Whiskey, Hewitt, and Shell Lakes Pike Suppression
Progress Report 2024

Prepared by:
Emily Heale, Biologist
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DISCLAIMER

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Cook Inlet Aquaculture Association conducts salmon enhancement and restoration projects in Area H, Cook Inlet, and associated waters. As an integral part of these projects a variety of monitoring and evaluation studies are conducted. The following final report is a synopsis of the studies conducted under an Alaska Sustainable Salmon Fund grant entitled "Mobile Northern Pike Suppression Crew." Field research was conducted by CIAA at Shell, Whiskey, and Hewitt lakes. The purpose of this report is to provide a vehicle to distribute the information produced by the pike supression and research work conducted under this project. The information presented in this report has not undergone an extensive review. As reviews are completed, the information may be updated and presented in other reports.

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ACKNOWLEDGEMENTS

Many individuals contributed to the success of the Mobile Northern Pike Suppression Crew Project (Whiskey, Hewitt, and Shell lakes pike suppression). Cook Inlet Aquaculture Association (CIAA) recognizes interns, seasonal fisheries technicians, and regular staff who helped plan and execute this project. Trail Ridge Air provided needed assistance with hauling gear and supplies. Many local residents of Shell, Whiskey, and Hewitt lakes provided a great deal of help and were vital to the project, particularly Christa and Martin Wegscheider who were so gracious in hosting CIAA staff and Calvin Flannigan for allowing CIAA to access Shell Creek via his property. Gratitude is also extended to the staff at the Student Conservation Association and the Alaska Sustainable Salmon Fund, in particular Debbie Maas from AKSSF.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

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ABSTRACT

In 2024, Cook Inlet Aquaculture Association started the first year of a three-year northern pike (*Esox Lucius*) suppression project at Shell, Whiskey, and Hewitt lakes by removing pike during the summer season primarily with gillnets. In 2024, a total of 600 pike were removed from these lakes while deploying gillnets for 11,266 hours. Catch per unit effort calculated for 2024 showed decreases in the number of pike caught per hour at all lakes when compared to catch per unit effort from a study conducted in 2012.

Surveys for the invasive waterweed Elodea were also conducted on Shell, Whiskey, and Hewitt lakes and no elodea was detected.

Adult and smolt salmon enumeration was attempted at Shell Lake in 2024. The target species moving through the smolt weir was sockeye salmon (*Oncorhyncus nerka*). The weir operated from June 3 through June 27. Staff counted 42 sockeye and 2,108 coho (*O. kisutch*) smolt. The remote video weir to enumerate adults was installed and operational as of July 10 but the video was not able to be reviewed due to an error in the computer. Therefore a complete count was not obtained in 2024. Onsite staff opportunistically counted salmon they saw around the weir site and in the lake, an estimated 47 sockeye were seen moving it into Shell Lake in 2024.

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INTRODUCTION AND PURPOSE

Nonnative species are altering aquatic communities worldwide, with opportunistic predators having particularly catastrophic effects (Sepulveda et al. 2013). The introduction of northern pike (*Esox lucius*) to freshwater systems outside their native range has resulted in negative impacts on resident fish populations (Lee 2001, Patankar et al. 2006, Sepulveda et al. 2013). Outside their native range, northern pike have the potential to interfere with ecosystem function and destroy economically important fisheries.

In Alaska, northern pike are native north of the Alaska Range (Morrow 1980), but were illegally introduced to the Matanuska-Susitna Valley in Southcentral Alaska in the 1950s (Rutz 1999). Pike have spread throughout the Matanuska-Susitna Valley, Anchorage, and the Kenai Peninsula (Alaska Department of Fish and Game 2015). The Cook Inlet drainage (Figure 1) encompasses the Susitna River watershed, which comprises 49,210 km^2 originating in the Alaska Range, and contains a myriad of shallow lakes, sloughs, and clear water tributaries, many of which provide prime northern pike spawning and rearing habitats.

Pike are voracious predators and it is hypothesized their expansion is responsible for the decline of salmonid species in many water bodies in the Susitna basin (Rutz 1999, Patankar et al. 2006, Sepulveda et al. 2013). Once established, northern pike can be devastating to juvenile salmonids and have impacted numerous coho (*Oncorhynchus kisutch*), Chinook (*O. tshawytscha*), and sockeye salmon (*O. nerka*) runs from the Susitna River watershed (Alaska Department of Fish and Game 2015).

The Yentna drainage contains one-half of the sockeye salmon producing lakes that flow into the Susitna River; among the most productive systems in the Yentna are Chelatna, Shell, Hewitt, and Judd lakes. The Susitna River sockeye salmon was designated as a stock of yield concern at the February 2008 Board of Fisheries (BOF) meeting and was attributed to low salmon numbers from predation by invasive northern pike. The BOF subsequently removed the stock of yield concern from the Susitna sockeye population but continued to restrict fishing opportunities stating that there are multiple issues facing the sockeye populations including predation from invasive northern pike (Brehmer 2020).

Although Cook Inlet Aquaculture Association (CIAA) had been monitoring sockeye runs in various Susitna systems since the early 1990s, the invasive pike threat steered CIAA into a new direction. Along with the Alaska Department of Fish and Game (ADF&G), CIAA began to monitor salmon populations at lakes throughout the Susitna River watershed specifically related to invasive pike. Information was lacking about the health of salmon stocks returning to lakes that previously did not have the presence of northern pike. Under a joint CIAA-ADF&G project, several lakes—which included Chelatna, Shell, Hewitt and Whiskey lakes—were monitored for

numbers of salmon returning to spawn (Alaska Sustainable Salmon Fund 2013). Historically, all of these lakes had populations of salmon. Monitoring indicated that eight of these lakes now had northern pike populations, four of which no longer had returning salmon, and three lakes were found to have salmon populations considered to be below historical averages including Shell, Whiskey, and Hewitt lakes near Skwentna. Through this project it was determined that lake depth played a significant factor in pike predation and salmon survival. In shallow lakes (less than 20 meters mean depth), the number of juvenile salmon produced per spawner was significantly lower in lakes with northern pike versus lakes without northern pike. Overall, the mean number of juvenile sockeye salmon produced per spawner was significantly greater in deep lakes versus shallow lakes and the project also found that juvenile salmon are more susceptible to predation by northern pike in shallow lakes (Diana et al. 1977, Glick and Willette 2013).

After realizing the extent of the problem invasive northern pike have caused, CIAA developed a project entitled Northern Pike Investigations (Smukall 2015). It was a three-year project intended to help meet CIAA's ultimate goal for the Susitna River watershed of increasing salmon production by removal of northern pike and rehabilitation of lakes throughout the system. The Northern Pike Investigations Project focused on Chelatna, Whiskey and Hewitt lakes.

Since the conclusion of the Northern Pike Investigations Project, CIAA continued maintenance gillnetting at Whiskey and Hewitt lakes for approximately one week per summer during 2016–2017 catching 251 and 365 northern pike respectively, as funding was sought to continue intensive pike harvests at the lakes. From 2018–2020 the Hewitt and Whiskey Lakes Pike Suppression Project (Alaska Sustainable Salmon Fund 2021) was implemented and designed to build on prior pike suppression efforts. By continuing to remove pike from these lakes while evaluating the fry population in Hewitt Lake, CIAA and ADF&G wanted to determine if measurable increased salmon production could be documented in light of pike suppression efforts. Although the goal of increasing salmon fry rearing in Hewitt Lake to a million was not reached, the Hewitt Lake sockeye fry population did increase by 20% over the course of the 2018–2020 project.

CIAA has funded suppression work and rehabilitation efforts at Shell Lake since 2012 using a combination of its own funding and various grants. Shell Lake was once a significant contributor to sockeye production in the Susitna River watershed (Wizik 2023). Shell Lake can potentially contribute 10% to the sockeye salmon return to the Susitna River watershed (Tarbox and Kyle 1989). Due to a notable decline in the salmon population (smolt and adult) within Shell Lake CIAA initiated rehabilitation efforts. Starting in 2012, the project included smolt and adult enumeration, salmon stocking, disease screening, invasive northern pike suppression, beaver dam surveys and notching, and an evaluation of what effect the harvesting of northern pike may have on both northern pike and salmon populations.

In 2016 CIAA enlisted the help of researchers at the University of Alaska Fairbanks (UAF) Institute of Arctic Biology and College of Fisheries and Ocean Sciences to model effects that intensive netting may be having on the Shell Lake pike population. This was prompted when CIAA staff noticed a decline in mean length of northern pike harvested at Shell Lake. Observations from other studies within the region have indicated that smaller pike tend to consume more juvenile salmon (Rutz 1999).

Using CIAA pike data obtained from 2013–2016, UAF was able to build a bioenergetics model to estimate the per-capita consumption rates of northern pike ages 1–5 in Shell Lake (Deslauriers 2017). That analysis determined that northern pike of all sizes consumed salmon, but on average salmon made up a smaller fraction of the diets of larger northern pike but larger northern pike consumed more salmon biomass per capita than smaller pike. Total consumption of salmon by all age classes of northern pike decreased substantially from 2013–2016. All five age classes of northern pike consumed less salmon at the population level in 2016 than in 2013. Overall, in comparison to 2013, the northern pike population consumed 67% less salmon in 2014, 74% less in 2015, and 81% less in 2016. Based on this model CIAA continued the intensive harvest of northern pike in Shell Lake from 2020 to 2023 in an attempt to determine if this reduced consumption can translate into positive natural sockeye salmon production in Shell Lake.

CIAA initiated efforts to maintain the genetic lineage of the Shell Lake sockeye population through the collection of broodstock and gametes and back stocking to Shell Lake. The goal of this effort was to rebuild the Shell Lake sockeye salmon population to a sustainable level. Gametes were collected in 2012, 2016, and 2017. From 2013–2015, adult returns were insufficient to allow gamete collection. Sockeye salmon escapements to Shell Lake from 2020–2023 were expected to be comprised primarily of hatchery progeny from brood years 2016 and 2017. Because the State of Alaska salmon genetics policy recommends not taking eggs from hatchery-produced salmon, Shell Lake sockeye salmon returning to the lake during 2020–2023 needed to successfully reproduce naturally if this stock is able to survive extirpation.

An Alaska Sustainable Salmon Fund (AKSSF) grant titled Mobile Northern Pike Suppression to continue pike suppression work in Chelatna, Shell, Whiskey and Hewitt lakes from 2021–2023 was secured. From the onset of invasive pike suppression at the project lakes in 2012 to the end of 2023, the relative abundance of northern pike has decreased at Shell, Whiskey, Hewitt, and Chelatna lakes by 99%, 96% 48%, and 76% respectively (Heale 2024). From 2021–2023, pike suppression has further reduced biomass of northern pike in all lakes by decreasing the number of year classes of northern pike. In addition to reducing the number of pike and their inferred consumption on juvenile salmonids, changing the demographics of these pike populations to that of younger/smaller fish reduces the number of northern pike eggs available for spawning each spring. Reducing these populations and transforming the demographic to a population dominated by small one-year-old fish will reduce consumption of juvenile salmonids by pike and may enable

the recovery of important sockeye salmon populations. If netting operations were to cease, it is likely these pike populations would recover within a few years.

Additional funding was received from AKSSF to continue pike suppression work at Shell, Whiskey, and Hewitt lakes from 2024–2026. The following report details findings from the first year, 2024, of this project. Other historical data are provided for reference.

PROJECT AREA

Shell, Whiskey, and Hewitt lakes are located in the Cook Inlet drainage in Southcentral Alaska (Figure 1).

Figure 1: Northern pike suppression project sites in relation to Cook Inlet, Alaska.

Shell Lake

Shell Lake is located at 61º58’ N latitude and 151º33’ W longitude at the base of Shell Hills in the Susitna River drainage approximately 121 kilometers northwest of Anchorage, Alaska (Figure 2). The lake has a surface elevation of 123 meters. Shell Lake has a surface area of 523 hectares, has maximum depth of 29 m, a mean depth of 11.9 m and 16.6 km of shoreline (Kyle at al. 1994). Shell Lake has seven small tributaries and discharges southeast via Shell Creek, which runs approximately six river miles to the Skwentna River. Shell Lake is part of the Anadromous Waters Catalog, code 247-41-10200-2053-3205-4052-0010 (Giefer and Graziano 2024).

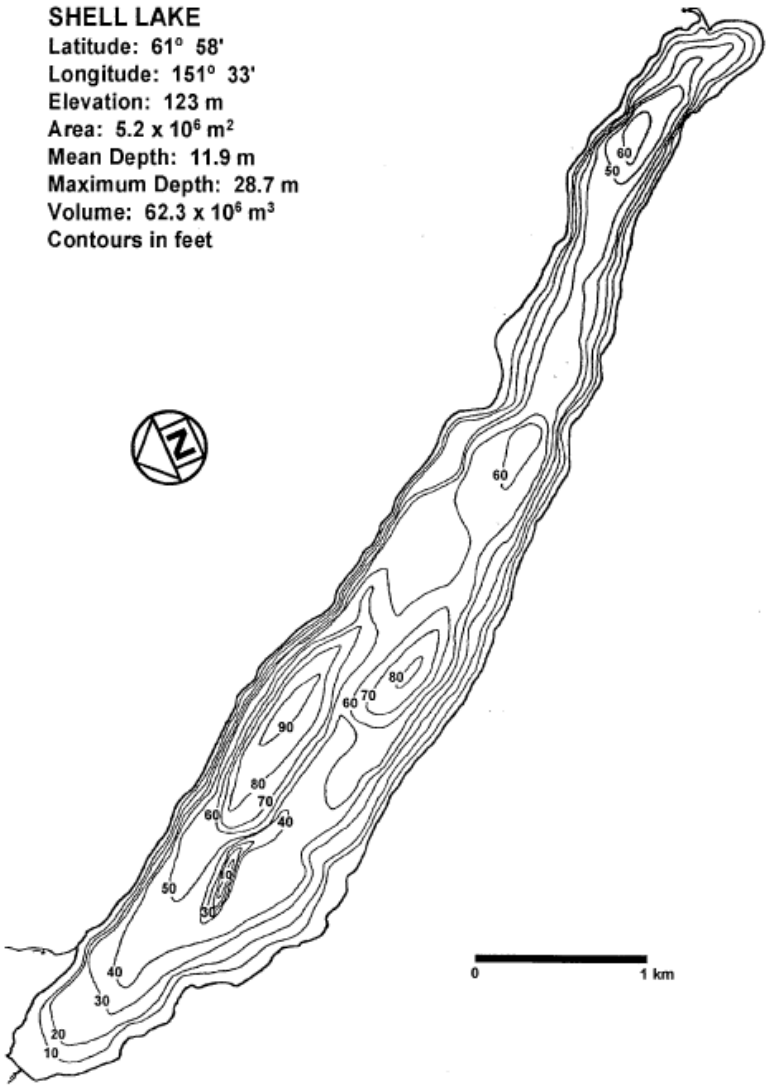

Figure 2: Bathymetric map of Shell Lake

Whiskey Lake

Whiskey Lake is located at 61º59’ N latitude and 151º24’ W longitude at the base of the Shell Hills in the Susitna River drainage, approximately 118 kilometers northwest of Anchorage, Alaska (Figure 3). The lake has an elevation of 45 meters and a surface area of 110 hectares (Spafard and Edmundson 2000). There is one small unnamed tributary of Whiskey Lake located on the north side of the lake. The lake’s discharge forms Whiskey Creek, which flows into Hewitt Creek and the Yentna River. Whiskey Lake is part of the Anadromous Waters Catalog, code 247-41-10200-2053-3213-4052-0010 (Giefer and Graziano 2024).

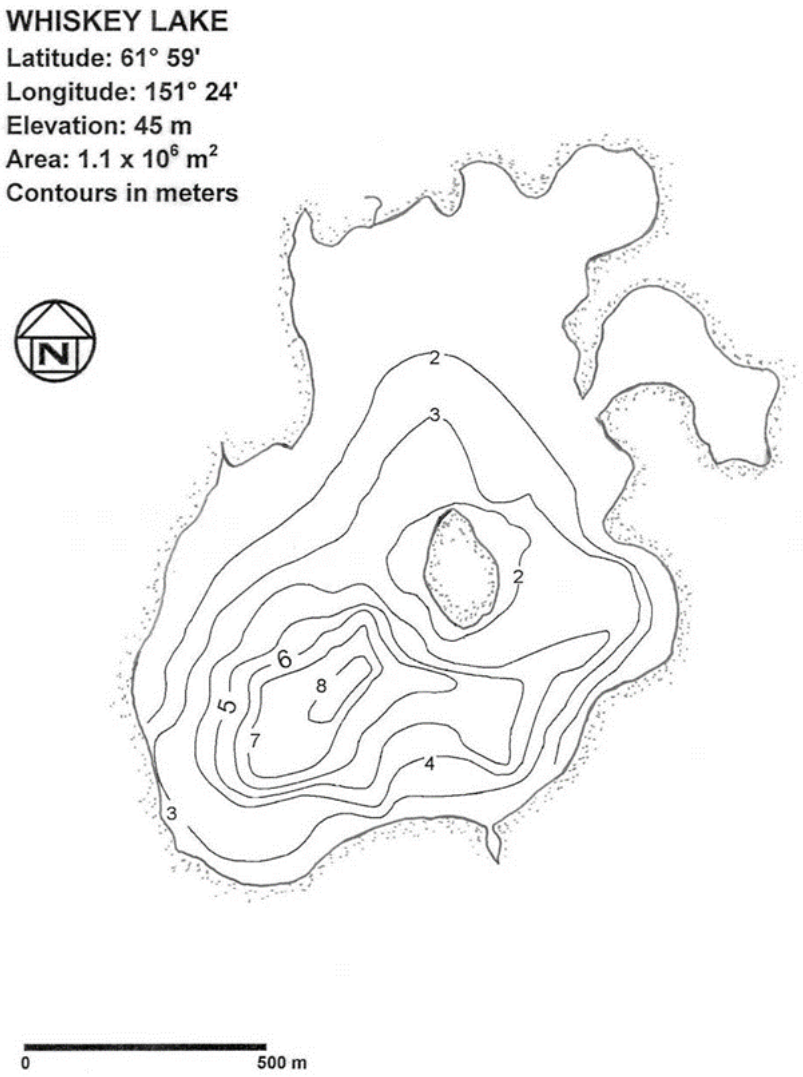

Figure 3: Bathymetric map of Whiskey Lake.

Hewitt Lake

Hewitt Lake (Figure 4) is located approximately 0.5 km to the east of Whiskey Lake. Hewitt Creek is a common outlet for both lakes, and flows 6.4 meandering kilometers to the Yentna River. Hewitt Lake covers 226 hectares, has a maximum depth of 34 m, a mean depth of 13.5 m, a 10.6 km shoreline, and is located at an elevation of 40 m above sea level (Spafard and Edmundson 2000). Hewitt Lake is part of the Anadromous Waters Catalog, code 247-41-10200-2053-3213-4050-0010 (Giefer and Graziano 2024).

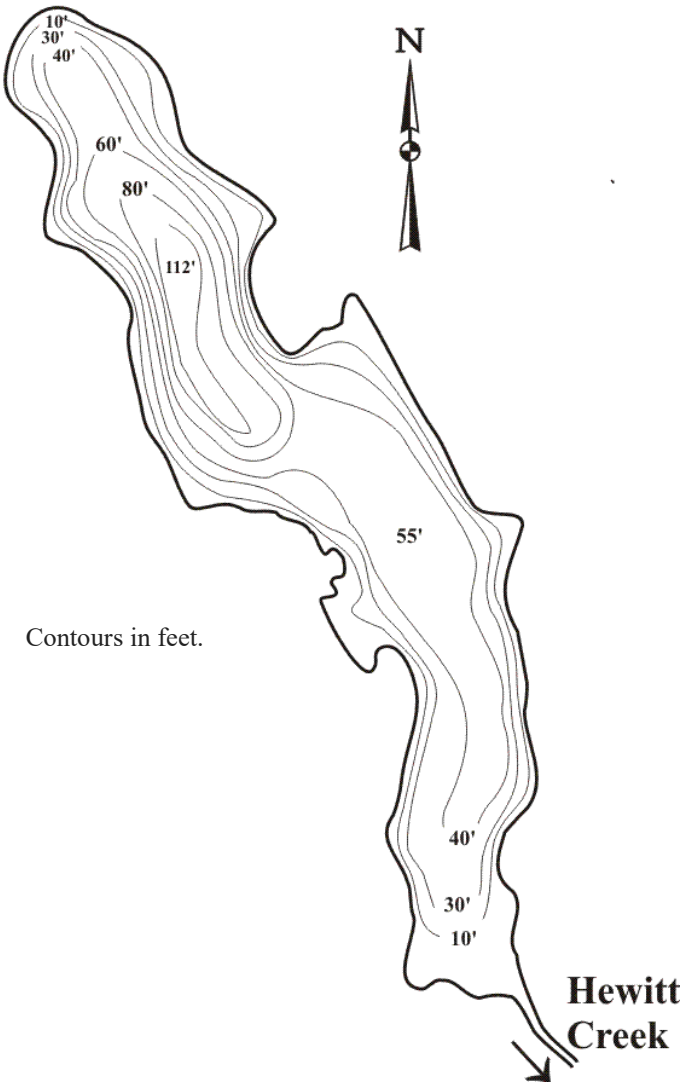

Figure 4: Bathymetric map of Hewitt Lake.

METHODS

Invasive Northern Pike Suppression

Staff from CIAA used one inch bar mesh gillnets to capture and remove northern pike in Shell, Whiskey, and Hewitt lakes and the Hewitt-Whiskey Creek outlet that connects these two lakes to the Yentna River. Staff removed northern pike at Shell Lake in June and August; and at the Whiskey and Hewitt lakes system from July through mid-August. Staff also used hook-and-line fishing. Fish caught via hook-and-line were sampled for age, length, weight, and sex but no attempt to calculate catch per unit effort (CPUE) was made for angled fish due to the differences in techniques and skill of anglers.

Each day, staff deployed up to 10 one inch bar mesh gillnets at 10 different shallow and vegetated sites that typically provide optimal northern pike habitat. Nets were checked at least every 24 hours. Staff recorded the time of each net set and retrieval to the nearest minute. Gillnets were 15.2 m long x 2.4 m deep and constructed of monofilament line with a one inch bar mesh size. The top line was a floating core line and the bottom line was lead weighted to sink (CIAA 2024a).

Northern pike CPUE was recorded after each net set by dividing the number of northern pike caught by the number of hours the net was in the water. Staff also calculated CPUE figures to factor in the mass of pike by multiplying the CPUE figure by the average weight of pike caught during 2024 to give the biomass of pike caught per effort hour in addition to the number of fish per hour.

Staff recorded any catch of species other than northern pike, and any bycatch still alive was removed and released immediately. Staff removed captured pike from the nets and quickly dispatched any living pike using a small bat. When possible, northern pike were donated to local residents. If no one was available to take the fish, then the fish were cut completely in half and disposed in the middle of the lake in which they were caught.

All northern pike captured during the project that had not been partially eaten by wildlife were measured from the fork of the tail to the tip of the snout, to the nearest mm; and were weighed to the nearest 0.01 kg. Sex was determined for all whole pike by examining the gonads of the fish. The left cleithrum was removed for later age determination at the CIAA Kenai office (Laine et al. 1991). Stomach contents were visually inspected and quantified for individual prey items.

At Shell Lake, there has been a near collapse of the pike population through pike suppression and a spawning failure in 2019. In a normal population, such a failure would generally be recovered because the population would not be so dependent on spawning. This suppressed population at Shell Lake is primarily comprised of age 1 pike from the year prior, so a spawning failure in

combination with intense suppression efforts allows for the chance to nearly or completely extirpate pike from a system.

Since 2019, CIAA have recorded low numbers of pike but there is a chance that the few pike remaining in the lake could have a good spawning year. Without a suppression crew on site the possibility that this population spirals out of control is a real threat to the effort that has been put into the lake.

Environmental Conditions

The suppression crew recorded environmental data at their respective camp site; one site for Shell Lake and one site on Hewitt Lake, which encompassed time at both Whiskey and Hewitt lakes. Data collected included percent cloud cover (visually estimated) and precipitation measured to the nearest millimeter, both recorded at 5:00 pm each day. Water and air temperatures were recorded during the project using data loggers (Hobo®) that recorded water and air temperature every hour. Recordings were then averaged over a 24-hour period to provide a daily average air and water temperatures. A manual recording of air and water temperature occurred at 5:00 pm each day which serves as a backup to the Hobo data loggers.

Elodea Surveys

The CIAA suppression crew conducted full shoreline surveys for the presence of elodea. These surveys followed a combination of the U.S. Fish and Wildlife Service Aquatic Invasive Species Survey Protocol (2012) and the Survey Design and Methodology for Elodea Detection in Alaska Lakes (Fulkerson 2021). The crew reviewed lake maps with size information, depth and contour information, shoreline length, and adjoining land usage information when available.

Staff conducted full shoreline surveys on Shell, Whiskey, and Hewitt lakes. The crew worked as a team with one person steering the boat and the other doing a visual shoreline survey. At each designated point one crew member threw a vegetation rake to identify all vegetation at the site. When vegetation could not be identified it was collected in a zip-lock bag and labelled with the site number, lake name, and date for later identification with the aid of a field guide; or it would be sent back to the CIAA Kenai office for identification by the biologist. At high risk areas like boat launches, docks, outlets and inlets, more thorough visual surveys were completed and additional rake throws were conducted if visual identification of vegetation was not possible. Information was recorded in a weatherproof notebook and shared with Alaska Exotic Plants Information Clearinghouse (AKEPIC) by November of the survey season.

Smolt Enumeration

The smolt migration from Shell Lake was monitored by placing a smolt trap in Shell Creek. The smolt trap consisted of a modified fyke net with Vexar® netting leads and a double compartment live-box. The leads and fyke net funneled migrating smolt into one of the two live-box compartments where they were enumerated. A total count was made during smolt migrations (CIAA 2024b).

During the 2024 smolt enumeration staff analyzed age, weight, and length characteristics of emigrating sockeye and coho salmon smolts. Staff collected smolt scale samples in proportion to the emigration. This was accomplished by attempting to collect every 100th sockeye and coho salmon smolt that was counted and passed through the smolt trap. The numbering sequence began when the first fish passed through the trap and continued consecutively until the smolt migration was complete. Smolt lengths and weights were recorded for all sampled fish and the mean values of those measurements are presented in this report.

The fish collected for sampling were placed in a plastic container filled with a diluted solution of 99.5% pure Tricaine Methanesulfonate Finquel® MS-222® and water to anesthetize the fish during the sampling event. Sockeye and coho salmon smolts were first measured to the nearest millimeter for fork length and then weighed to the nearest 0.1 gram. Up to 10 scales were removed from the primary growth area and mounted on a glass slide for subsequent age determination for all sampled smolts. All salmon smolts were allowed to recover in a bucket of fresh water and released unharmed after biological data were recorded.

Adult Enumeration

To enumerate adult salmon, staff installed a fixed picket weir fitted with video recording equipment in Shell Creek. The weir was constructed of 1.9 cm galvanized and 7.6 cm aluminum channel. The galvanized pipe was picketed through 1.9 cm holes in the aluminum channel spaced 2.54 cm apart. A gap approximately 2.5 feet wide located in the thalweg of the creek allowed fish to pass the weir via a passage chute without handling stress. Attached to the passage chute was a camera box that was triggered by motion and filmed all passing fish. Footage downloaded from the video weir was to be segregated into motion events allowing the reviewer to count all passing fish while eliminating all non-event footage (CIAA 2024c). Due to technical difficulties with the recording software no video footage was reviewable during 2024.

Beaver Dam Monitoring

Beaver dams throughout Shell Creek are monitored via aerial surveys from either helicopter or fixed wing aircraft as funding allows. Aerial surveys will span the 3.8 miles of Shell Creek from Shell Lake to the confluence with the Skwentna River. If beaver dams are found to be blocking the upstream passage of salmon, staff would make a notch approximately 3–5 feet wide in the dam to allow them to pass.

RESULTS

Invasive Northern Pike Suppression

Gillnetting of northern pike from Shell Lake occurred from June 4–June 27 and August 13–August 28, 2024. Gillnetting of northern pike occurred from Whiskey Lake from July 11–August 10, 2024. Gillnetting of northern pike from Hewitt Lake occurred from July 13–August 10, 2024.

Effort hours were recorded to the nearest minute for all gillnets set on all lakes. During 2024, gillnets fished Whiskey Lake for 4,144.3 hours, Hewitt Lake for 369.6 hours, and Shell Lake for 6,752.3 hours.

The total number of pike removed from the lakes via gillnets and hook-and-line fishing from 2024 was 600 with 262 captured in Whiskey Lake, 267 removed from Hewitt Lake, and 71 from Shell Lake. Bycatch caught in each lake is reported in Appendix 1.

Catch per unit effort was calculated for all lakes and all efforts undertaken on Hewitt-Whiskey Creek were attributed to Hewitt Lake. CPUE in Whiskey Lake was 0.063; CPUE at Hewitt Lake was 0.495; and the CPUE at Shell Lake was 0.010 pike/hour.

The 2024 CPUE data for each lake has decreased since initial netting efforts in 2012 (Figure 5). When compared with the intensive harvest at Whiskey, Hewitt, and Shell lakes in 2012, 2024 CPUE at all lakes has been reduced: 97.6% at Whiskey, 66.7% at Hewitt, and 97.3% at Shell.

Raw CPUE figures calculated for the project lakes were multiplied by the average weights of pike captured to determine the biomass of northern pike caught per hour. Biomass-per-hour calculations from Hewitt Lake was 0.356; Whiskey Lake was 0.030; and Shell Lake was 0.002 kg/hour.

Staff collected data from all of the harvested pike regarding age, sex, length, and weight. Missing data from some of the pike captured was due to predation by river otters (*Lontra canadensis*). For all lakes, average lengths and weights of captured pike are provided in Table 1.

Stomach contents for all captured northern pike were visually inspected and quantified. Results from that are presented in tables 2–4. Fish species other than pike and salmonids dominated the diets of northern pike in all of the project lakes.

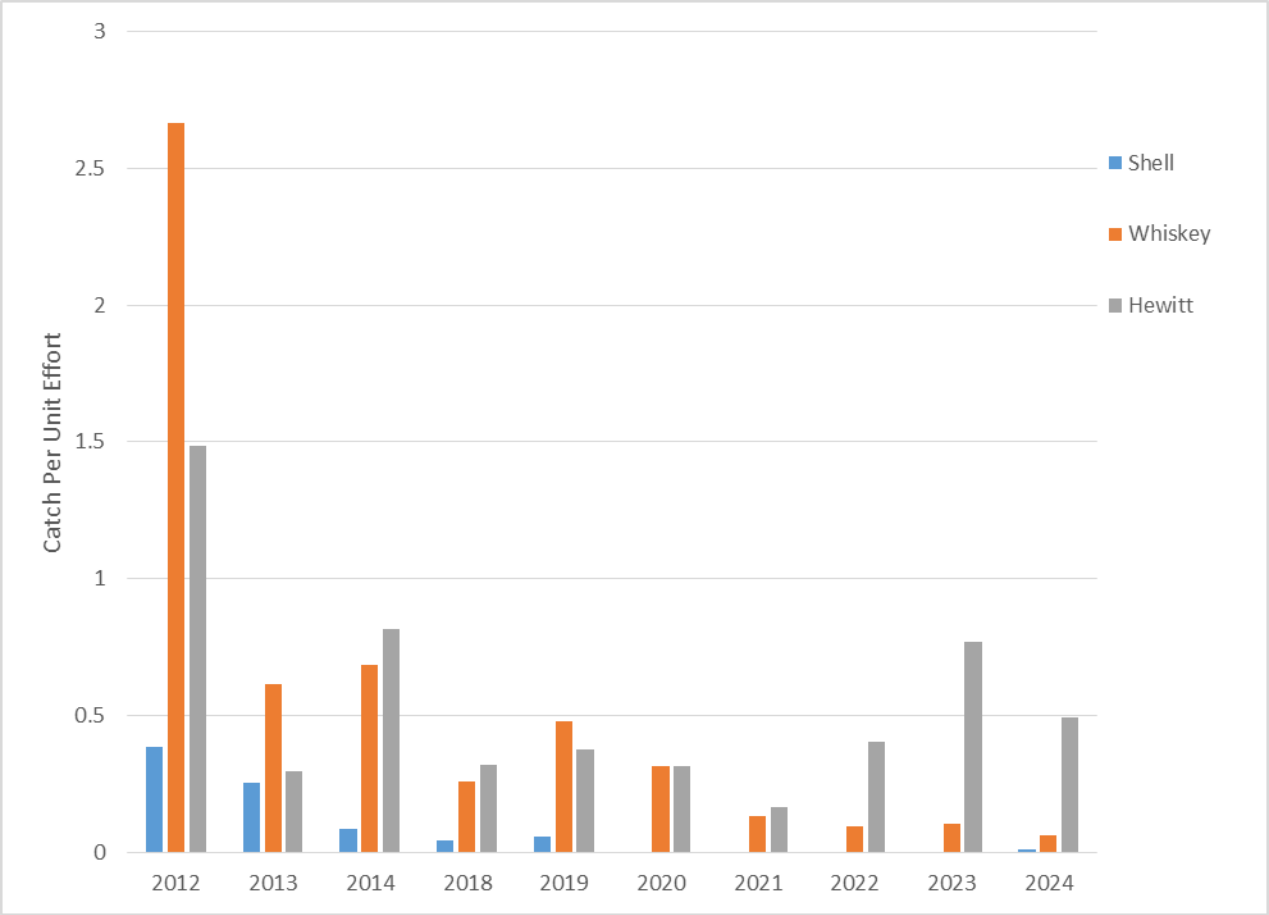

Figure 5: Catch per unit effort for Whiskey, Hewitt, and Shell lakes northern pike suppression 2012–2014, 2018–2024.

Table 1: Northern pike characteristics from Whiskey, Hewitt, and Shell lakes, 2024.

Lake	No. of pike	Weight (kg)	Length (mm)	Age	% Female
Shell Lake	71	0.20	268	0.41	43.7%
Whiskey Lake	248	0.47	372	1.51	64.5%
Hewitt Lake	267	0.72	450	2.39	50.6%

Table 2: Stomach contents of northern pike captured at Whiskey Lake, 2024.

		Non-Empty Stomachs						
	Empty	Pike	Sockeye Salmon	Coho Salmon	Unidentified Salmon	Other Fish	Invertebrates	Other
Samples	78	3	0	8	18	90	56	3
Percentage of Pike	14.7%	0.6%	0.0%	6.8%	10.6%	40.6%	21.4%	5.3%

Other fish includes whitefish and stickleback.
Invertebrates includes dragonfly larvae and leeches.
Other includes a frog and unidentifiable stomach contents.

Table 3: Stomach contents of northern pike captured at Hewitt Lake, 2024.

		Non-Empty Stomachs						
	Empty	Pike	Sockeye Salmon	Coho Salmon	Unidentified Salmon	Other Fish	Invertebrates	Other
Samples	75	3	0	0	1	56	124	19
Percentage of Pike	9.9%	0.4%	0.0%	0.0%	0.9%	42.7%	43.5%	2.6%

Other fish includes stickleback and other unidentified fish that were not salmon.
Invertebrates include leech, dragonsly larvae, snails, caddisfly larvae, amphipod, and clams.
Other includes unidentified items, mammals, and frogs.

Table 4: Stomach contents of northern pike captured at Shell Lake, 2024.

		Non-Empty Stomachs						
	Empty	Pike	Sockeye Salmon	Coho Salmon	Unidentified Salmon	Other Fish	Invertebrates	Frogs
Samples	8	20	3	14	13	15	3	0
Percentage of Pike	8.8%	25.3%	3.3%	15.4%	14.3%	29.7%	3.3%	0.0%

Other fish includes rainbow trrout, burbot, stickleback, sculpin,and suckers.
Invertebrates include leeches and insects.

Environmental Conditions

Environmental data taken at Shell and Hewitt (encompassed both Whiskey and Hewitt lakes as described in the Methods section) lakes including air and water temperature are presented in Appendix 2. Hobo data loggers installed to monitor the water temperature at Whiskey and Hewitt lakes were not retrieved in 2024 due to high water making them inaccessible. Unfortunately the crew did not take water temperatures manually due to a misunderstanding that will be corrected for the rest of this project. The Shell Lake water data was accidentally deleted upon download and is not retrievable. The Shell Lake water data in Appendix 2 are from the backup thermometer recordings that the crew took daily.

Elodea Surveys

Surveys for elodea were conducted when time and weather allowed at each lake. There were 146 points on Whiskey; 357 points on Shell; and 244 points on Hewitt. In general it took the crew two days to survey each lake. No elodea was detected in any of the surveys. All survey data was submitted to the AKEPIC in November 2024. Table 5 depicts the native vegetation that was found at each of the lakes during the surveys.

Table 5: Elodea survey data, Whiskey, Hewitt, and Shell lakes, 2024.

		Lakes Surveyed		
Common Name	**Scientific Name**	Shell	Whiskey	Hewitt
Horsetail	*Equisetum fluviatile*	X	X	X
Mare's Tail	*Hippuris vulgaris*	-	X	X
Lillies	*Nuphar lutea*	X	X	X
Pygmy Waterlilly	*Nymphaea tetragona*	-	X	X
ribbon-leaf pondweed	*Potamogeton epihydrus*	X	-	-
two-headed water starwort	*Callitriche heterophylla*	-	-	X
vernal water starwort	*Callitriche palustris*	-	-	X
Coon's Tail	*Ceratophyllum demersum*	-	X	X
quillworts	*Isoetes* sp.	-	X	-
star duckweed	*Lemna trisulca*	-	X	X
nodding waternymph	*Najas flexilis*	-	X	-
small pondweed	*Potamogeton pusillus*	-	X	X
Richardson's pondweed	*Potamogeton richardsonii*	X	X	X
fern-leaf pondweed	*Potamogeton robbinsii*	-	-	X
water buttercup	*Ranunculus aquatilis*	X	-	-
spiral ditch-grass	*Ruppia cirrhosa*	-	X	X
swaying bulrush	*Schoenoplectus subterminalis*	X	X	X
common bladderwort	*Utricularia macrorhiza*	-	-	X
common watermoss	*Fontinalis antipyretica*	-	X	X
sedges	*Carpex sp.*	X	X	X
sweetgale	*Myrica gale*	X	X	-
bluntleaf pondweed	*Potamogeton friessii*	-	X	X
purple marshlocks	*Comarum palustre*	X	X	X
sago pondweed	*Stuckenia pectinata*	-	X	-
buckbean	*Menyanthes trifoliata*	-	X	-
bluejoint	*Calamagrostis canadensis*	X	-	-

Smolt Enumeration

Staff monitored Shell Lake salmon smolt migration from June 3 through June 27, 2024 and counted 42 sockeye salmon smolt and 2,108 coho salmon (Appendix 3). Samples were collected from 22 of the coho smolt. On average the coho smolt measured at 131 mm and weighed 23.9 grams; and were age 1. Because of the low numbers of emigrating smolt, no statistical analysis of demographic data was performed in 2024.

Adult Enumeration

A fixed picket weir fitted with video recording equipment was installed in Shell Creek on July 10 and it ran continuously until the end of August. Unfortunately there were technical difficulties with the video recording system not functioning properly, therefore the video footage was not reviewable. While staff were present at Shell Lake from August 12 through 28 they opportunistically counted adult salmon they saw in the lake and around the weir site, in total they counted 47 sockeye salmon.

Beaver Dam Monitoring

Beaver dam surveys were conducted on Shell Creek twice in 2024. On Tuesday, July 30 CIAA staff flew the length of Shell Creek in a fixed wing aircraft looking for the presence of salmon impounded behind beaver dams. The crew flew from Shell Lake to the confluence of Shell Creek and the Skwentna River; staff observed a number of dams that would block the upstream movement of salmon but there were no salmon visible below the dams so no dams were notched. A second survey was flown via helicopter by a Shell Lake resident on Tuesday, August 13. Several dams were noted to be blown out due to high water conditions and they were passable for salmon, although no salmon were seen during the survey.

No subsequent surveys were conducted because salmon were making it into Shell Lake as reported by the onsite crew.

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DISSCUSSION

From the onset of intensive pike suppression at the project lakes in 2012 to the end of the current project in 2024, the relative abundance of northern pike has decreased at Shell, Whiskey, and Hewitt lakes by 97.3%, 97.6%, and 66.7% respectively. If netting operations were to cease, it is likely that these pike populations would recover within a few years. Funding should continually be sought to ensure the pressure is kept on these pike populations in order to give salmon a fighting chance at rebounding within the Susitna drainage.

Sockeye salmon originating from these lakes are genetically distinct populations that are pieces of a larger mosaic of genetic diversity making up the Susitna sockeye population. Genetic diversity provides this larger Susitna population with resilience by increasing phenotypic variety and increases the likelihood that a stock will be able to withstand weather anomalies, a disease outbreak, or a variety of other factors detrimental to salmon survival. While working to restore the positive production of Susitna River sockeye salmon is a noble goal, it will be the act of preserving unique genetic stocks within the larger population of Susitna River sockeye that will ensure that any potential recovery can be sustained long term. The loss of any of these stocks will weaken the recovery and future potential of sockeye salmon in this watershed.

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RECOMMENDATIONS

Suppression of northern pike in Shell, Whiskey, and Hewitt lakes should continue as CIAA or other organizations are able. The CPUE of gillnets should still serve as a measurement of relative pike abundance and age, sex, weight, and length data should still be collected to enable the demographic description of the pike population. Crews should continue to collect stomach content analysis to get a better picture of the pike diet as preferred prey species (i.e., salmon) appear to be rebounding in some of these lakes.

If the adult sockeye population at Shell Lake is adequate another egg take may be warranted to increase the salmon production within the lake. If the adult sockeye population remains too small for an egg take and smolt migration is also small for natural recolonization, CIAA should work with ADF&G to in order to identify a genetically similar stock that could be used for future enhancement of the sockeye population within the lake.

Beaver dam surveys have been conducted annually by CIAA—when funding allows—during the late summer and fall when adult salmon are migrating to their natal lakes to spawn. These surveys are conducted to aid in the salmon migration by identifying barriers that salmon would not be able to bypass without intervention such as notching or heavy rain and increased water flows. Beaver dam surveys should continue to aid with the natural migration of adult salmon into Shell Lake. Shell Creek has had many dams in the recent past so it is a system in great need of beaver dam monitoring in addition to the other significant efforts and resources that have already been put into rehabilitating the salmon population in the lake.

Alternative methods to keep northern pike population from rebounding in Shell Lake should also be investigated. The spawning failure in 2019 is attributed to a significant water level drop in the lake, which likely caused pike eggs to go dry before they emerged. Could that water level drop be recreated in subsequent years and paired with intensive suppression efforts to eradicate pike from Shell Lake? CIAA has received funding from AKSSF to conduct a feasibility study for a flow control structure at the outlet of Shell Lake with the goal of possible eradication of pike from the lake. The flow control structure could also aid in salmon monitoring by ensuring a weir could function within it; it could also aid in salmon migration by releasing water at critical times for adult salmon to overcome obstacles within the creek system, which has seen a lot of beaver activity in the last few years. The results of the feasibility study will be available in December of 2025.

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APPENDICES

Appendix 1: Bycatch across all lakes, 2024

		Longnose Sucker *Castostomus catostomus*		**Rainbow Trout** *Oncorhynchus mykiss*		**Sockeye Salmon** *Oncorhynchus nerka*		**Lake Trout** *Salvelinus namaycush*		**Coho Salmon** *Oncorhynchus kisutch*		**Burbot** *Lota lota*		**Bird** *Aves* species		**Pink Salmon** *Oncorhynchus gorbuscha*	
		Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Shell Lake	2024	239	58	10	31	1	13	24	6	0	1	0	1	0	2	-	-
Whiskey Lake	2024	11	-	-	-	11	9	-	-	-	-	-	-	0	1	-	-
Hewitt Lake	2024	-	-	-	-	7	3	-	-	-	-	-	-	1	0	8	-

Dashes (-) represent zero fish cuaght.

Appendix 2: Environmental Conditions 2024

Shell Lake

Date	Sky	Precip. (mm)	Water Temp. (°C)	Air Temp. (°C)
4-Jun	2	0.0	7.0	12.20
5-Jun	4	2.0	6.0	9.89
6-Jun	4	4.0	6.0	10.65
7-Jun	4	1.0	6.0	11.54
8-Jun	4	0.0	8.0	13.73
9-Jun	3	0.0	7.0	15.64
10-Jun	2	0.0	7.0	13.16
11-Jun	3	9.0	6.5	10.90
12-Jun	4	0.0	4.0	9.71
13-Jun	3	3.0	9.0	12.30
14-Jun	1	0.0	12.0	15.34
15-Jun	1	0.0	13.0	17.65
16-Jun	1	0.0	14.0	18.41
17-Jun	1	0.0	9.0	15.70
18-Jun	1	0.0	10.0	14.39
19-Jun	2	0.0	14.0	13.32
20-Jun	2	0.0	11.0	14.35
21-Jun	1	0.0	11.0	16.66
22-Jun	2	0.0	16.0	20.23
23-Jun	3	0.0	19.0	19.49
24-Jun	1	11.0	16.0	17.39
25-Jun	2	0.0	15.0	17.47
26-Jun	2	0.0	16.0	16.95
12-Aug	2	ND	ND	9.20
13-Aug	2	0.0	ND	10.76
14-Aug	2	0.0	ND	12.60
15-Aug	3	0.0	ND	11.07
16-Aug	5	10.0	ND	12.71
17-Aug	4	0.0	ND	13.24
18-Aug	5	20.0	ND	14.45
19-Aug	4	0.0	ND	12.27
20-Aug	4	1.0	ND	11.55
21-Aug	4	0.0	ND	10.50
22-Aug	4	0.0	ND	11.56
23-Aug	4	2.0	ND	9.89
24-Aug	4	0.0	ND	10.91
25-Aug	1	0.0	ND	11.91
26-Aug	1	0.0	ND	9.25
27-Aug	5	11.0	ND	10.71
28-Aug	5	13.0	ND	11.81

ND indicates no data was collected

Hewitt Lake

Date	Sky	Precip. (mm)	Water Temp. (°C)	Air Temp. (°C)
12-Jul	ND	ND	ND	16.63
13-Jul	5	ND	ND	12.86
14-Jul	5	ND	ND	11.34
15-Jul	3	2.0	ND	11.71
16-Jul	5	17.0	ND	11.67
17-Jul	4	8.0	ND	11.70
18-Jul	5	32.0	ND	11.42
19-Jul	1	0.0	ND	14.36
20-Jul	1	0.0	ND	17.88
21-Jul	2	0.0	ND	17.67
22-Jul	2	0.0	ND	18.56
23-Jul	2	0.0	ND	17.79
24-Jul	4	0.0	ND	17.65
25-Jul	4	0.0	ND	15.55
26-Jul	3	28.0	ND	13.31
27-Jul	3	10.0	ND	12.18
28-Jul	4	0.0	ND	13.73
29-Jul	4	18.0	ND	12.07
30-Jul	2	14.0	ND	13.80
31-Jul	3	0.0	ND	14.77
1-Aug	2	0.0	ND	13.71
2-Aug	2	0.0	ND	13.89
3-Aug	2	0.0	ND	12.83
4-Aug	3	0.0	ND	14.03
5-Aug	1	0.0	ND	14.84
6-Aug	5	0.0	ND	14.68
7-Aug	4	35.0	ND	14.89
8-Aug	4	0.0	ND	14.55
9-Aug	4	0.0	ND	12.55
10-Aug	4	8.0	ND	13.50
11-Aug	4	42.0	ND	ND

Shell Lake			
Total	87	Water	Air
Avg.	2.2	10.5	13.3
Min.	0.0	4.0	9.2
Max.	20.0	19.0	20.2
Hewitt Lake			
Total	214	Water	Air
Avg.	7.6	ND	14.2
Min.	0.0	ND	11.3
Max.	42.0	ND	18.6

Appendix 3: Shell Lake 2024 Daily Smolt Migration

Shell Lake 2024 Smolt Migration											
	Sockeye			Coho		Rainbow		Dolly Varden		Pink	
Date	Daily	Mortality	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
3-Jun	1	0	1	2	2	0	0	0	0	0	0
4-Jun	2	0	3	6	8	0	0	0	0	0	0
5-Jun	0	0	3	1	9	0	0	0	0	0	0
6-Jun	0	0	3	2	11	0	0	0	0	0	0
7-Jun	0	0	3	81	92	0	0	0	0	0	0
8-Jun	0	0	3	24	116	0	0	0	0	0	0
9-Jun	0	0	3	8	124	0	0	0	0	0	0
10-Jun	2	0	5	68	192	0	0	0	0	0	0
11-Jun	0	0	5	123	315	0	0	0	0	0	0
12-Jun	3	0	8	64	379	0	0	0	0	0	0
13-Jun	12	0	20	227	606	0	0	0	0	0	0
14-Jun	14	0	34	354	960	0	0	0	0	0	0
15-Jun	2	0	36	69	1,029	0	0	0	0	0	0
16-Jun	4	0	40	129	1,158	0	0	0	0	0	0
17-Jun	1	0	41	273	1,431	0	0	0	0	0	0
18-Jun	0	0	41	302	1,733	0	0	0	0	0	0
19-Jun	0	0	41	18	1,751	0	0	0	0	0	0
20-Jun	1	0	42	19	1,770	0	0	0	0	0	0
21-Jun	0	0	42	170	1,940	0	0	0	0	0	0
22-Jun	0	0	42	83	2,023	0	0	0	0	0	0
23-Jun	0	0	42	31	2,054	0	0	2	2	0	0
24-Jun	0	0	42	12	2,066	0	0	0	2	0	0
25-Jun	0	0	42	9	2,075	1	1	0	2	0	0
26-Jun	0	0	42	33	2,108	0	1	0	2	0	0
27-Jun	0	0	42	0	2,108	0	1	0	2	0	0
Total	**42**			**2,108**		**1**		**2**		**0**	