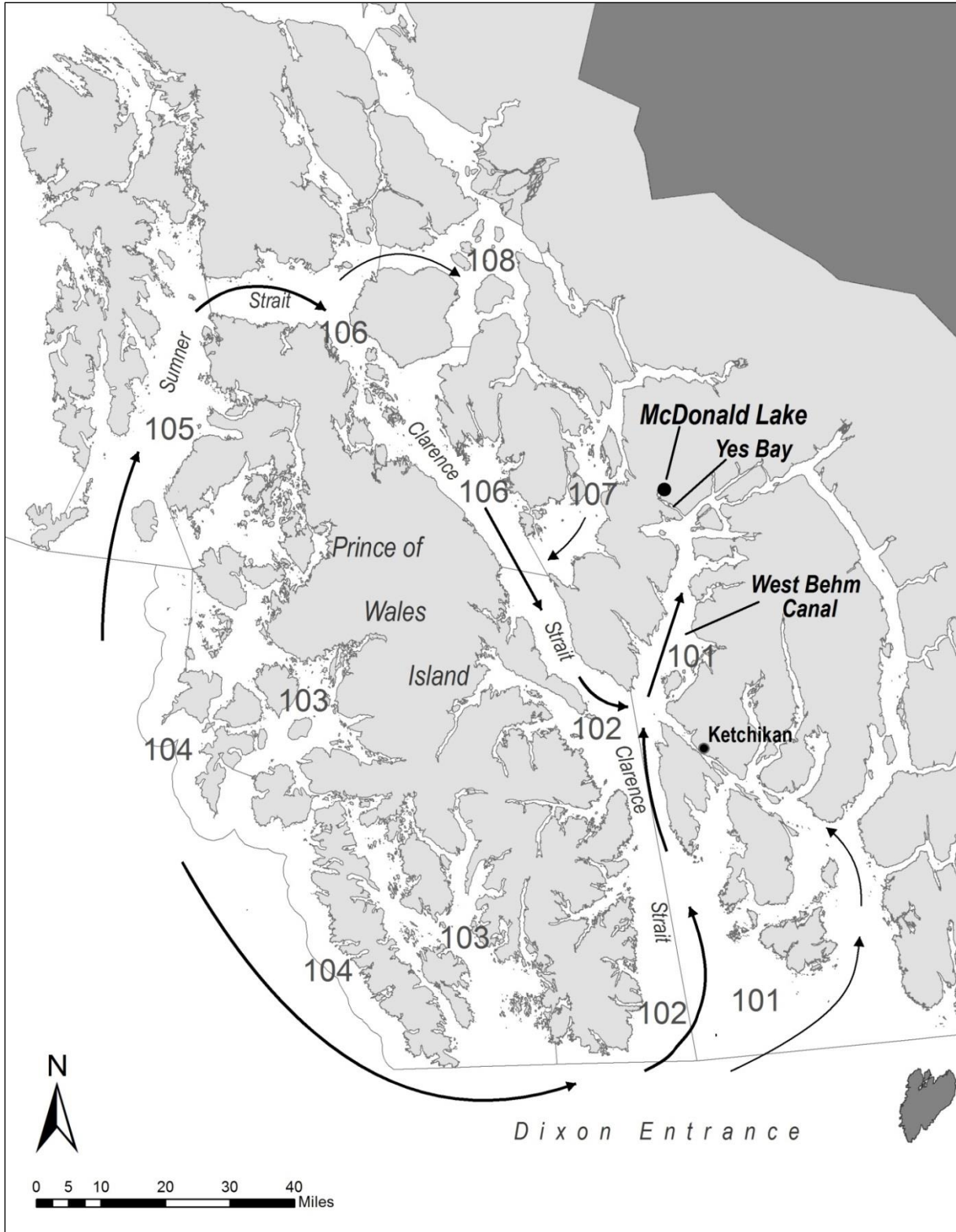


Figure 1.—Major (thick arrows) and minor (thin arrows) migration routes of McDonald Lake sockeye salmon through southern SEAK and management Districts 1–8.

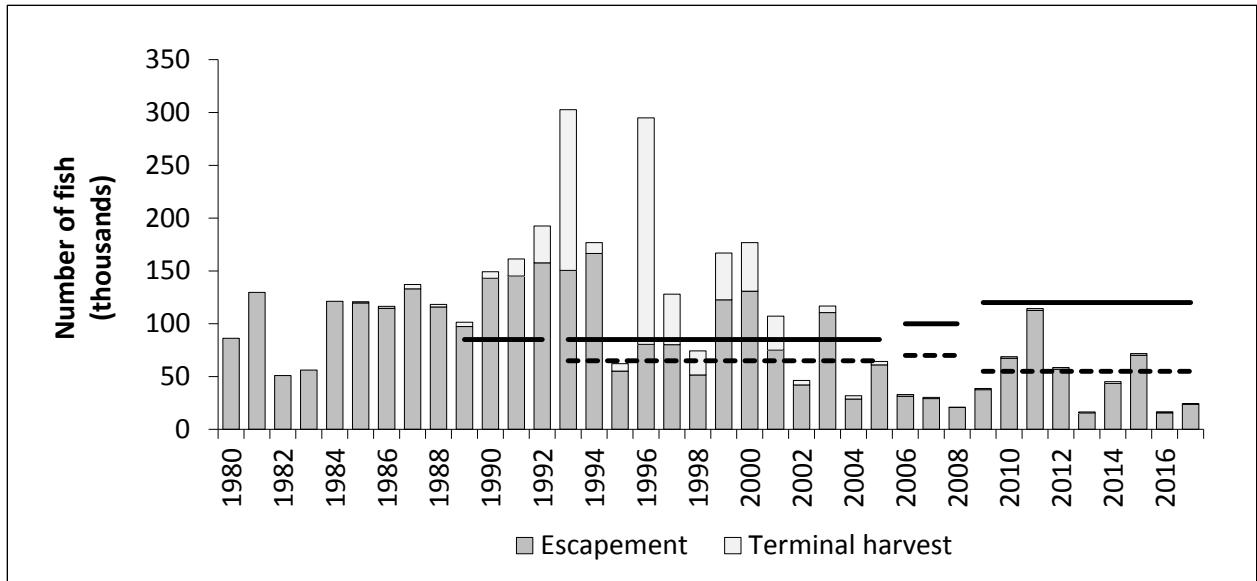


Figure 2.—Estimated McDonald Lake sockeye salmon spawning escapements and terminal harvest (purse seine and personal use) in Yes Bay and upper West Behm Canal, 1980–2017. Historical escapement goals are shown as horizontal black lines. The current sustainable escapement goal is a range of 55,000–120,000 sockeye salmon.

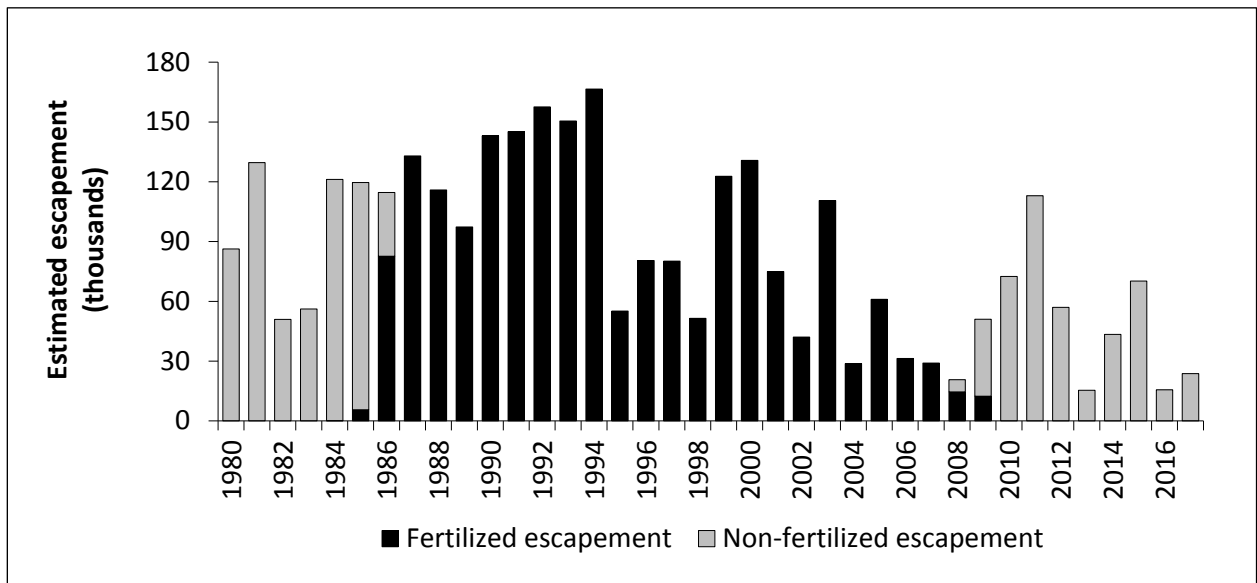


Figure 3.—Estimated McDonald Lake sockeye salmon spawning escapements, 1980–2017. Black bars represent approximate numbers of fish that experienced lake fertilization during rearing years 1982–2004.

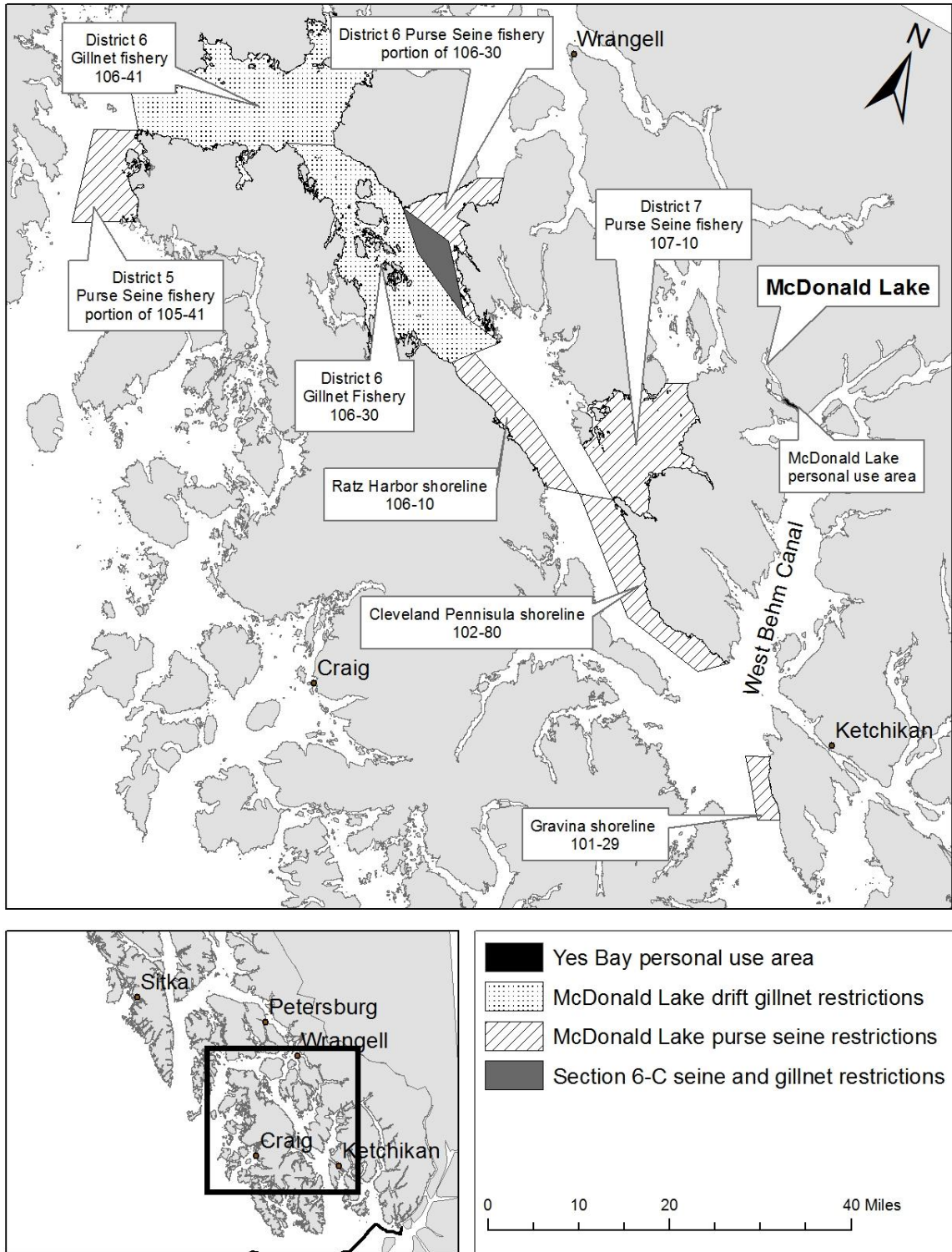


Figure 4.—Commercial fishing districts in southern SEAK and locations identified for time and area restrictions in the 2009 McDonald Lake action plan (Bergmann et al. 2009).

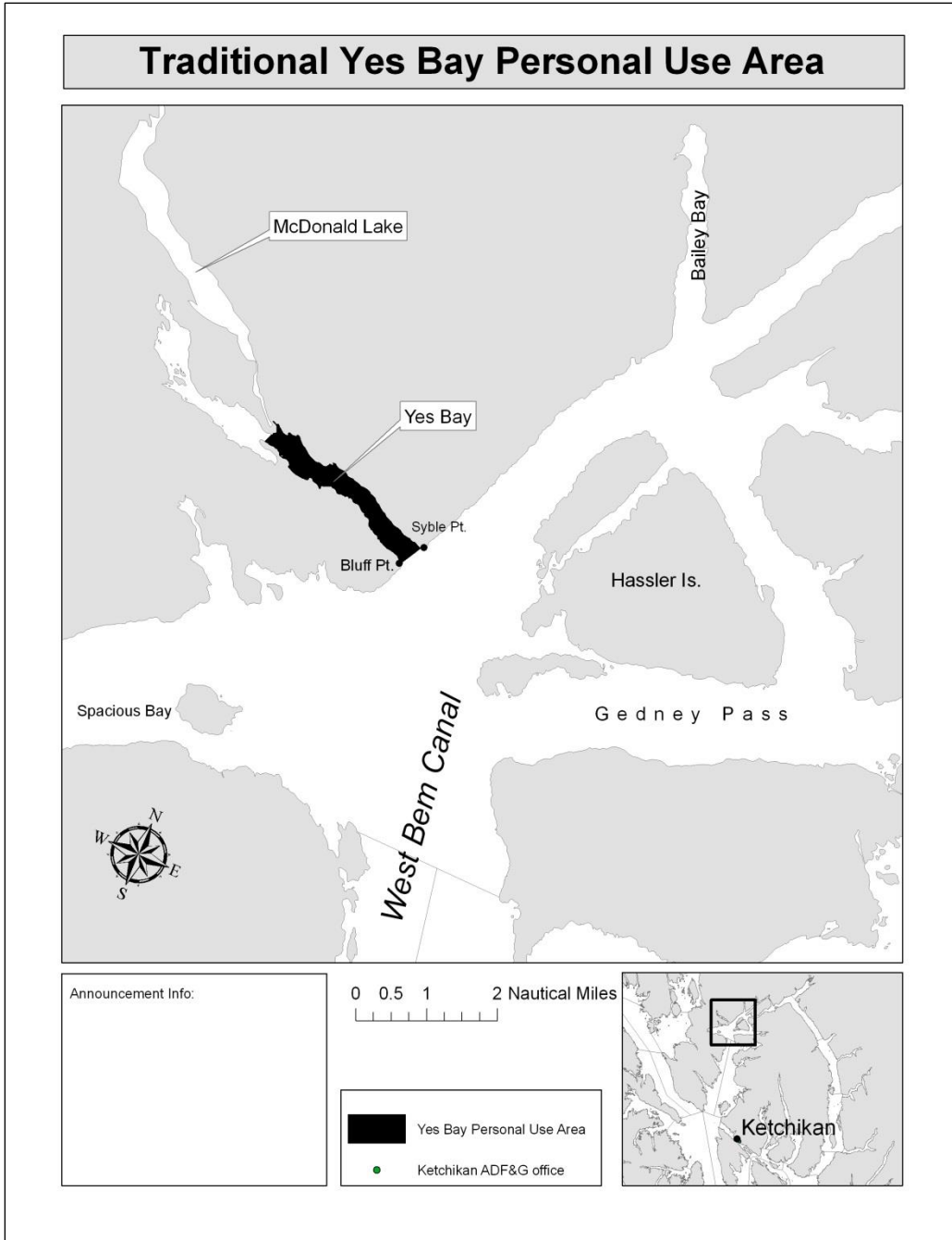


Figure 5.—Location of the Yes Bay personal use area and McDonald Lake in upper West Behm Canal, southern SEAK.

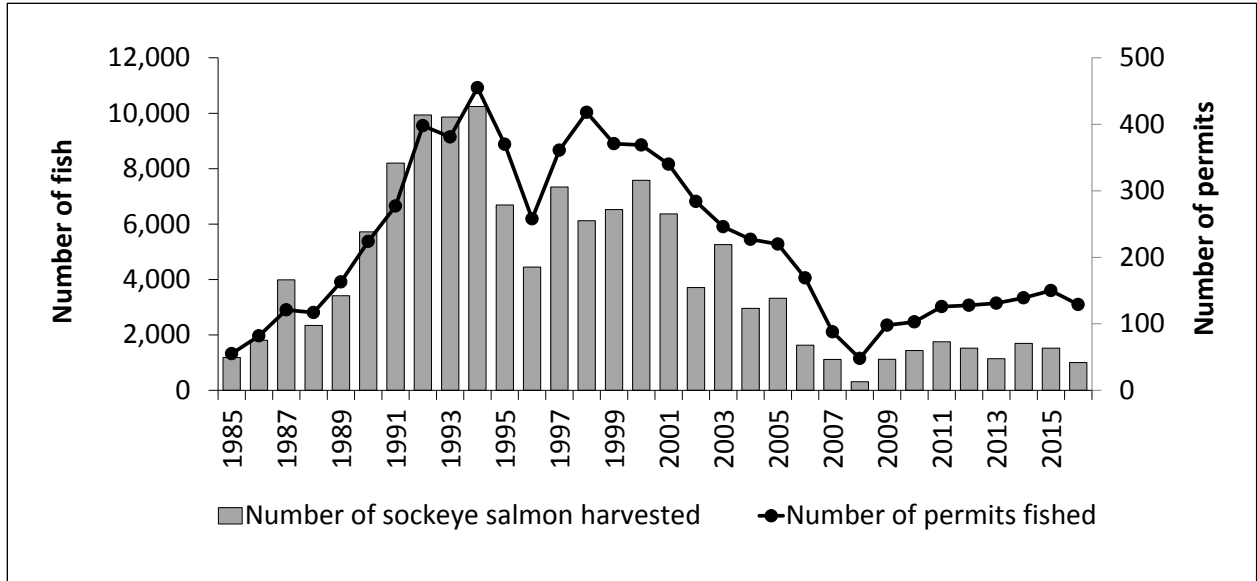


Figure 6.—Reported McDonald Lake (Yes Bay) sockeye salmon personal use harvest and number of permits fished, 1985–2016.

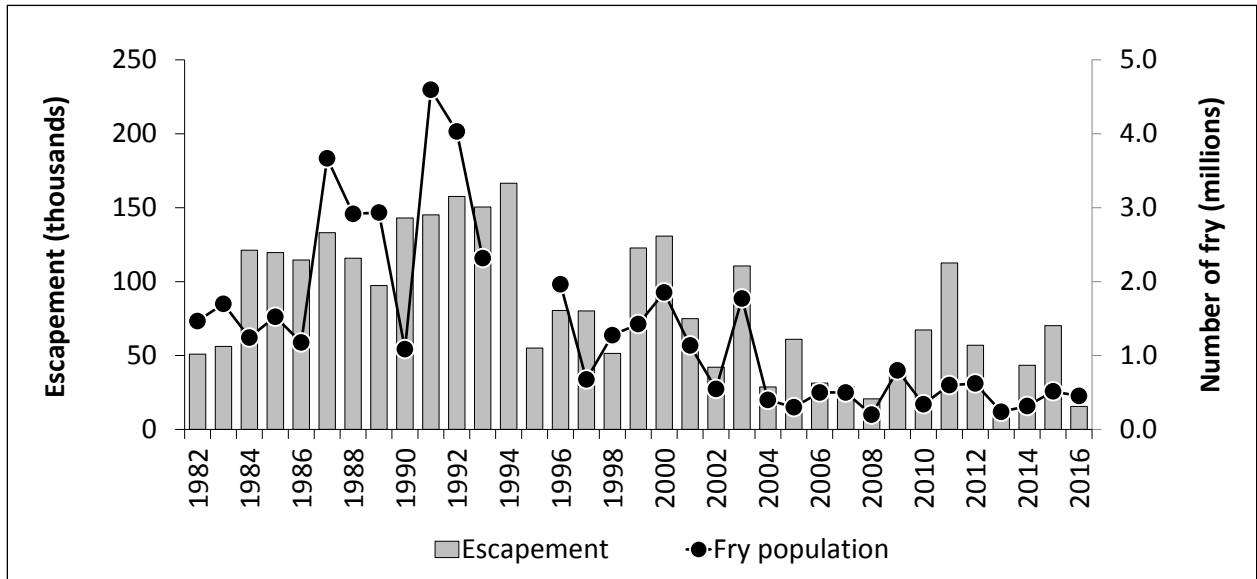


Figure 7.—Estimated McDonald Lake sockeye salmon escapements (1982–2016) and estimated fall rearing fry populations in the following year (1983–2017).



**APPENDIX**  
**MCDONALD LAKE SOCKEYE SALMON HARVEST**  
**INFORMATION**

Appendix A.—Distribution of coded wire tag recoveries of McDonald Lake sockeye salmon (expanded for sampling rate) in southern SEAK commercial fisheries, 1985 and 1989–1991 (from Johnson et al. 2005).

|                                   | Proportion by Area and Gear |      |      |                   |         |
|-----------------------------------|-----------------------------|------|------|-------------------|---------|
|                                   | 1985                        | 1989 | 1990 | 1991 <sup>a</sup> | Average |
| Total Tags Recovered              | 47                          | 90   | 190  | 32                | 90      |
| Total Expanded Tags               | 203                         | 370  | 670  | 112               | 339     |
| District 1 drift gillnet          | 7%                          | 2%   | 2%   | 26%               | 9%      |
| District 1 Annette Island gillnet | 4%                          | 2%   | 7%   | ---               | 3%      |
| District 1 Annette Island seine   | 3%                          | ---  | ---  | 5%                | 2%      |
| District 1 Annette Island trap    | 1%                          | ---  | ---  | ---               | <1%     |
| District 1 purse seine            | 40% <sup>b</sup>            | 8%   | 9%   | 15%               | 18%     |
| District 2 purse seine            | 9%                          | 17%  | 9%   | 16%               | 13%     |
| District 3 purse seine            | ---                         | ---  | <1%  | ---               | <1%     |
| District 4 purse seine            | 10%                         | 13%  | 17%  | 32%               | 18%     |
| District 6 drift gillnet          | 28%                         | 57%  | 56%  | 6%                | 37%     |
| District 7 purse seine            | ---                         | 1%   | ---  | ---               | <1%     |
| District 2 troll                  | ---                         | ---  | <1%  | ---               | <1%     |
| Total                             | 100%                        | 100% | 100% | 100%              | 100%    |

<sup>a</sup> Tag recovery information for 1991 may have been biased by a very low tagging rate in 1988; fewer than 6,000 smolts were tagged (compared to 22,000 in 1986, and 38,000 in 1987), 51% of which were tagged during the last 3 days of the 6-week tagging period (Johnson et al. 2005).

<sup>b</sup> In 1985 nearly 60% of the expanded District 1 purse seine tags were recovered in West Behm Canal subdistricts 101-85 and 101-90.

Appendix B.—Total sockeye salmon harvest, sample size, and estimated proportion and number (and 90% credibility intervals) of McDonald Lake sockeye salmon harvested in the District 106-41 commercial drift gillnet fishery based on genetic mixed stock analysis, 2007–2009 (from Gilk-Baumer et al. 2013; gray cells indicate weeks when McDonald Lake management measures were in effect).

| Year | Statistical Week | Total Harvest | Sample Size | Proportion McDonald | 90% CI: |       | Number McDonald | 90% CI: |       |
|------|------------------|---------------|-------------|---------------------|---------|-------|-----------------|---------|-------|
|      |                  |               |             |                     | Lower   | Upper |                 | Lower   | Upper |
| 2007 | 27–28            | 11,734        | 379         | 0.045               | 0.021   | 0.073 | 528             | 246     | 857   |
| 2007 | 29               | 5,077         | 380         | 0.193               | 0.138   | 0.251 | 981             | 701     | 1276  |
| 2007 | 30               | 4,443         | 380         | 0.203               | 0.154   | 0.255 | 902             | 685     | 1133  |
| 2008 | 25–26            | 4,098         | 379         | 0.003               | 0       | 0.017 | 12              | 0       | 70    |
| 2008 | 27               | 5,716         | 377         | 0.006               | 0       | 0.023 | 34              | 0       | 132   |
| 2008 | 28               | 4,303         | 376         | 0.077               | 0.043   | 0.114 | 332             | 185     | 491   |
| 2008 | 29               | 4,192         | 379         | 0.159               | 0.114   | 0.208 | 667             | 478     | 873   |
| 2008 | 30               | 980           | 325         | 0.305               | 0.239   | 0.373 | 299             | 234     | 366   |
| 2008 | 31–34            | 995           | 270         | 0.270               | 0.210   | 0.332 | 269             | 209     | 330   |
| 2009 | 27–28            | 23,414        | 376         | 0.085               | 0.052   | 0.123 | 1,990           | 1,218   | 2880  |
| 2009 | 29               | 5,948         | 379         | 0.115               | 0.071   | 0.163 | 683             | 422     | 968   |
| 2009 | 30–31            | 7,694         | 328         | 0.320               | 0.250   | 0.389 | 2,457           | 1,920   | 2987  |
| 2009 | 32               | 5,098         | 380         | 0.207               | 0.157   | 0.258 | 1,055           | 801     | 1316  |
| 2009 | 33               | 3,167         | 379         | 0.205               | 0.162   | 0.250 | 648             | 512     | 791   |



Appendix C.—Total sockeye salmon harvest, sample size, and estimated proportion and number (and 90% credibility intervals) of McDonald Lake sockeye salmon harvested in the District 106-30 commercial drift gillnet fishery based on genetic mixed stock analysis, 2007–2009 (from Gilk-Baumer et al. 2013; gray cells indicate weeks when McDonald Lake management measures were in effect).

| Year | Statistical Week | Total Harvest | Sample Size | Proportion McDonald | 90% CI: |       | Number McDonald | 90% CI: |       |
|------|------------------|---------------|-------------|---------------------|---------|-------|-----------------|---------|-------|
|      |                  |               |             |                     | Lower   | Upper |                 | Lower   | Upper |
| 2007 | 28–29            | 6,644         | 380         | 0.149               | 0.108   | 0.193 | 990             | 717     | 1,282 |
| 2007 | 30               | 2,277         | 380         | 0.213               | 0.163   | 0.267 | 485             | 371     | 608   |
| 2007 | 31               | 2,251         | 379         | 0.397               | 0.316   | 0.474 | 894             | 712     | 1,067 |
| 2007 | 32–33            | 3,170         | 379         | 0.353               | 0.295   | 0.410 | 1,119           | 935     | 1,300 |
| 2007 | 34               | 1,235         | 190         | 0.468               | 0.392   | 0.542 | 579             | 485     | 670   |
| 2008 | 26–27            | 1,974         | 380         | 0.018               | 0       | 0.044 | 36              | 0       | 87    |
| 2008 | 28               | 913           | 380         | 0.102               | 0.063   | 0.146 | 93              | 57      | 133   |
| 2008 | 29               | 2,017         | 380         | 0.123               | 0.083   | 0.167 | 248             | 168     | 337   |
| 2008 | 30–31            | 2,827         | 378         | 0.388               | 0.325   | 0.449 | 1,098           | 919     | 1,270 |
| 2008 | 32–34            | 1,853         | 310         | 0.567               | 0.503   | 0.628 | 1,051           | 933     | 1,164 |
| 2009 | 27–28            | 8,606         | 380         | 0.127               | 0.087   | 0.170 | 1,094           | 750     | 1,465 |
| 2009 | 29               | 4,783         | 380         | 0.250               | 0.201   | 0.301 | 1,196           | 961     | 1,439 |
| 2009 | 30               | 1,992         | 380         | 0.460               | 0.401   | 0.517 | 914             | 797     | 1,027 |
| 2009 | 31               | 3,297         | 379         | 0.551               | 0.482   | 0.616 | 1,817           | 1,589   | 2,031 |
| 2009 | 32               | 5,351         | 380         | 0.454               | 0.382   | 0.527 | 2,425           | 2,040   | 2,815 |
| 2009 | 33–34            | 4,132         | 380         | 0.395               | 0.342   | 0.448 | 1,633           | 1,414   | 1,852 |

Appendix D.—Total sockeye salmon harvest, sample size, and estimated proportion and number (and 90% credibility intervals) of McDonald Lake sockeye salmon in the District 101-29 and District 107-10 commercial purse seine fishery based on genetic mixed stock analysis, 2007–2009 (from Gilk-Baumer et al. 2013; gray cells indicate weeks when McDonald Lake management measures were in effect).

| Year | Area   | Statistical Week | Total Harvest | Sample Size | Proportion McDonald | 90% CI: |       | Number McDonald | 90% CI: |       |
|------|--------|------------------|---------------|-------------|---------------------|---------|-------|-----------------|---------|-------|
|      |        |                  |               |             |                     | Lower   | Upper |                 | Lower   | Upper |
| 2007 | 101-29 | 30               | 3,655         | 354         | 0.306               | 0.238   | 0.377 | 1,119           | 870     | 1,378 |
| 2007 | 101-29 | 31               | 5,509         | 380         | 0.247               | 0.189   | 0.307 | 1,359           | 1,050   | 1,689 |
| 2007 | 101-29 | 32               | 4,597         | 380         | 0.294               | 0.228   | 0.362 | 1,351           | 1,048   | 1,664 |
| 2007 | 101-29 | 33–34            | 4,123         | 190         | 0.251               | 0.187   | 0.320 | 1,035           | 771     | 1,320 |
| 2008 | 101-29 | 32               | 282           | 215         | 0.109               | 0.063   | 0.160 | 31              | 18      | 45    |
| 2008 | 101-29 | 33–34            | 3,245         | 378         | 0.073               | 0.046   | 0.102 | 237             | 149     | 331   |
| 2009 | 101-29 | 31               | 4,251         | 260         | 0.166               | 0.111   | 0.226 | 705             | 472     | 960   |
| 2009 | 101-29 | 32–33            | 8,557         | 240         | 0.171               | 0.120   | 0.225 | 1,464           | 1,028   | 1,927 |
| 2009 | 101-29 | 34–35            | 4,238         | 220         | 0.082               | 0.042   | 0.128 | 347             | 178     | 541   |
| 2007 | 107-10 | 31–32            | 4,175         | 379         | 0.605               | 0.542   | 0.664 | 2,531           | 2,268   | 2,778 |
| 2008 | 107-10 | 32–33            | 1,038         | 248         | 0.306               | 0.238   | 0.376 | 318             | 247     | 391   |
| 2009 | 107-10 | 31–34            | 8,030         | 369         | 0.469               | 0.411   | 0.526 | 3,770           | 3,304   | 4,229 |

Appendix E.—Estimated commercial harvest (and 90% credibility intervals) of McDonald Lake sockeye salmon in southern SEAK by area based on genetic mixed stock analysis, and estimated escapement and harvest rate, 2014–2017 (ADF&G Gene Conservation Laboratory, unpublished data). Salmon fisheries in Annette Island waters of District 1 and purse seine fisheries in Districts 5, 6, and 7 were not sampled.

| Year | Gear          | Area   | McDonald Harvest | 90% CI: |        | Harvest Distribution | Estimated Escapement | Harvest Rate |
|------|---------------|--------|------------------|---------|--------|----------------------|----------------------|--------------|
|      |               |        |                  | Lower   | Upper  |                      |                      |              |
| 2014 | Drift Gillnet | 101-11 | 2,635            | 1,904   | 3,365  | 6%                   | 43,400               | 51%          |
|      | Drift Gillnet | 106-30 | 2,965            | 2,501   | 3,430  | 6%                   |                      |              |
|      | Drift Gillnet | 106-41 | 2,944            | 2,478   | 3,410  | 6%                   |                      |              |
|      | Drift Gillnet | 108    | 269              | 188     | 349    | 1%                   |                      |              |
|      | Purse Seine   | 101    | 9,103            | 6,155   | 12,050 | 20%                  |                      |              |
|      | Purse Seine   | 102    | 4,386            | 2,607   | 6,164  | 10%                  |                      |              |
|      | Purse Seine   | 103    | 44               | 0       | 2,071  | 0%                   |                      |              |
|      | Purse Seine   | 104    | 23,658           | 15,011  | 32,305 | 51%                  |                      |              |
|      | Total         |        | 46,004           | 30,844  | 63,144 | 100%                 |                      |              |
| 2015 | Drift Gillnet | 101-11 | 4,263            | 3,714   | 4,812  | 6%                   | 70,200               | 48%          |
|      | Drift Gillnet | 106-30 | 8,762            | 7,838   | 9,687  | 13%                  |                      |              |
|      | Drift Gillnet | 106-41 | 6,521            | 5,394   | 7,647  | 10%                  |                      |              |
|      | Drift Gillnet | 108    | 318              | 178     | 457    | 0%                   |                      |              |
|      | Purse Seine   | 101    | 10,148           | 7,682   | 12,614 | 15%                  |                      |              |
|      | Purse Seine   | 102    | 4,735            | 3,335   | 6,136  | 7%                   |                      |              |
|      | Purse Seine   | 103    | 43               | 0       | 388    | 0%                   |                      |              |
|      | Purse Seine   | 104    | 30,800           | 18,662  | 42,937 | 47%                  |                      |              |
|      | Total         |        | 65,590           |         |        | 100%                 |                      |              |
| 2016 | Drift Gillnet | 101-11 | 1,254            | 810     | 1,698  | 5%                   | 15,600               | 63%          |
|      | Drift Gillnet | 106-30 | 3,742            | 3,240   | 4,244  | 14%                  |                      |              |
|      | Drift Gillnet | 106-41 | 4,914            | 3,989   | 5,839  | 18%                  |                      |              |
|      | Drift Gillnet | 108    | 140              | 25      | 256    | 1%                   |                      |              |
|      | Purse Seine   | 101    | 8,145            | 5,517   | 10,773 | 31%                  |                      |              |
|      | Purse Seine   | 102    | 1,747            | 905     | 2,589  | 7%                   |                      |              |
|      | Purse Seine   | 103    | 415              | 139     | 691    | 2%                   |                      |              |
|      | Purse Seine   | 104    | 6,215            | 3,183   | 9,247  | 23%                  |                      |              |
|      | Total         |        | 26,572           |         |        | 100%                 |                      |              |
| 2017 | Drift Gillnet | 101-11 | 1,002            | 603     | 1,401  | 12%                  | 24,000               | 26%          |
|      | Drift Gillnet | 106-30 | 2,265            | 1,892   | 2,637  | 27%                  |                      |              |
|      | Drift Gillnet | 106-41 | 2,274            | 1,928   | 2,620  | 27%                  |                      |              |
|      | Drift Gillnet | 108    | 115              | 52      | 178    | 1%                   |                      |              |
|      | Purse Seine   | 101    | 816              | 360     | 1,272  | 10%                  |                      |              |
|      | Purse Seine   | 102    | 180              | 47      | 314    | 2%                   |                      |              |
|      | Purse Seine   | 103    | 94               | 0       | 243    | 1%                   |                      |              |
|      | Purse Seine   | 104    | 1,790            | 914     | 2,666  | 21%                  |                      |              |
|      | Total         |        | 8,536            |         |        | 100%                 |                      |              |

Appendix F.–Estimated weekly harvest contributions (and 90% credibility intervals) of McDonald Lake sockeye salmon to the Subdistrict 106-41 drift gillnet fishery, 2014–2017 (ADF&G Gene Conservation Laboratory, unpublished data).

| Year | Statistical Week | Sample Size | Sockeye Harvest | Estimated McDonald | 90% CI: |       | Estimated McDonald | 90% CI: |       |
|------|------------------|-------------|-----------------|--------------------|---------|-------|--------------------|---------|-------|
|      |                  |             |                 |                    | Lower   | Upper |                    | Lower   | Upper |
| 2014 | 25               | 280         | 2,683           | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2014 | 26               | 30          | 1,729           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2014 | 27               | 290         | 3,189           | 2.3%               | 0.5%    | 5.0%  | 74                 | 15      | 159   |
| 2014 | 28               | 300         | 5,064           | 14.1%              | 9.3%    | 19.5% | 713                | 470     | 987   |
| 2014 | 29               | 300         | 4,477           | 13.7%              | 9.2%    | 18.8% | 613                | 411     | 841   |
| 2014 | 30               | 300         | 4,213           | 9.8%               | 5.5%    | 14.7% | 412                | 230     | 620   |
| 2014 | 31               | 300         | 2,446           | 18.0%              | 12.8%   | 23.7% | 440                | 312     | 579   |
| 2014 | 32               | 300         | 3,664           | 18.4%              | 13.1%   | 24.2% | 673                | 478     | 885   |
| 2014 | 33               | 300         | 1,124           | 1.6%               | 0.2%    | 4.7%  | 18                 | 2       | 53    |
| 2014 | 34–39            | 240         | 4,289           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2015 | 25               | 200         | 1,290           | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2015 | 26               | 300         | 6,035           | 0.2%               | 0.0%    | 1.7%  | 15                 | 0       | 102   |
| 2015 | 27               | 300         | 9,201           | 0.2%               | 0.0%    | 1.2%  | 15                 | 0       | 107   |
| 2015 | 28               | 300         | 13,219          | 0.9%               | 0.0%    | 3.2%  | 116                | 0       | 425   |
| 2015 | 29               | 200         | 6,946           | 7.6%               | 4.2%    | 11.6% | 526                | 291     | 805   |
| 2015 | 30               | 300         | 7,737           | 16.5%              | 11.5%   | 21.6% | 1,277              | 891     | 1,674 |
| 2015 | 31               | 60          | 7,484           | 20.8%              | 12.4%   | 30.4% | 1,556              | 927     | 2,272 |
| 2015 | 32               | 200         | 7,150           | 20.4%              | 15.3%   | 25.9% | 1,461              | 1,094   | 1,854 |
| 2015 | 33               | 300         | 5,315           | 21.9%              | 16.1%   | 28.2% | 1,164              | 857     | 1,497 |
| 2015 | 34–40            | 24          | 6,401           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 25               | 240         | 1,161           | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2016 | 26               | 280         | 5,038           | 0.1%               | 0.0%    | 0.1%  | 4                  | 0       | 7     |
| 2016 | 27               | 139         | 7,311           | 0.6%               | 0.0%    | 2.9%  | 42                 | 0       | 212   |
| 2016 | 28               | 61          | 10,471          | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 29               | 210         | 10,730          | 3.2%               | 0.4%    | 6.4%  | 342                | 45      | 692   |
| 2016 | 30               | 300         | 13,519          | 9.7%               | 6.7%    | 13.0% | 1,306              | 908     | 1,755 |
| 2016 | 31               | 298         | 8,900           | 14.9%              | 10.9%   | 19.2% | 1,325              | 971     | 1,713 |
| 2016 | 32               | 302         | 8,275           | 12.9%              | 8.8%    | 17.4% | 1,069              | 731     | 1,441 |
| 2016 | 33               | 300         | 3,600           | 6.6%               | 2.5%    | 11.4% | 238                | 88      | 410   |
| 2016 | 34               | 218         | 2,281           | 7.7%               | 3.0%    | 13.7% | 175                | 67      | 312   |
| 2016 | 35               | 0           | 1,062           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 36               | 136         | 393             | 1.8%               | 0.0%    | 8.8%  | 7                  | 0       | 34    |
| 2016 | 37–39            | 0           | 213             | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2017 | 25               | 300         | 2,287           | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2017 | 26               | 300         | 4,714           | 0.0%               | 0.0%    | 0.0%  | 1                  | 0       | 0     |
| 2017 | 27               | 320         | 4,938           | 0.6%               | 0.0%    | 2.8%  | 31                 | 0       | 141   |
| 2017 | 28               | 300         | 4,461           | 6.1%               | 3.1%    | 9.5%  | 270                | 138     | 424   |
| 2017 | 29               | 300         | 3,571           | 12.2%              | 7.8%    | 17.1% | 434                | 279     | 612   |
| 2017 | 30               | 120         | 2,474           | 21.9%              | 15.1%   | 29.3% | 541                | 373     | 724   |
| 2017 | 31               | 300         | 1,616           | 20.2%              | 13.9%   | 27.1% | 327                | 224     | 438   |
| 2017 | 32               | 300         | 1,507           | 16.8%              | 10.8%   | 23.5% | 252                | 162     | 354   |
| 2017 | 33               | 300         | 1,507           | 11.6%              | 6.9%    | 17.1% | 175                | 103     | 258   |
| 2017 | 34–35            | 514         | 1,158           | 20.9%              | 14.8%   | 27.2% | 242                | 171     | 315   |
| 2017 | 36–39            | 0           | 211             | ND                 | ND      | ND    | ND                 | ND      | ND    |

Appendix G.—Estimated weekly harvest contributions (and 90% credibility intervals) of McDonald Lake sockeye salmon to the Subdistrict 106-30 drift gillnet fishery, 2014–2017 (ADF&G Gene Conservation Laboratory, unpublished data).

| Year | Statistical Week | Sample Size | Sockeye Harvest | Estimated McDonald | 90% CI: |       | Estimated McDonald | 90% CI: |       |
|------|------------------|-------------|-----------------|--------------------|---------|-------|--------------------|---------|-------|
|      |                  |             |                 |                    | Lower   | Upper |                    | Lower   | Upper |
| 2014 | 25               | 120         | 535             | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2014 | 26               | 200         | 897             | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2014 | 27               | 300         | 2,029           | 3.9%               | 1.3%    | 7.5%  | 79                 | 26      | 151   |
| 2014 | 28               | 300         | 5,600           | 8.6%               | 4.7%    | 13.3% | 482                | 263     | 743   |
| 2014 | 29               | 300         | 3,681           | 17.2%              | 12.1%   | 22.8% | 633                | 446     | 840   |
| 2014 | 30               | 300         | 5,083           | 19.7%              | 14.2%   | 25.7% | 1,001              | 724     | 1,305 |
| 2014 | 31               | 300         | 1,099           | 11.6%              | 6.9%    | 16.8% | 127                | 76      | 185   |
| 2014 | 32               | 300         | 3,260           | 11.7%              | 7.5%    | 16.5% | 383                | 245     | 538   |
| 2014 | 33               | 300         | 667             | 25.1%              | 19.7%   | 30.8% | 167                | 132     | 205   |
| 2014 | 34               | 300         | 1,894           | 4.9%               | 2.2%    | 8.5%  | 93                 | 41      | 161   |
| 2014 | 35–39            | 0           | 807             | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2015 | 25               | 200         | 396             | 3.6%               | 0.0%    | 12.1% | 14                 | 0       | 48    |
| 2015 | 26               | 300         | 1,244           | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2015 | 27               | 300         | 2,815           | 0.6%               | 0.0%    | 2.5%  | 17                 | 0       | 70    |
| 2015 | 28               | 300         | 7,001           | 5.4%               | 2.8%    | 8.5%  | 376                | 195     | 595   |
| 2015 | 29               | 300         | 4,967           | 6.1%               | 2.8%    | 10.1% | 305                | 141     | 503   |
| 2015 | 30               | 180         | 10,414          | 15.8%              | 10.6%   | 21.5% | 1,642              | 1,100   | 2,234 |
| 2015 | 31               | 300         | 8,066           | 29.6%              | 24.7%   | 34.7% | 2,389              | 1,989   | 2,797 |
| 2015 | 32               | 300         | 8,836           | 28.1%              | 22.9%   | 33.3% | 2,481              | 2,020   | 2,939 |
| 2015 | 33               | 300         | 3,694           | 31.6%              | 25.2%   | 38.4% | 1,168              | 930     | 1,420 |
| 2015 | 34               | 300         | 1,429           | 25.9%              | 17.4%   | 34.9% | 371                | 249     | 499   |
| 2015 | 35–39            | 0           | 2,281           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 25               | 10          | 74              | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 26               | 120         | 798             | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2016 | 27               | 289         | 2,225           | 0.7%               | 0.0%    | 4.2%  | 16                 | 0       | 92    |
| 2016 | 28               | 304         | 5,554           | 4.3%               | 0.0%    | 8.4%  | 236                | 0       | 467   |
| 2016 | 29               | 300         | 4,112           | 6.7%               | 3.7%    | 10.3% | 276                | 151     | 425   |
| 2016 | 30               | 300         | 3,432           | 14.0%              | 9.5%    | 18.9% | 481                | 327     | 649   |
| 2016 | 31               | 300         | 5,296           | 14.0%              | 10.2%   | 18.1% | 741                | 542     | 959   |
| 2016 | 32               | 300         | 7,264           | 18.0%              | 14.1%   | 22.3% | 1,309              | 1,025   | 1,617 |
| 2016 | 33               | 300         | 2,100           | 14.8%              | 9.4%    | 20.7% | 310                | 197     | 435   |
| 2016 | 34               | 300         | 1,758           | 18.6%              | 12.7%   | 25.0% | 328                | 223     | 440   |
| 2016 | 35               | 263         | 747             | 0.0%               | 0.0%    | 0.0%  | 0                  | 0       | 0     |
| 2016 | 36–39            | 91          | 335             | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2017 | 25–26            | 315         | 1,953           | 0.2%               | 0.0%    | 1.0%  | 3                  | 0       | 20    |
| 2017 | 27               | 216         | 1,707           | 8.4%               | 4.1%    | 13.5% | 143                | 71      | 230   |
| 2017 | 28               | 300         | 2,012           | 9.8%               | 4.3%    | 16.0% | 198                | 87      | 322   |
| 2017 | 29               | 300         | 2,788           | 18.4%              | 11.8%   | 25.6% | 512                | 330     | 713   |
| 2017 | 30–31            | 299         | 3,341           | 18.5%              | 13.2%   | 24.1% | 617                | 442     | 807   |
| 2017 | 32               | 300         | 2,508           | 18.4%              | 12.2%   | 25.2% | 461                | 307     | 632   |
| 2017 | 33–35            | 393         | 2,056           | 16.0%              | 9.6%    | 23.3% | 329                | 197     | 479   |
| 2017 | 36–39            | 0           | 196             | ND                 | ND      | ND    | ND                 | ND      | ND    |

Appendix H.—Estimated weekly harvest contributions (and 90% credibility intervals) of McDonald Lake sockeye salmon to the District 101 and 102 purse seine fisheries, 2014–2017 (ADF&G Gene Conservation Laboratory, unpublished data).

| Year | District | Statistical Week | Sample Size | Sockeye Harvest | Estimated McDonald | 90% CI: |       | Estimated McDonald | 90% CI: |       |
|------|----------|------------------|-------------|-----------------|--------------------|---------|-------|--------------------|---------|-------|
|      |          |                  |             |                 |                    | Lower   | Upper |                    | Lower   | Upper |
| 2014 | 101      | 28–30            | 295         | 20,979          | 15.5%              | 10.7%   | 20.7% | 3,251              | 2,238   | 4,337 |
| 2014 | 101      | 31–32            | 295         | 30,526          | 9.0%               | 5.9%    | 12.4% | 2,742              | 1,804   | 3,779 |
| 2014 | 101      | 33–34            | 296         | 21,344          | 14.6%              | 10.7%   | 18.6% | 3,110              | 2,292   | 3,975 |
| 2014 | 101      | 35               | 0           | 2,529           | ND                 | ND      | ND    |                    |         |       |
| 2015 | 101      | 28–29            | 190         | 14,418          | 11.1%              | 6.3%    | 16.7% | 1,603              | 906     | 2,402 |
| 2015 | 101      | 30–31            | 195         | 27,432          | 8.4%               | 4.3%    | 13.2% | 2,313              | 1,178   | 3,618 |
| 2015 | 101      | 32–33            | 206         | 36,564          | 17.0%              | 11.8%   | 22.7% | 6,232              | 4,302   | 8,311 |
| 2016 | 101      | 28–30            | 199         | 17,309          | 0.8%               | 0.0%    | 5.9%  | 146                | 0       | 1,018 |
| 2016 | 101      | 31–32            | 370         | 55,972          | 12.8%              | 8.9%    | 16.9% | 7,147              | 4,990   | 9,473 |
| 2016 | 101      | 33–34            | 198         | 21,853          | 3.9%               | 0.0%    | 9.9%  | 851                | 0       | 2,157 |
| 2017 | 101      | 27–29            | 193         | 4,177           | 6.6%               | 0.0%    | 12.4% | 274                | 0       | 517   |
| 2017 | 101      | 30–33            | 196         | 3,500           | 6.2%               | 0.0%    | 13.6% | 219                | 0       | 476   |
| 2017 | 101      | 34–35            | 286         | 7,693           | 4.2%               | 0.0%    | 7.9%  | 323                | 0       | 609   |
| 2014 | 102      | 25–27            | 298         | 5,194           | 5.5%               | 3.3%    | 8.1%  | 286                | 170     | 420   |
| 2014 | 102      | 28–30            | 296         | 14,075          | 16.8%              | 12.4%   | 21.1% | 2,363              | 1,750   | 2,974 |
| 2014 | 102      | 31–34            | 300         | 22,409          | 7.7%               | 5.0%    | 10.7% | 1,736              | 1,131   | 2,408 |
| 2014 | 102      | 35               | 0           | 1,288           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2015 | 102      | 26–31            | 190         | 20,487          | 6.5%               | 3.6%    | 10.1% | 1,341              | 744     | 2,064 |
| 2015 | 102      | 32–35            | 380         | 55,076          | 6.2%               | 4.1%    | 8.5%  | 3,394              | 2,241   | 4,695 |
| 2015 | 102      | 36–39            | 0           | 862             | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 102      | 26–30            | 196         | 14,329          | 0.2%               | 0.0%    | 1.6%  | 28                 | 0       | 234   |
| 2016 | 102      | 31               | 0           | 3,574           | ND                 | ND      | ND    | ND                 | ND      | ND    |
| 2016 | 102      | 32–33            | 280         | 35,571          | 4.8%               | 2.7%    | 7.3%  | 1,719              | 967     | 2,607 |
| 2017 | 102      | 25–27            | 224         | 6,177           | 0.2%               | 0.0%    | 1.3%  | 10                 | 0       | 82    |
| 2017 | 102      | 28–29            | 219         | 5,597           | 3.0%               | 1.2%    | 5.4%  | 170                | 69      | 304   |
| 2017 | 102      | 30–37            | 0           | 2,197           | ND                 | ND      | ND    | ND                 | ND      | ND    |

Appendix I.—Estimated commercial harvest (and 95% credibility intervals) and distribution of thermal-marked McDonald Lake sockeye salmon in southern SEAK by area, 2011–2012 (from Brunette et al. 2015).

| Year | Gear          | Area                     | McDonald Harvest | 95% CI: |       | CV   | Distribution |
|------|---------------|--------------------------|------------------|---------|-------|------|--------------|
|      |               |                          |                  | Lower   | Upper |      |              |
| 2011 | Drift Gillnet | 101-11                   | 63               | 0       | 143   | 64%  | 4%           |
| 2011 | Drift Gillnet | 106-30                   | 671              | 462     | 880   | 16%  | 41%          |
| 2011 | Drift Gillnet | 106-41                   | 448              | 230     | 667   | 25%  | 27%          |
| 2011 | Drift Gillnet | 108                      | 11               | 0       | 38    | 125% | 1%           |
| 2011 | Purse Seine   | 101-inside <sup>a</sup>  | 32               | 0       | 74    | 68%  | 2%           |
| 2011 | Purse Seine   | 101-outside <sup>b</sup> | 124              | 31      | 218   | 38%  | 8%           |
| 2011 | Purse Seine   | 102                      | 86               | 17      | 156   | 41%  | 5%           |
| 2011 | Purse Seine   | 104                      | 209              | 0       | 543   | 82%  | 13%          |
| 2011 | Purse Seine   | 107                      | ND               | ND      | ND    | ND   | ND           |
| 2011 | Total         |                          | 1,644            |         |       |      | 100%         |
| 2012 | Drift Gillnet | 101-11                   | 165              | 50      | 279   | 35%  | 5%           |
| 2012 | Drift Gillnet | 106-30                   | 557              | 451     | 663   | 10%  | 17%          |
| 2012 | Drift Gillnet | 106-41                   | 821              | 624     | 1,018 | 12%  | 25%          |
| 2012 | Drift Gillnet | 108                      | 13               | 0       | 27    | 60%  | 0%           |
| 2012 | Purse Seine   | 101-inside <sup>a</sup>  | 317              | 160     | 473   | 25%  | 10%          |
| 2012 | Purse Seine   | 101-outside <sup>b</sup> | 483              | 324     | 643   | 17%  | 15%          |
| 2012 | Purse Seine   | 102                      | 400              | 237     | 564   | 21%  | 12%          |
| 2012 | Purse Seine   | 104                      | 505              | 58      | 951   | 45%  | 15%          |
| 2012 | Purse Seine   | 107                      | 43               | 0       | 92    | 59%  | 1%           |
| 2012 | Total         |                          | 3,304            |         |       |      | 100%         |

<sup>a</sup> The District 101-inside area includes combined subdistricts 101-23 and 101-41 in Revillagigedo channel.

<sup>b</sup> The District 101-outside area includes combined subdistricts 101-29 and 101-25 in Clarence Strait.