U.S. Fish & Wildlife Service

Assessment of Fish Migration in Soldotna Creek with an Emphasis on Invasive Northern Pike, Southcentral Alaska, 2009 and 2010

Alaska Fisheries Data Series Number 2011-2

Kenai Fish and Wildlife Field Office
Soldotna, Alaska
April, 2011

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Kenneth S. Gates and James K. Boersma

Abstract

A fish weir with an underwater video system was installed in Soldotna Creek to count northern pike *Esox lucius* emigrating from the creek into the Kenai River. The weir and video system was operated during 2009 and 2010 between 21 April and 4 November and 13 April and 3 September, respectively. A total of three northern pike were observed leaving Soldotna Creek during these two periods (2009, *N*=2; 2010, *N*=1). Because only a few northern pike were observed, the magnitude of immediate threat to native fish in the mainstem Kenai River from northern pike is thought to be minimal. However, northern pike can use the Kenai River as a migration corridor to access other critical watersheds like the Moose River watershed, where significant habitat overlap would occur between northern pike and native salmonids. If northern pike become established in watersheds similar to the Moose River, impacts from northern pike predation could be severe. In addition to northern pike, a total of 10 other fish species were identified and enumerated including Dolly Varden *Salvelinus malma*, steelhead *Oncorhynchus mykiss* (anadromous rainbow trout), rainbow trout, lamprey *Lampetra* sp., round whitefish *Prosopium cylindraceum*, eulachon *Thaleichthys pacificus*, coho salmon *O. kisutch.*, pink salmon *O. gorbuscha*, sockeye salmon *O. nerka*, and Chinook salmon *O. tshawytscha*. Steelhead were previously undocumented in the Soldotna Creek watershed and their run timing and population structure was similar to other steelhead populations identified on the Kenai Peninsula.

Introduction

Northern pike *Esox lucius* are indigenous to Alaska north and west of the Alaska Range, but are an invasive species to the Kenai Peninsula where they were first illegally introduced into the Soldotna Creek drainage during the 1970s. Since then, they have been observed or reportedly harvested throughout the Kenai Peninsula in 19 different lakes and in the Moose and Swanson rivers (Booth and Otis 1996; Gamblin et al. 2004; Massengill 2008; Massengill 2010). Harvest of northern pike throughout the Kenai Peninsula reporting area has ranged from 36 to 2,321 between 1994 and 2008 according to the Alaska Department of Fish and Game's (Department) Statewide Harvest Survey (Howe et al. 1995, Howe et al. 1996; Howe et al. 2001 a-b; Jennings et al. 2010). Harvest primarily occurs in area lakes and the Kenai River (e.g., 2008: 85% harvest in lakes and 10% harvest in the Kenai River; Jennings et al. 2010). Although northern pike are occasionally caught in the Kenai River, there is no evidence of a spawning population in the mainstem (Begich and Pawluk 2010). Several projects have been implemented to document the distribution and control the spread of northern pike throughout the Kenai Peninsula. Projects include presence/absence sampling, the installation of control barriers in Stormy Lake, intensive netting throughout all known and suspected infested lakes, the documentation of movement patterns using radio telemetry in Stormy Lake, and the total removal of northern pike in Arc and

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Scout Lakes using rotenone (Palmer and Tobin 1996; Begich and McKinley 2005; Massengill 2008; Begich 2010; Begich and Pawluk 2010; Massengill 2010).

The continued spread of northern pike throughout the Kenai Peninsula could result in the establishment of additional reproducing populations in key salmon rearing areas. This could threaten important fisheries on the Kenai Peninsula, especially in the Moose and Swanson rivers where suitable northern pike habitat (shallow, vegetated, slow moving water) would overlap with rearing habitat for native salmonids. Several fish populations in numerous locations throughout southcentral Alaska have already been altered to such an extent that once-viable sport fisheries have been completely eliminated and replaced by monocultures of northern pike (Alaska Department of Fish and Game 2007) and the Soldotna Creek drainage is an example of how non-native northern pike can change fish assemblages. Traditional knowledge from area residents of Soldotna Creek indicates that the East and West Mackey lakes historically supported populations of Dolly Varden *Salvelinus malma*, rainbow trout *Oncorhynchus mykiss*, and anadromous fishes but now are dominated by northern pike (Begich and McKinley 2005). The presence of northern pike in the Soldotna Creek drainage is especially alarming because it empties into the Kenai River. The Kenai River supports major recreational and commercial fisheries and contributes substantially to the annual economic values of Alaska's sport fisheries which exceed $500 million dollars (U.S. Department of Interior and U.S. Department of Commerce 2001). Information on the movement of northern pike in the Soldotna Creek watershed is needed to ensure conservation of anadromous and resident fish species in the Kenai River watershed. A fish weir and underwater video system was used during 2009 and 2010 to evaluate the abundance of northern pike emigrating Soldotna Creek. The results of this project will assist with the management and development of control measures for invasive northern pike in the Kenai River watershed.

Study Area

The Soldotna Creek watershed falls within the Department's Northern Kenai Peninsula Management Area, which is comprised of federal, state, borough, city, private, and native lands. Soldotna Creek is a small stream that flows approximately 14 km before it drains into the Kenai River at river kilometer 35.5 (N 60.48313˚, W 151.05774˚; WGS84; Figure 1). The Soldotna Creek watershed is located in the lowlands of the western Kenai Peninsula and encompasses bog meadows, ponds, and several lakes (Elliot and Finn 1984). Several species of anadromous fish are present in this watershed, including Chinook salmon *O. tshawytscha*, coho salmon *O. kisutch*, sockeye salmon *O. nerka*, Dolly Varden, and lamprey *Lampetra* sp. (Johnson and Daigneault 2008). Historically, the drainage supported a viable population of rainbow trout but recent gillnet surveys found that northern pike dominated seven of eight major lakes in the Soldotna Creek drainage (Gamblin et al. 2004; Begich and McKinley 2005).

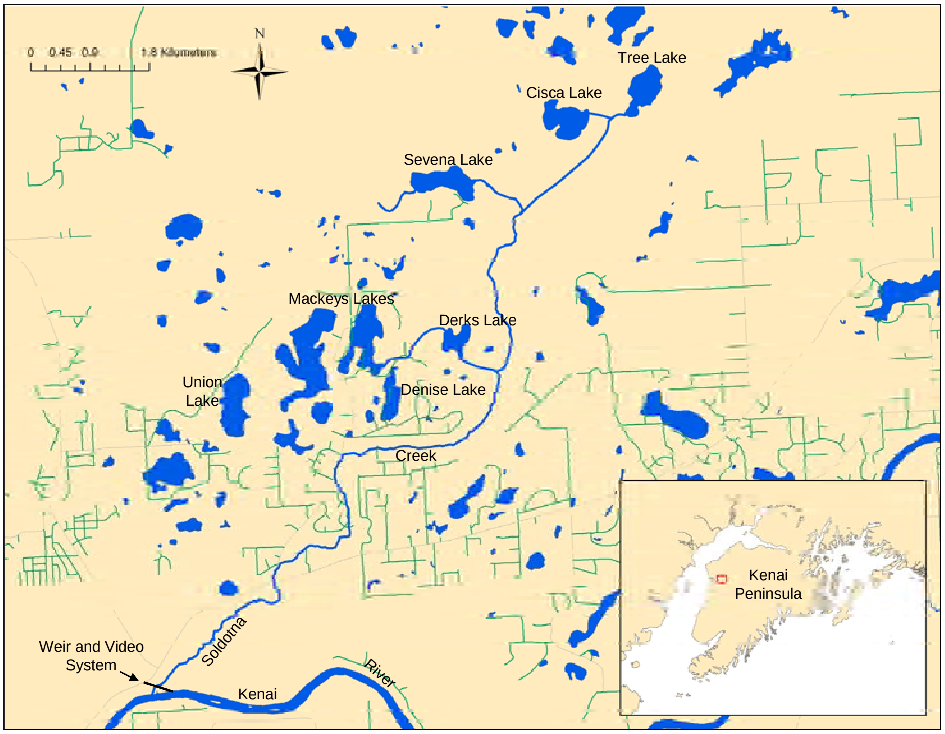

FIGURE 1. —Map of the Soldotna Creek watershed in southcentral Alaska.

Methods

Weir and Video Operations and Design

A weir equipped with an underwater video system was installed in Soldotna Creek approximately 80 m upstream from its confluence with the Kenai River. Passage information was collected for migrating adult fish including northern pike. The video weir was installed on 21 April 2009 and 13 April 2010 and operated until 4 November 2009 and 3 September 2010.

The weir facilitated upstream and downstream fish passage. The portion that facilitated upstream passage was similar to that used on Shantatalik Creek (Palmer et al. 2008) and measured approximately 4.2 m wide and 1.5 m tall (Appendix 1). To facilitate downstream passage, two rigid weir segments were angled forty five degrees upstream and spanned the distance between the stream bank and the front of the video chute (Appendix 1). The two rigid weir segments measured approximately 3.4 m and 2.1 m wide and 1.5 m tall. The video chute separated the upstream and downstream weir components (Appendix 1). The weir framework was composed of several pieces of 6.4-cm aluminum angle bolted together forming a self-standing frame. The weir pickets were made from 25-mm diameter schedule 40 aluminum pipe. Each picket measured 1.8 m in length and attached to the frame by sliding through 28.6-mm diameter holes drilled in two pieces of aluminum angle bolted to the front of the weir frames. Weir pickets for both upstream and downstream components were spaced 3.2 cm apart. This weir was unmanned and outfitted with a video system.

An underwater video system was placed between the upstream and downstream weir components and was used to monitor fish passage at the weir. Setup and design of the video system was similar to that used by Gates et al. (2010) in Crooked and Nikolai creeks in the Kasilof River watershed. One underwater video camera was located inside a sealed video box attached to the fish passage chute. The video box was constructed of 3.2-mm aluminum sheeting and was filled with filtered water. Safety glass was installed on the front of the video box to allow for a scratch-free, clear surface through which video images were captured. The passage chute was constructed from aluminum angle and enclosed in plywood, thereby isolating it from exterior light. The backdrop of the passage chute from which video images were captured adjusted laterally to minimize the number of fish passing through the chute at one time. The backdrop could also be easily removed from the video chute when dirty and replaced with a new one. The video box and fish passage chute were artificially lit using a pair of 12-V DC underwater pond lights. Pond lights were equipped with 20-W bulbs to provide a quality image and a consistent source of lighting during day and night hours. Video images were recorded using a digital video recorder (DVR) located at the weir site. Fish passage was recorded 24 hours per day seven days each week and stored video files were reviewed several times a week. The DVR was equipped with motion detection to minimize the amount of blank video footage and review time. All video images were recorded on a removable 500 gigabyte hard drive at 30 frames-per-second. All video equipment was supplied with 110-V AC power available at the site and converted to 12-V DC for the underwater camera and lights. An 1100-W inverter and 55-A charger was used inline with two 6-V DC batteries wired in series creating a large battery backup rated at 12-V and 400 ampere-hours. Appendix 2 contains a complete list of all equipment used.

Data analysis. —Counts of fish moving past the weir were entered daily into an Excel® spreadsheet. Counts were recorded as upstream or downstream passage and further summarized into weekly passage. Steelhead (anadromous rainbow trout) were differentiated from resident rainbow trout during video review using visual external characteristics similar to those used by Fleming (1999) in upper Copper River drainages. Resident rainbow trout typically have a dense spotting pattern covering the entire body of the fish whereas steelhead have fewer spots that do not extend to the ventral side of the fish. Sex of steelhead was also determined by observing external characteristics. All data were summarized using line and bar graphs and tables.

Results

Weir and Video Operations

The weir and video system was operated for a total of 198 days between 21 April and 4 November 2009 and for 143 days between 13 April and 3 September 2010. The video system ran smoothly during the operational period, with the exception of image loss on six occasions resulting in 35 days of no or incomplete counts. The dates of no or incomplete counts during 2009 included periods from 24 to 25 April, 30 May to 8 June, 20 to 26 August and 14 to 19 October. The dates of no or incomplete counts during 2010 occurred from 8 to 10 June and 24 to 30 August. The resulting image loss during these periods was due to the loss of power, vandalism, or malfunctions of the external hard drive. Repairs were completed as soon as possible when each outage was discovered. The weir and video system was removed earlier than planned in 2010 because of construction near the weir site that eliminated the power supply to the video system. No attempt was made to estimate passage for dates with incomplete passage.

Weir Counts

Eleven species of fish including northern pike were observed moving upstream or downstream through the video weir in Soldotna Creek during 2009 and 2010 (Table 1; Appendices 3 and 4). A total of three individual northern pike emigrated the creek on 30 April and 19 June 2009 and 22 July 2010. The remaining passage was composed primarily of Dolly Varden, steelhead, rainbow trout, and coho salmon (Table 1). Run timing for these four species is presented in Figures 2 and 3. Weekly passage for all species is summarized in Appendices 3 and 4.

TABLE 1. —A list of species identified passing through the Soldotna Creek weir during 2009 and 2010.

		2009[a]		2010[b]	
Scientific Name	Common Name	Upstream Passage (*N*)	Downstream Passage (*N*)	Upstream Passage (*N*)	Downstream Passage (*N*)
Esox lucius	northern pike	0	2	0	1
Salvelinus malma	Dolly Varden	1,094	965	501	450
Oncorhychus mykiss	steelhead (anadromous rainbow trout)	124	64	97	49
Oncorhychus mykiss	rainbow trout	97	77	141	115
Lampetra spp.	lamprey	7	51	0	54
Prosopium cylindraceum	round whitefish	1	1	1	1
Thaileichthys pacificus	eulachon[c]	112	1	30	3
Oncorhychus kisutch	coho salmon	486	177	36	27
Oncorhychus gorbuscha	pink salmon	39	29	55	48
Oncorhychus nerka	sockeye salmon	32	32	24	19
Oncorhychus tshawytscha	Chinook salmon	3	3	1	1

[a] Counts were collected from 21 Apil to 4 November

[b] Counts were collected from 13 April to 3 September

[c] Eulachon counts are incomplete because of the difficulty in distinguishing them from salmon smolt.

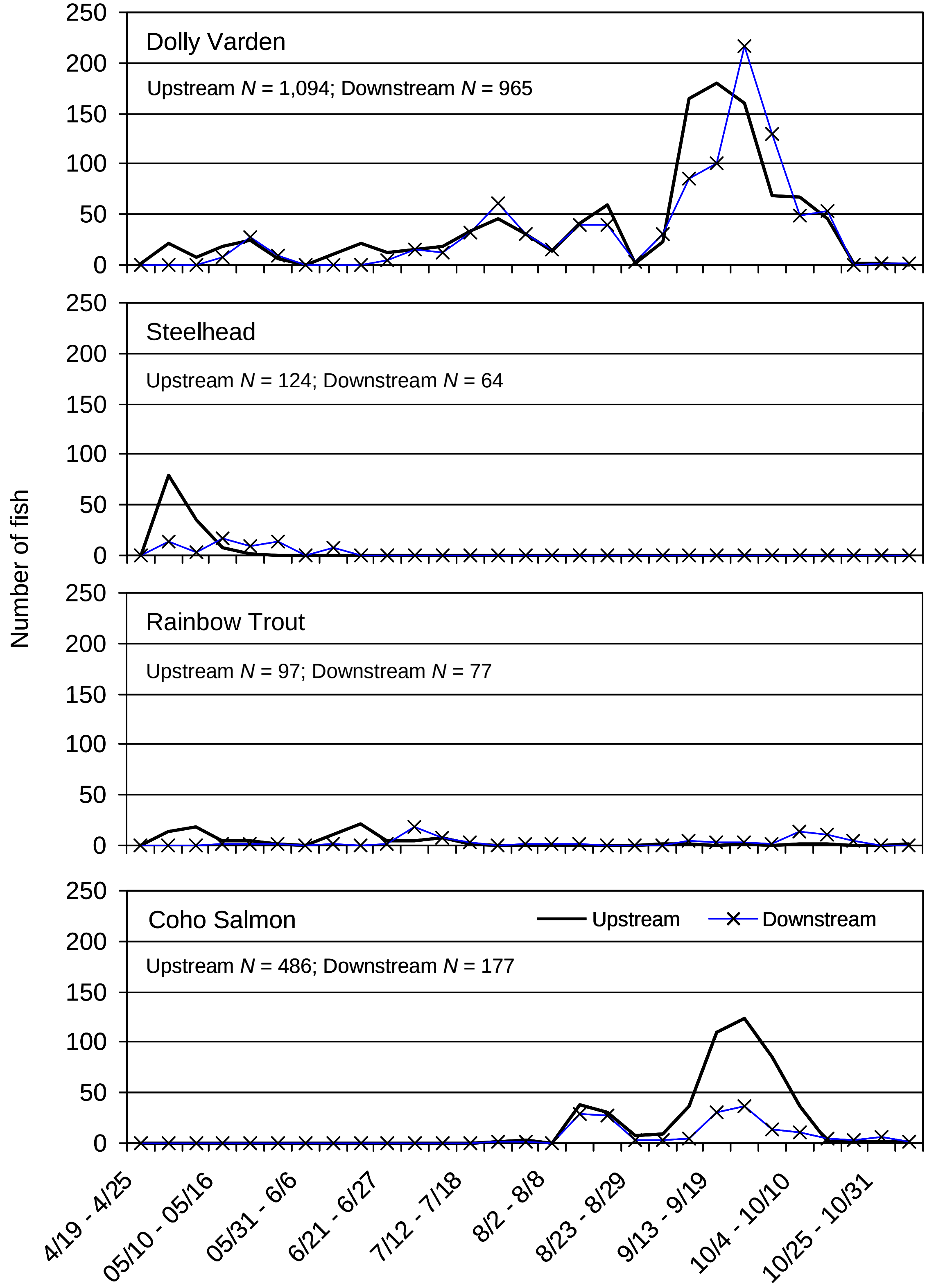

FIGURE 2. —Weekly upstream and downstream passage of the four primary species observed in Soldotna Creek during 2009.

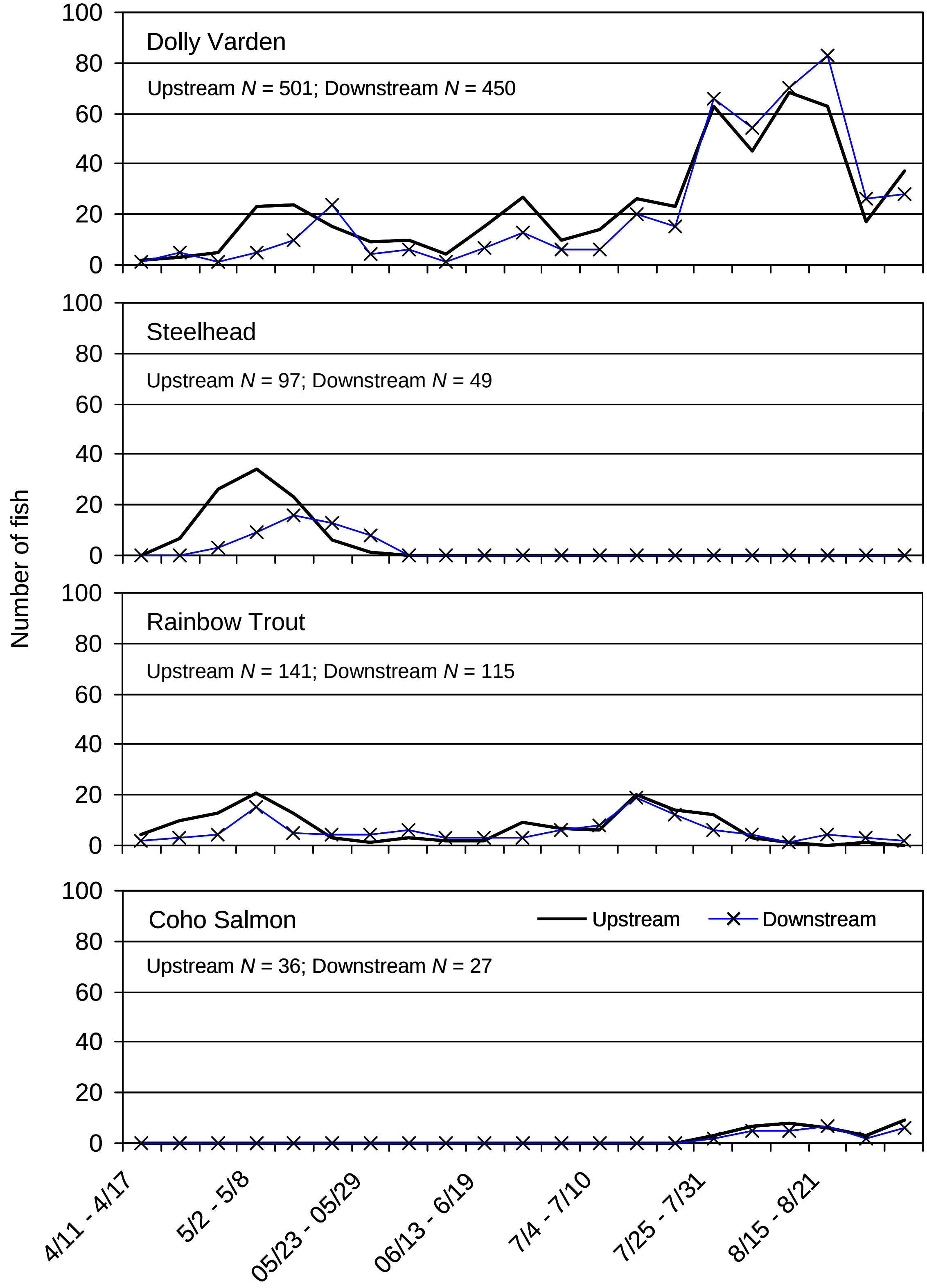

FIGURE 3. —Weekly upstream and downstream passage of the four primary species observed in Soldotna Creek during 2010. The peak of the coho salmon run was not monitored because of the loss of power at the weir and the subsequent termination of the project.

Steelhead observed in Soldotna Creek exhibited similar run timing to other populations monitored on the Kenai Peninsula. Peak weekly upstream passage took place between 26 April and 2 May 2009 and 5 and 8 May 2010 (Figures 2 and 3; Appendices 3 and 4). Peak weekly downstream passage occurred between 10 and 16 May 2009 and 9 and 15 May 2010 (Figures 2 and 3; Appendices 3 and 4). Female steelhead comprised 58% (2009) and 57% (2010) of upstream escapement (Appendix 5). The sex composition during 2009 was nearly 50% males and females for the first week of counting (26 April – 2 May) but was dominated by females throughout the remainder of the run. During 2010, the sex composition was skewed towards males early in the run but then became skewed towards females during the remainder of the run (Figure 4). Emigrating steelhead were composed primarily of females during 2009 (75%) and 2010 (71%; Appendix 5). Downstream passage occurred between 26 April and 10 June during 2009 and 2010 (Figure 5).

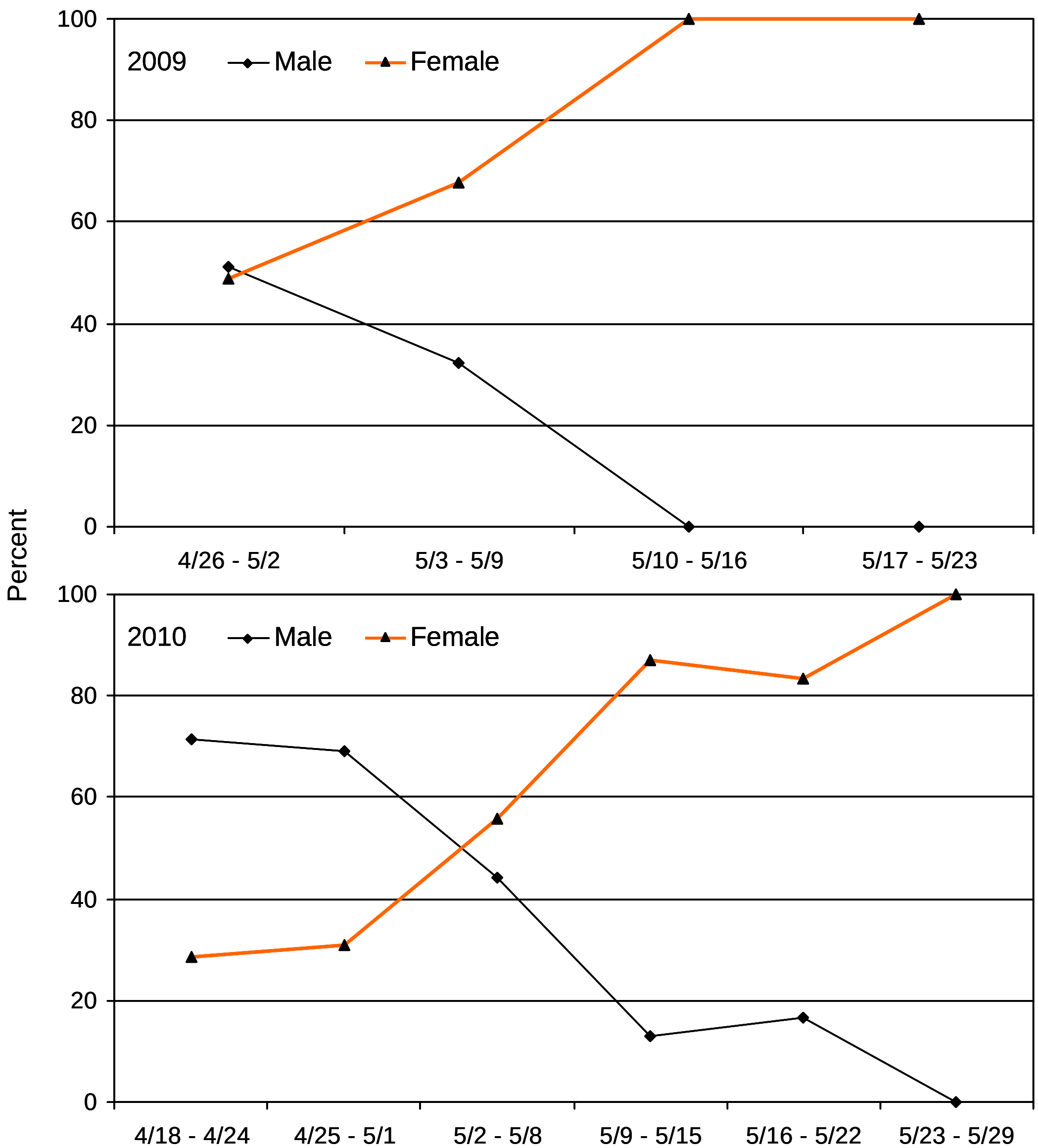

FIGURE 4. —Weekly sex composition of adult steelhead observed migrating upstream in Soldotna Creek during 2009 and 2010. Steelhead with undetermined sex were omitted from this figure (2009: *N*=3). The week of 11 to 17 April was omitted from 2010 because no steelhead passage was observed.

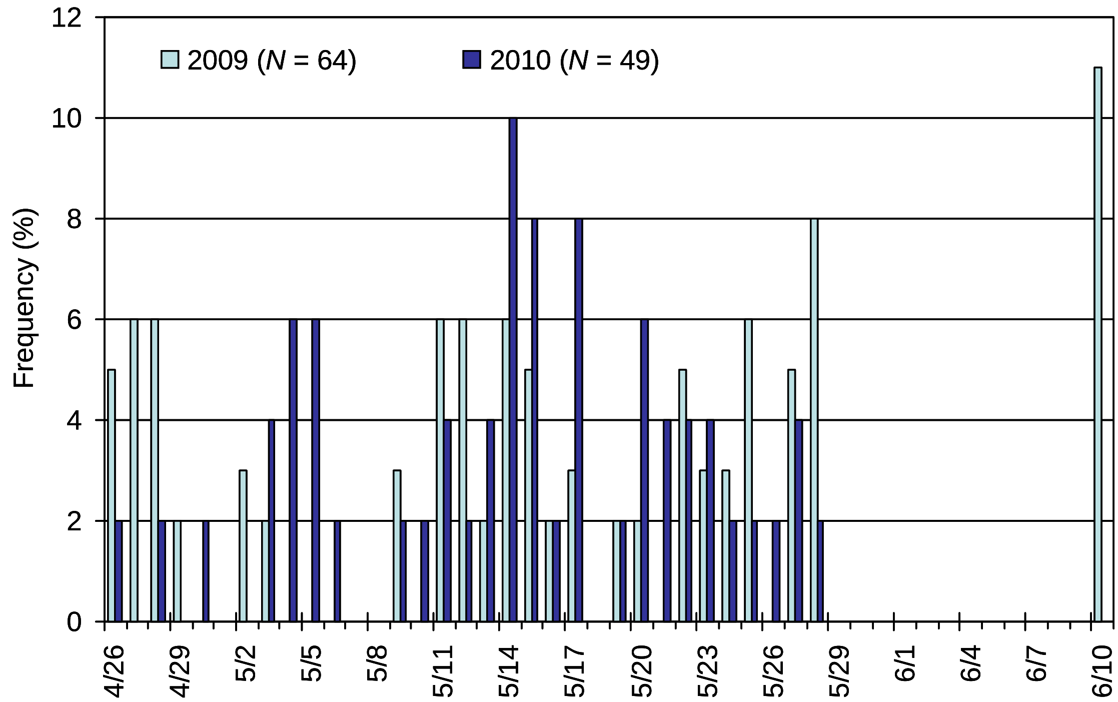

FIGURE 5. —Frequency of steelhead emigrating Soldotna Creek each day between 26 April and 10 June during 2009 and 2010.

Discussion

Very few northern pike (*N* = 3) were observed emigrating from Soldotna Creek into the Kenai River during most of the ice-free season in 2009 and during spring and summer 2010. Based on this low level of observed movement, the magnitude of immediate threat to native fish in the mainstem Kenai River from northern pike emigrating Soldotna Creek is minimal. However, the potential for northern pike to enter the Kenai River from Soldotna Creek will always exist as long as they are present within the watershed. Knowing that some northern pike are emigrating from Soldotna Creek into the Kenai River still causes great concern for the important recreational and commercial fisheries within the Kenai River watershed, which contribute significantly to the net economic value of commercial and sport fisheries in the upper Cook Inlet region (Kenai River Sport Fishing Association 2008). The Department's ultimate goal is to implement an action plan that will control or eradicate northern pike that threaten the Kenai River drainage (Massengill 2010).

Although the Kenai River is a swift-flowing river that does not provide much suitable habitat for northern pike, the river can serve as a migration corridor to access other areas of the watershed that do provide good pike habitat. For example, the Moose River watershed provides vast areas of shallow, vegetated, slow moving water in small lakes and streams that is suitable pike habitat. Unfortunately, these areas also provide important rearing habitat for native salmonids, primarily coho salmon, rainbow trout, and Dolly Varden. A single northern pike was observed in the Moose River in 1986 (Booth and Otis 1996), but subsequent sampling throughout the watershed failed to capture any pike (Palmer and Tobin 1996). Anglers have also reported harvesting small numbers of northern pike from several lakes in the Moose River watershed (Begich and Pawluk 2010). If a viable northern pike population becomes established in the Moose River watershed, impacts to native species and the fisheries they support could be severe since northern pike can alter fish communities through predation (Paukert and Willis 2003).

Northern pike passing downstream during 2009 were observed immediately following schools of salmon smolt. The demand for prey and high densities of salmon smolt egressing Soldotna Creek may account for this movement since bioenergetics and prey availability principally affect northern pike consumption rates (Muhlfeld et al. 2008). The single northern pike observation in 2010 occurred much later than the smolt outmigration but none the less northern pike are highly piscivorous and will take advantage of almost any available prey fish (Scott and Crossman 1973). One factor that might be limiting or delaying the emigration of northern pike from Soldotna Creek is an active complex of beaver dams above the Sterling Highway. These beaver dams are extensive and could be serving as a natural migration barrier (Robert Begich, Alaska Department of Fish and Game, personal communication). It is also likely that years of intensive gill netting by the Department throughout the Soldotna Creek watershed (Begich and McKinley 2005; Begich 2010; Massengill 2010) has reduced the overall abundance of northern pike within the watershed.

Fish counts during 2009 and 2010 represent the relative abundance for most species observed in Soldotna Creek. However, estimates for some species are conservative because of periodic interruptions in the video caused by loss of power, vandalism, or malfunctions of the DVR hard drive and the premature removal of the weir and video system in 2010. Interruptions resulted in no or incomplete counts for a total of 25 days during 2009 and a total of 10 days in 2010. The removal of the weir and video system on 3 September 2010 prevented us from estimating the peak run timing of coho salmon and Dolly Varden. We are uncertain as to how many individual Dolly Varden were observed during each year because we suspect some fish were counted multiple times as they milled in the vicinity of the weir. We recommend relocating the weir site further upstream to minimize these occurrences for any future monitoring.

The immigration of steelhead into Soldotna Creek was previously undocumented and followed similar run timing and population structure as other populations on the Kenai Peninsula and in Southeast Alaska (Love and Harding 2009; Gates et al. 2010). Males were greater in abundance during the early part of the run prior to a dominant female return (Figure 4). A sex ratio of more females than males suggests that there is a higher rate of repeat spawning for females which is also supported by the lower proportion of male kelts egressing the creek.

In conclusion, installing the Soldotna Creek weir and successfully operating it during 2009 and 2010 documented low numbers (N = 3) of northern pike emigrating Soldotna Creek. The weir also allowed us to monitor abundance of other migrating fish species. Information collected from this project will be useful in formulating future management strategies for northern pike in the Soldotna Creek drainage and throughout the Kenai Peninsula. The final operational year for this project was 2010 and we do not plan to continue operations in the future.

Acknowledgements

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APPENDIX 1. —Picture of the Soldotna Creek weir highlighting the major weir components.

APPENDIX 2. —List of video equipment used to monitor fish passage in Soldotna Creek during 2009 and 2010.

Item	Model #	Manufacturer	Contact
Digital Video Recorder	DVSM 4-120	Veltek International, Inc.	http://www.veltekcctv.com/
Digital Video Recorder	Intellex LT	American Dynamics	http://www.americandynamics.net
Underwater Camera	Model 10	Applied Micro Video	http://www.appliedmicrovideo.com/
Underwater Lights	Lunaqua 2 12-v	OASE	http://www.pondusa.com
External Harddrive	One Touch 500 GB	Maxtor.com	http://www.maxstore.com
400 Ah 6 Volt Battery	S-530	Rolls	http://www.rollsbattery.com/
Charger	GPC 55	Go Power	http://www.gpelectric.com/
Inverter	XP 1100	Excel Tech	http://www.exeltech.com/

APPENDIX 3. —Weekly counts of all species observed at the Soldotna Creek weir during 2009.

	Northern Pike		Dolly Varden		Steelhead		Rainbow Trout		Lamprey spp.		Round Whitefish	
Week	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
4/19 - 4/25	0	0	1	0	0	0	0	0	0	0	0	0
4/26 - 5/2	0	1	22	0	80	14	13	0	1	0	0	0
5/3 - 5/9	0	0	8	0	35	3	18	0	0	0	0	0
05/10 - 05/16	0	0	18	7	8	17	4	1	0	1	0	0
05/17 - 05/23	0	0	25	27	1	9	4	2	0	0	0	0
05/24 - 05/30	0	0	6	9	0	14	1	1	0	0	0	0
05/31 - 6/6	0	0	0	0	0	0	0	0	0	0	0	0
6/7 - 6/13	0	0	10	0	0	7	10	1	1	5	0	0
06/14 - 6/20	0	1	21	0	0	0	21	0	1	0	0	0
6/21 - 6/27	0	0	12	5	0	0	5	1	0	1	0	0
6/28 - 7/4	0	0	16	15	0	0	5	18	0	0	0	0
7/5 - 7/11	0	0	19	12	0	0	7	7	0	0	0	0
7/12 - 7/18	0	0	34	32	0	0	2	3	0	3	0	0
7/19 - 7/25	0	0	46	61	0	0	0	0	0	1	0	0
7/26 - 8/1	0	0	30	30	0	0	0	1	0	0	0	0
8/2 - 8/8	0	0	14	16	0	0	0	1	3	9	1	0
8/9 - 8/15	0	0	41	40	0	0	0	1	1	26	0	0
8/16 - 8/22	0	0	59	39	0	0	0	0	0	0	0	0
8/23 - 8/29	0	0	2	3	0	0	0	0	0	0	0	0
8/30 - 9/5	0	0	23	30	0	0	1	0	0	2	0	0
9/6 - 9/12	0	0	165	86	0	0	1	4	0	3	0	0
9/13 - 9/19	0	0	180	101	0	0	0	3	0	0	0	0
9/20 - 9/26	0	0	160	217	0	0	1	3	0	0	0	0
9/27 - 10/3	0	0	68	129	0	0	0	2	0	0	0	0
10/4 - 10/10	0	0	67	49	0	0	2	13	0	0	0	0
10/11 - 10/17	0	0	45	54	0	0	1	11	0	0	0	0
10/18 - 10/24	0	0	1	0	0	0	0	4	0	0	0	0
10/25 - 10/31	0	0	1	2	0	0	0	0	0	0	0	0
11/1 - 11/7	0	0	0	1	0	0	1	0	0	0	0	1
Total	0	2	1094	965	124	64	97	77	7	51	1	1

–continued–

APPENDIX 3. —(Page 2 of 2)

	Eulachon		Coho Salmon		Pink Salmon		Sockeye Salmon		Chinook Salmon	
Week	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
4/19 - 4/25	0	0	0	0	0	0	0	0	0	0
4/26 - 5/2	3	0	0	0	0	0	0	0	0	0
5/3 - 5/9	5	0	0	0	0	0	0	0	0	0
05/10 - 05/16	2	1	0	0	0	0	0	0	0	0
05/17 - 05/23	0	0	0	0	0	0	0	0	0	0
05/24 - 05/30	102	0	0	0	0	0	0	0	0	0
05/31 - 6/6	0	0	0	0	0	0	0	0	0	0
6/7 - 6/13	0	0	0	0	0	0	1	0	0	0
06/14 - 6/20	0	0	0	0	0	0	0	0	0	0
6/21 - 6/27	0	0	0	0	0	0	1	0	0	0
6/28 - 7/4	0	0	0	0	0	0	0	0	0	0
7/5 - 7/11	0	0	0	0	0	0	1	0	0	0
7/12 - 7/18	0	0	0	0	0	0	1	0	0	0
7/19 - 7/25	0	0	2	1	9	7	18	20	0	0
7/26 - 8/1	0	0	3	1	17	11	15	12	2	2
8/2 - 8/8	0	0	0	0	0	0	1	0	1	1
8/9 - 8/15	0	0	38	29	7	7	0	0	0	0
8/16 - 8/22	0	0	30	28	5	3	0	0	0	0
8/23 - 8/29	0	0	7	3	0	0	1	0	0	0
8/30 - 9/5	0	0	9	3	1	1	0	0	0	0
9/6 - 9/12	0	0	36	5	0	0	0	0	0	0
9/13 - 9/19	0	0	110	31	0	0	0	0	0	0
9/20 - 9/26	0	0	123	36	0	0	0	0	0	0
9/27 - 10/3	0	0	86	14	0	0	0	0	0	0
10/4 - 10/10	0	0	36	11	0	0	0	0	0	0
10/11 - 10/17	0	0	2	5	0	0	0	0	0	0
10/18 - 10/24	0	0	1	3	0	0	0	0	0	0
10/25 - 10/31	0	0	1	6	0	0	0	0	0	0
11/1 - 11/7	0	0	2	1	0	0	0	0	0	0
Total	112	1	486	177	39	29	39	32	3	3

APPENDIX 4. —Weekly counts of all species observed at the Soldotna Creek weir during 2010

	Northern Pike		Dolly Varden		Steelhead		Rainbow Trout		Lamprey spp.		Round Whitefish	
Week	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
4/11 - 4/17	0	0	2	1	0	0	4	2	0	0	0	0
4/18 - 4/24	0	0	3	5	7	0	10	3	0	0	0	0
4/25 - 5/1	0	0	5	1	26	3	13	4	0	0	0	0
5/2 - 5/8	0	0	23	5	34	9	21	15	0	0	0	0
05/09 - 05/15	0	0	24	10	23	16	13	5	0	2	0	0
05/16 - 05/22	0	0	15	24	6	13	3	4	0	0	0	0
05/23 - 05/29	0	0	9	4	1	8	1	4	0	7	0	0
05/30 - 6/5	0	0	10	6	0	0	3	6	0	1	0	0
6/6 - 6/12	0	0	4	1	0	0	2	3	0	3	0	0
06/13 - 6/19	0	0	15	7	0	0	2	3	0	3	0	0
6/20 - 6/26	0	0	27	13	0	0	9	3	0	0	0	0
6/27 - 7/3	0	0	10	6	0	0	7	6	0	1	0	0
7/4 - 7/10	0	0	14	6	0	0	6	8	0	0	0	0
7/11 - 7/17	0	0	26	20	0	0	20	19	0	0	0	0
7/18 - 7/24	0	1	23	15	0	0	14	12	0	1	1	1
7/25 - 7/31	0	0	63	66	0	0	12	6	0	0	0	0
8/1 - 8/7	0	0	45	54	0	0	3	4	0	5	0	0
8/8 - 8/14	0	0	68	70	0	0	1	1	0	18	0	0
8/15 - 8/21	0	0	63	83	0	0	0	4	0	13	0	0
8/22 - 8/28	0	0	17	26	0	0	1	3	0	0	0	0
8/29 - 9/4	0	0	37	28	0	0	0	2	0	0	0	0
Total	0	1	501	450	97	49	141	115	0	54	1	1

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APPENDIX 4. —(Page 2 of 2)

	Eulachon		Coho Salmon		Pink Salmon		Sockeye Salmon		Chinook Salmon	
Week	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
4/11 - 4/17	0	0	0	0	0	0	0	0	0	0
4/18 - 4/24	0	0	0	0	0	0	0	0	0	0
4/25 - 5/1	0	0	0	0	0	0	0	0	0	0
5/2 - 5/8	0	0	0	0	0	0	0	0	0	0
05/09 - 05/15	0	0	0	0	0	0	0	0	0	0
05/16 - 05/22	0	0	0	0	0	0	0	0	0	0
05/23 - 05/29	0	0	0	0	0	0	0	0	0	0
05/30 - 6/5	30	3	0	0	0	0	0	0	0	0
6/6 - 6/12	0	0	0	0	0	0	0	0	0	0
06/13 - 6/19	0	0	0	0	0	0	0	0	0	0
6/20 - 6/26	0	0	0	0	0	0	0	0	0	0
6/27 - 7/3	0	0	0	0	0	0	1	0	0	0
7/4 - 7/10	0	0	0	0	0	0	0	0	0	0
7/11 - 7/17	0	0	0	0	0	0	2	1	0	0
7/18 - 7/24	0	0	0	0	4	1	8	7	0	0
7/25 - 7/31	0	0	3	2	20	14	11	9	0	0
8/1 - 8/7	0	0	7	5	16	18	0	0	0	0
8/8 - 8/14	0	0	8	5	15	15	1	1	1	1
8/15 - 8/21	0	0	6	7	0	0	1	1	0	0
8/22 - 8/28	0	0	3	2	0	0	0	0	0	0
8/29 - 9/4	0	0	9	6	0	0	0	0	0	0
Total	30	3	36	27	55	48	24	19	1	1

APPENDIX 5. —Weekly counts of male and female steelhead in Soldotna Creek during 2009 and 2010.

2009						
	Upstream			Downstream		
Week	Female	Male	Unknown Sex	Female	Male	Unknown Sex
4/19 - 4/25	0	0	0	0	0	0
4/26 - 5/2	38	40	2	6	3	5
5/3 - 5/9	23	11	1	3	0	0
5/10 - 5/16	8	0	0	13	3	1
5/17 - 5/23	1	0	0	4	3	2
5/24 - 5/30	0	0	0	12	2	0
5/31 - 6/6	0	0	0	0	0	0
6/7 - 6/13	0	0	0	4	3	0
6/14 - 6/20	0	0	0	0	0	0
6/21 - 6/27	0	0	0	0	0	0
6/28 - 7/4	0	0	0	0	0	0
7/5 - 7/11	0	0	0	0	0	0
7/12 - 7/18	0	0	0	0	0	0
7/19 - 7/25	0	0	0	0	0	0
7/26 - 8/1	0	0	0	0	0	0
8/2 - 8/8	0	0	0	0	0	0
8/9 - 8/15	0	0	0	0	0	0
8/16 - 8/22	0	0	0	0	0	0
8/23 - 8/29	0	0	0	0	0	0
8/30 - 9/5	0	0	0	0	0	0
9/6 - 9/12	0	0	0	0	0	0
9/13 - 9/19	0	0	0	0	0	0
9/20 - 9/26	0	0	0	0	0	0
9/27 - 10/3	0	0	0	0	0	0
10/4 - 10/10	0	0	0	0	0	0
10/11 - 10/17	0	0	0	0	0	0
10/18 - 10/24	0	0	0	0	0	0
10/25 - 10/31	0	0	0	0	0	0
11/1 - 11/7	0	0	0	0	0	0
Total	70	51	3	42	14	8

2010						
	Upstream			Downstream		
Week	Female	Male	Unknown Sex	Female	Male	Unknown Sex
4/11 - 4/17	0	0	0	0	0	0
4/18 - 4/24	2	5	0	0	0	0
4/25 - 5/1	8	18	0	0	3	0
5/2 - 5/8	19	15	0	5	4	0
5/9 - 5/15	20	3	0	14	2	0
5/16 - 5/22	5	1	0	9	4	0
5/23 - 5/29	1	0	0	7	1	0
5/30 - 6/5	0	0	0	0	0	0
6/6 - 6/12	0	0	0	0	0	0
6/13 - 6/19	0	0	0	0	0	0
6/20 - 6/26	0	0	0	0	0	0
6/27 - 7/3	0	0	0	0	0	0
7/4 - 7/10	0	0	0	0	0	0
7/11 - 7/17	0	0	0	0	0	0
7/18 - 7/24	0	0	0	0	0	0
7/25 - 7/31	0	0	0	0	0	0
8/1 - 8/7	0	0	0	0	0	0
8/8 - 8/14	0	0	0	0	0	0
8/15 - 8/21	0	0	0	0	0	0
8/22 - 8/28	0	0	0	0	0	0
8/29 - 9/4	0	0	0	0	0	0
Total	55	42	0	35	14	0