Red Lake Remote Video Salmon Escapement Monitoring Project, 2025

by

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and

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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.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

From 21 May to 4 November 2025, Alaska Department of Fish and Game (ADF&G) staff operated an autonomous video counting tower (AVCT) positioned below the outlet of Red Lake, within the Southern District of the Lower Cook Inlet Management Area (LCIMA). This project, initiated during the 2022 field season, is part of the Alaska Energy Authority's preliminary assessment of fishery resources in the Martin River drainage, a site under consideration for future hydroelectric development. The AVCT was programmed to continuously record time-lapse video across all diurnal and nocturnal periods to document the run timing and magnitude of Pacific salmon (*Oncorhynchus* spp.) escapements into Red Lake. During the 2025 monitoring period, sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and Dolly Varden (*Salvelinus malma*) were observed migrating upstream to Red Lake. Juvenile salmonids were also recorded emigrating from the system, though their small size precluded species identification or enumeration. The AVCT operated almost continuously throughout the season, capturing a total of 3,967 hours of video, with a brief recording outage occurring from 7 to 12 September, which fortunately coincided with the lull between the sockeye and coho salmon runs. The peak daily count of sockeye salmon was 294 individuals on 16 June, with a total escapement of 1,500 fish, of which 955 (63.7%) migrated upstream during nocturnal hours. The coho salmon run peaked at 38 fish on 10 October, with a total observed escapement of 214 individuals – 203 (94.9%) of these were documented migrating at night. No pink salmon were detected during the 2025 season. Additionally, the AVCT recorded at least 885 Dolly Varden and detected the presence of eight wildlife species, including brown (*Ursus arctos*) and black bear (*Ursus americanus*).

Keywords   Lower Cook Inlet, Kachemak Bay, Red Lake, Martin River, Pacific salmon, sockeye salmon, coho salmon, Dolly Varden, video, escapement monitoring, autonomous video counting tower (AVCT)

INTRODUCTION

This project was initiated in 2022 and continued through 2025 as part of the Alaska Energy Authority's (AEA) preliminary assessment of fishery resources within the Martin River drainage, a potential site for future hydroelectric development. The AEA commissioned the Alaska Department of Fish and Game (ADF&G) to document the timing and magnitude of Pacific salmon (*Oncorhynchus spp.*) escapements into Red Lake, situated in the Southern District of ADF&G's Lower Cook Inlet Management Area (LCIMA; Figure 1).

Aerial surveys have been employed to monitor salmon escapement in small, clear streams across Alaska since the 1930s (Eicher 1953) and continue today (Otis and Hollowell 2025). This method is particularly advantageous for remote and marginally productive stocks that are often overlooked due to the high cost of intensive monitoring techniques such as weirs or sonar. Nevertheless, aerial surveys are subject to several limitations. Factors including observer experience, water clarity, stream morphology and habitat type, timing and frequency of survey flights, and fish stream residency influence the accuracy and precision of escapement estimates derived from aerial surveys (Bevan 1961; Neilson and Geen 1981; Cousens et al. 1982; Shardlow et al. 1987; Perrin and Irvine 1990; Hill 1997; Bue et al. 1998; Jones et al. 2007). Although advanced statistical models have been developed to address some of these challenges (Hilborn et al. 1999; Adkison and Su 2001; Su et al. 2001), aerial surveys remain an imprecise tool. At best, they provide consistent relative indices of inriver escapement across years but do not yield accurate or reliable estimates of total spawner abundance, particularly under conditions of high inriver exploitation or

predation, and when observer efficiency and fish residency times are unknown (Perrin and Irvine 1990; Bue et al. 1998; Jones et al. 1998; Peirce et al. 2011; Peirce et al. 2013).

Accurate and reliable estimates of spawner abundance are critical for assessing stock-recruit relationships (Walters and Ludwig 1981), monitoring long-term salmon population trends (Baker et al. 1996), establishing appropriate spawning escapement goals for individual streams (Otis et al. 2023), and managing commercial fisheries in season (Hollowell et al. 2023). Given that aerial surveys often fail to provide this level of precision and that more accurate methods may be prohibitively expensive for streams with modest escapements, remote video technology has emerged as a valuable tool. Uncrewed (autonomous) underwater video systems that are integrated with fish weirs are not practical for most Alaskan streams due to risks from high water events and wildlife interference, so researchers in Alaska have trialed human-operated (Hetrick et al. 2004) and uncrewed video counting towers (Otis and Dickson 2002; O'Neal 2007; Otis 2012; Otis and Blackmon 2025). Uncrewed video towers are more advantageous for remote operations because the video tower does not obstruct fish passage, present vulnerabilities to inquisitive bears, or risk damage from high-water events. Unlike traditional counting towers that rely on periodic human observations, video counting towers can continuously record fish passage and are well suited for many small clear streams that are otherwise monitored by aerial survey. Uncrewed or autonomous video counting towers (AVCT), when deployed at small clear streams, can collect near census quality escapement estimates (Otis et al. 2010) that far surpass the accuracy of aerial survey indices.

Red Lake presents challenges for fixed-wing aerial surveys due to its small size, topography, and dark, vegetated bottom substrate. In contrast, the lake's outlet stream exhibits characteristics favorable for AVCT deployment: it is narrow, clear, shallow with laminar flow, and receives sufficient solar exposure, all essential for obtaining high-quality video imagery of migrating salmon. Given the expected modest escapement and costly access logistics (i.e., helicopter transport), the AVCT was selected as the most efficient and cost-effective assessment tool. Currently, ADF&G also employs AVCTs to monitor sockeye salmon (*Oncorhynchus nerka*) escapements in Mikfik Lake and Chenik Lake within the LCIMA (Otis and Blackmon 2025). The AVCT deployed at Red Lake was designed following the established models of these systems.

OBJECTIVES

1. Operate an AVCT at Red Lake to census the daily escapement of adult Pacific salmon during all daylight and nighttime hours, from 21 May through 4 November.

2. Identify and document other fish and wildlife species (e.g., juvenile salmonids, bears, etc.) captured on video transiting the camera site.

METHODS

STUDY SITE

Red Lake is located approximately 8.8 river km (5.5 mi) upstream of the mouth of the Martin River near the head of Kachemak Bay, in the Southern District of the LCIMA (Figure 1). The Red Lake AVCT was located approximately 100 m below Red Lake along the outlet stream that flows into the Martin River (Figure 2; approximately 59.6966 N, 151.0031 W). This location was selected because it met key criteria for successful AVCT operations (e.g., shallow/clear water, laminar

flow, narrow stream width, and adequate southern exposure for generating enough solar power to meet system requirements).

VIDEO COMPONENTS

The Red Lake AVCT consisted of a camera, external hard drive, batteries, solar panels, and an auxiliary lighting system. The video and lighting systems were independent of one another:

Video System:

- (1) video surveillance camera *(GeoVision Model GV-BX3400)*
- (1) 2 TB hard drive *(Oyen Novus 7200RPM)*
- (4) 85 W solar panels *(Model BP585U)*
- (2) 15 A solar power regulators *(Model AST-15A)*
- (2) 12 V batteries *(Absorbed Glass Mat [AGM], Group 31)*
- (1) 12 V timer switch *(Model JVR 12V)*
- (1) 12 Circuit fuse block *(Blue Sea Systems)*
- Other assorted wires and electrical components

Lighting System:

- (2) 85 W solar panels *(Model BP585U)*
- (1) 15 A solar power regulator *(Model AST-15A)*
- (2) 12 V battery *(Absorbed Glass Mat [AGM], Group 31)*
- (1) 12 V timer switch *(Model JVR 12V)*
- Other assorted wires and electrical components

Components for the video system were mounted to a 3-meter (10 ft) section of antenna tower. Approximately 30–60 cm (1–2 ft) of the bottom of the tower were buried in the ground to create a solid base. The top of the tower was stabilized by 3 radially spaced guy lines extending downward to *Duckbill* earth anchors (*Model-88*). A 122 cm (4 ft) length of 6.4 cm diameter (2.5 in) aluminum pipe was secured to the top of the tower for additional height and to provide a place to attach an adjustable video camera housing (Figure 3).

The camera (*GeoVision* Model *GV-BX3400*) was a 3 mega-pixel (MP) progressive scan CMOS IP box camera outfitted with a varifocal (*GeoVision* 3–10.5 mm), auto-iris lens. The camera was powered by a dedicated 12 V direct current (VDC) cable, but it also had power over ethernet (PoE) capability. Setup and review of the camera required a laptop computer running *GeoVision* software (Model *GV-IPCAM H.264*) that was connected to the camera via an ethernet cable. In the field, during setup and periodic maintenance visits, we confirmed the camera was functioning properly using the laptop or a portable monitor connected via coaxial cable.

The camera was enclosed in a custom-fabricated, aluminum, weatherproof camera housing attached to the top of the tower where it was adjusted so the view encompassed the entire wetted width of the creek. The other sensitive electronic components were protected inside a commercially available weatherproof aluminum strongbox (Model *UWS-ATV: 81.3 cm L x 30.5 cm W x 30.5 cm H*) set atop a platform secured to the tower approximately 1 m above ground (Figure 3). A 2.5 cm diameter (1 in) flexible conduit protected all cables needed for communication between the camera and strongbox components. Communication cables included: ethernet,

12/2 power, USB, and coaxial. Video from the camera was recorded to a 2 TB external hard drive via a 4.6 m (15 ft) length of USB cable (USB-C to 2.0 mini-B).

Electronic components in the video system were powered by 2 Group 31, 12 VDC, 110 ampere hour (Ah) absorbed glass mat (AGM) batteries. They were connected in parallel to provide a single 220 Ah capacity battery bank outputting 12 VDC. Four 85 W solar panels (Model *BP585U*), set up as 2 isolated pairs, were used to recharge the battery bank. Wire leads from each pair of solar panels were run through a 15 A fuse block and a 15 A solar power regulator (Model *AST 15*) before going to the battery bank (Figure 4). All sensitive electronic components (e.g., camera, hard drive, monitor) were protected by appropriately sized fuses inside a fuse block, like those used for small boat accessories.

To enhance the visibility of fish passing the AVCT, a high-contrast substrate panel was fabricated out of a 4.6 mm (3/16 in) mesh beach seine. It was dyed light green because fish can sometimes be reluctant to swim across a bright white panel (E. Otis, ADF&G Division of Commercial Fisheries Biologist, personal observation). The panel was placed across the bottom of the stream, perpendicular to water flow (Figure 3b). The upstream edge of the panel was secured to an anchor chain fastened to the stream bottom using a *Duckbill* earth anchor (Model *DB-68*). The downstream edge of the panel was left unencumbered as it was held flat to the stream bed by the current.

Auxiliary lighting was added to the Red Lake AVCT in 2023 (Figure 5) after it was learned that a high proportion of the coho salmon (*O. kisutch*) passage at nearby Battle Creek occurred during hours of darkness in 2022 (H. Dickson, ADF&G, Division of Sport Fish Biologist, Homer, personal communication, October 2022). At Red Lake in 2023, >97% of coho salmon migrated upstream at night (Blackmon and Otis 2024), so auxiliary lighting was again deployed in 2024. Illumination was provided by a single 5 W LED bulb powered via a 12 VDC timer *(Model JVR 12V)* that was programmed to turn on at sunset and off at sunrise each night. The system was powered by 2 Group 31, 12 VDC AGM battery and maintained by two 85 W solar panels (Model *BP585U*) and a 15 A solar power regulator (Model *AST-15A*). The light fixture was an underwater pond light (Best Pro Lighting Model: *LED-BPL500-FG*) ensconced in an aluminum protective housing with the cable routed though flexible conduit to the aluminum job box containing the electrical components. Large rocks were placed on top of the light and conduit to deter inquisitive bears (Figure 5).

VIDEO INSTALLATION, OPERATION, AND REMOVAL

Given the expense of accessing the site by helicopter, we coordinated with other researchers to share flights to service our respective field equipment. After an initial deployment on 21 May, hard drives were exchanged on 16 June, 25 July, and 12 and 23 September, with final retrieval on 4 November. A flight also occurred on 29 August, but flood induced high water precluded safe access to the video site. Another flight wasn't available until 12 September, resulting in the hard drive filling to capacity on 7 September at 1:56 PM. No video was recorded from then until 12 September at 3:00 PM, when the hard drive was swapped and video recording functions were restored. During the period before and after the loss of video recording, there was no escapement of sockeye salmon (due to the run being complete), little movement of Dolly Varden (*Salvelinus malma*), and no evidence of coho salmon arriving to the system until 27 September.

For more details on the installation, operation, and maintenance of the AVCT, including programming the camera and reviewing video using *GeoVision* software, see Otis and Bacon (2025), and Appendices A–E in Otis and Blackmon 2025).

VIDEO RECORDING

While the camera could record at resolutions up to 1440P (2560x1440), to balance hard drive capacity with image quality, we ultimately used 1.3MP (1280x960, 4:3), in the MJPEG codec, which compresses video within frames. We have found that other video codecs that compress video across frames, such as H.264, can result in rapid image degradation when recording through a medium of moving water, especially when surface turbulence is present. The AVCT was programmed to record 24 h per day. A time-lapse recording rate of 3 frames per second (fps) was selected to optimize hard drive space without compromising the reviewer's ability to track individual fish transiting the video site. Although disk space required for a day's video varies with the complexity of the images (e.g., varying light conditions, surface turbulence, cloud shadows), the 2 TB hard drives we use can accommodate approximately 50 days of recorded video when programmed to record 3 fps at 1280x960 resolution in the MJPEG format. Hard drives larger than 2 TB are not compatible with *GeoVision* cameras due to BIOS limitations. Auxiliary underwater lighting (UWL) was used to illuminate the stream channel during nighttime hours. A DC timer switch was used to trigger the UWL to illuminate from dusk until dawn of the following day, with the timer being reprogrammed upon each site visit day to account for seasonal differences in sunrise and sunset across the study period.

VIDEO REVIEW

Video footage was reviewed during and after the season to enumerate daytime and nocturnal fish passage (Figure 6). All recorded video was reviewed, with no subsampling. Image resolution was sufficient to speciate adult salmonids, but not juveniles. The run timing for sockeye and coho salmon did not overlap, which helped ensure the 2 most abundant species would not be misidentified. Dolly Varden were easily distinguished by their smaller size and behavior. Video review was easiest when run through the same *GeoVision* camera that was used to record the images, but that was not possible when the camera was still in the field recording fish passage. To overcome this, we installed software (*Ext2Fsd* and *RemoteViewlog*) on select office computers that allowed us to review video files directly from the *Linux* formatted field hard drives. *Ext2Fsd* is a free file system driver, written in *C* for *Microsoft* OS systems, which facilitates read/write access to *Linux* formatted drives and files (e.g., ext2, ext3, ext4). *RemoteViewlog* is *GeoVision*'s video review software, which provides the reviewer with control over a variety of playback features (e.g., screen size, playback speed, brightness, contrast). For more details on the use of *GeoVision* software for video review, see Appendix F in Otis and Blackmon (2025).

Fish counts and other noteworthy observations (e.g., weather, dawn/dusk, video quality, and wildlife sightings) were recorded in uniform *MS Excel* spreadsheets. Daily fish counts were stratified by species into 6-hour time blocks (00:00:00–05:59:59, 06:00:00–11:59:59, 12:00:00–17:59:59, and 18:00:00–23:59:59). Staff also recorded periods of video loss or other technical difficulties (e.g., loss of the UWL). See Appendix E in Otis and Blackmon (2025) for further details and an example of this spreadsheet.

RESULTS

AVCT PERFORMANCE

The AVCT operated 24 h per day (00:00–24:00) from 16:56 on 21 May until 11:44 on 4 November 2025 (3,870 h). There was 1 recording interruption in 2025 that led to lost video between 13:56 on 7 September and 15:00 on 12 September (121.1 h). This disruption resulted from the hard drive filling to capacity when a scheduled site visit on 29 August couldn't occur due to dangerously high water. That flood event eroded the area around the AVCT tower, so it was moved to higher ground on 12 September. The flood also modified the stream channel at the video site, so the high-contrast substrate panel was moved slightly upstream to a location with more laminar flow. Diminishing daylight and concurrent reduced solar capacity to recharge batteries resulted in the UWL turning off before there was sufficient daylight to view fish passage beginning on 26 July.

ADULT SALMONID ENUMERATION

During 2025 operations, sockeye salmon, coho salmon, and Dolly Varden were observed migrating towards Red Lake. The AVCT recorded a total sockeye salmon escapement of 1,500 individuals, with a peak daily count of 294 fish on 16 June (Table 1, Figure 7a). Coho salmon escapement totaled 214 fish, reaching a maximum daily count of 38 on 10 October (Table 1, Figure 7b). Underwater lighting revealed that 63.7% (n = 955) of the sockeye run and 94.9% (n = 203) of the coho run occurred during nocturnal hours. The AVCT documented a minimum of 855 Dolly Varden in 2025, with the highest daily count of 175 individuals recorded on 28 September (Table 1). However, enumeration of Dolly Varden transitioned from census-level counts to qualitative observation on 1 October due to extensive nocturnal milling behavior of Dolly Varden in front of the AVCT camera, which reduced the confidence of ADF&G video reviewers in the accuracy of subsequent Dolly Varden counts.

JUVENILE SALMON

During a brief opportunistic sampling event conducted on 8 June 2022, multiple juvenile salmon observed along the shoreline of Red Lake were captured using a makeshift beach seine. Collected specimens were transported to the laboratory in Homer and all were positively identified as coho salmon. No juvenile salmonids were collected by ADFG staff in 2025; however, video monitoring showed 80 schools of juvenile salmonids emigrating downstream from Red Lake, predominantly in late May and June. Species-level identification and individual counts were not feasible on these schools of juvenile salmonids.

OTHER WILDLIFE DOCUMENTED

- Bald eagle   *Haliaeetus leucocephalus*
- Beaver   *Castor canadensis*
- Belted kingfisher   *Megaceryle alcyon*
- Black bear   *Ursus americanus*
- Brown bear   *Ursus arctos*
- Common merganser   *Mergus merganser*
- River otter   *Lontra canadensis*
- Trumpeter swan   *Cygnus buccinator*
- Unidentified waterfowl spp.

Beaver activity around Red Lake increased in 2025. A substantial beaver dam just below the outlet of Red Lake was completed in late-July, after the sockeye run was over. The dam inhibited, but did not block coho salmon access to Red Lake, as adult coho salmon were observed in Red Lake on 4 November.

DISCUSSION

AVCT PERFORMANCE

There were no malfunctions with the AVCT hardware in 2025 and the camera never lost power. However, the hard drive did fill to capacity on 7 September and failed to record video from 13:56 on 7 September until 15:00 on 12 September (121.1 h), when a new hard drive was installed. There were also moments of brief downtime while hard drives were being swapped (<6 min each) when video was not recorded. Between 29 July and 4 November, the UWL was programmed to shut off in the morning before dawn arrived, resulting in short periods of nocturnal time when the video was unreviewable due to a lack of illumination (maximum non-illuminated time was 2 hrs, 34 min on 7 September, average non-illuminated time was 1 hr 12 min). These periods of unmonitored nocturnal migration (Table 2) may have affected coho salmon counts, as discussed in the next section. All other video that was recorded was reviewable, with generally good to great video quality noted.

ADULT SALMON ENUMERATION

Review of video footage indicated that 1,500 sockeye salmon, 214 coho salmon, and at least 855 Dolly Varden migrated upstream past the AVCT at the outlet of Red Lake during the 2025 season (Table 1). Following a minor spike the first week of June, the sockeye salmon run peaked in mid-June (Figure 7), consistent with observations from 2022 (Blackmon and Otis 2023) and 2024 (Otis 2026), and approximately 1 week earlier than the 2023 run (Blackmon and Otis 2024). Coho salmon run timing peaked between the first and second weeks of October (Figure 7), similar to the timing observed during the 2022–2024 seasons (Blackmon and Otis 2023 and 2024, Otis 2026). For both species, run duration was relatively brief across all years, with most individuals of each species passing the AVCT site within a 7 to 14-day period (Figure 7; Blackmon and Otis 2023 and 2024, Otis 2026).

When considering the run timing for Red Lake sockeye and coho salmon and evaluating potential impacts that may derive from future hydroelectric development activities in the drainage, it should be noted that there is an unknown migratory lag time between the date salmon enter the Martin River from Kachemak Bay and the date they are observed at the Red Lake AVCT. Anecdotally, it appeared the migratory lag time for coho may be slightly longer than sockeye salmon based on the former generally being more "blushed" in color when passing the video site.

A single significant interruption to video recording occurred between 7 and 12 September 2025 due to hard drive storage capacity being exceeded (Tables 1 and 2; Figure 7). This outage occurred after completion of the sockeye salmon run and prior to the beginning of the coho salmon run. No sockeye or coho salmon were observed immediately before or after the recording gap (Table 1; Figure 7), indicating that the outage likely had negligible influence on escapement estimates for either species.

Nocturnal passage accounted for the majority of total escapement for both sockeye salmon (63.7%) and coho salmon (94.9%) in 2025 (Table 1), representing a higher proportion of nocturnal

migration than observed in 2024 (sockeye salmon = 45.8%; coho salmon = 76.4%; Otis 2026). However, because the UWL was programmed to shut off in the early morning to conserve battery power, the UWL did not illuminate all hours of darkness in 2025 (Table 2). The UWL was operational during all nocturnal periods throughout the sockeye salmon run, enabling a complete census for that species, but during the coho salmon migration period (27 September to 4 November), the UWL illuminated 93.7% of nocturnal hours, with an average of 50 minutes per night non-illuminated (Table 2). Because most nocturnal video footage was illuminated and thus reviewable in 2025, no adjustment was applied to the 2025 coho salmon escapement estimate, unlike in 2023 (Blackmon and Otis 2024) and 2024 (Otis 2026), when nocturnal coho salmon escapements were adjusted to account for the high percentage of non-illuminated nocturnal review time. Total nocturnal coho salmon passage in 2025 (203 fish) exceeded the adjusted nocturnal estimate from 2024 (139 fish), while daytime passage was lower in 2025 (11 fish) than in 2024 (43 fish; Otis 2026). The high proportion of coho salmon migrating at night in 2025 (94.9%) was comparable to that observed in 2023 (97.5%; Blackmon and Otis 2024) and exceeded the proportion observed in 2024 (76.4%; Otis 2026), further supporting the conclusion that the 2022 coho salmon escapement estimate (48 fish), which was derived without auxiliary lighting, was likely conservative.

From mid- to late September 2025, Dolly Varden were observed in unusually high numbers and densities in the vicinity of the AVCT site at the outlet of Red Lake, a pattern not documented during the 2022, 2023, or 2024 monitoring periods. Individuals were observed milling directly in front of the AVCT camera, particularly during nocturnal hours, and potentially exhibiting spawning-related behaviors. The combination of high population densities, frequent upstream and downstream movements across the AVCT substrate panel, and partial nighttime illumination (approximately 70% of the stream channel) led ADF&G video reviewers to transition from census-level enumeration to qualitative documentation of Dolly Varden abundance and behavior on and after 1 October. Despite this limitation, a minimum of 885 Dolly Varden were documented in 2025, representing an order-of-magnitude increase compared to 2024 (88 fish; Otis 2026).

JUVENILE SALMON

Like past years, schools of juvenile salmonids were observed on video emigrating from Red Lake during the 2025 season. However, their small size precluded species-level identification and enumeration. Although systematically sampling juvenile salmonids was not an objective of this study, coho salmon fry were observed and opportunistically sampled in 2022. However, that sampling was limited in scope and effort and was not intended to characterize the full assemblage of juvenile salmonids in the system. Given the number of adult sockeye salmon documented passing the AVCT from 2022 to 2025, it appears likely that Red Lake also provides suitable rearing habitat for juvenile sockeye salmon. Future studies should consider investigating the life-history patterns of the Red Lake sockeye salmon population to determine whether juvenile sockeye salmon rear in Red Lake for 0, 1 or 2 years.

ADF&G staff coordinated with Kleinschmidt employees, who were on site, to collect moribund juvenile salmonids from Red Lake after several juveniles exhibiting lethargy and exophthalmia were observed along the lake margin. Six live juvenile coho (4 YOY and 2 age-1) and 3 live juvenile sockeye salmon (all YOY) were collected on 3 August and sent to the ADF&G Pathology lab for diagnostic examination. Water temperature and DO at the time of collection were 16.8 deg C and 13.4 mg/L, respectively. Bacterial Kidney Disease (BKD) and/or Gas Bubble Disease was

initially suspected due to the exophthalmia and high DO readings, respectively. However, subsequent analysis revealed that the mortality and morbidity of both coho and sockeye salmon were due to heavy infestations of larval digenean trematodes, also known as flukes (personal communication with J.A. Fergusen, ADF&G Fish Pathologist, 10 October 2025). It is unclear what conditions led to this event, or if it was anomalous or may be recurring. Future studies of Red Lake should monitor for additional outbreaks and coordinate with ADF&G staff to collect samples for diagnostic examination by the ADF&G Pathology Lab. Additional temperature and DO readings from Red Lake would also be useful to determine if this waterbody is regularly supersaturated with dissolved oxygen.

The observation of large numbers of adult and juvenile Dolly Varden in the vicinity of Red Lake in 2025, potentially exhibiting spawning behavior, also suggests that a population of Dolly Varden could successfully be utilizing the freshwater habitat(s) near Red Lake for critical life-history events, though further studies should investigate if Dolly Varden are exhibiting freshwater resident or anadromous life-histories and determine their distribution and habitat usage within the entire drainage.

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TABLES AND FIGURES

Table 1.–Day, night, and cumulative fish passage at Red Lake autonomous video counting tower by species in 2025.

Date	Sockeye salmon			Coho salmon			Dolly Varden[a]		
	Day	Night	Cumul-ative	Day	Night	Cumul-ative	Daily	Cumul-ative	
21-May	0	0	0	0	0	0	0	0	[b]
22-May	0	0	0	0	0	0	3	3	
23-May	2	0	2	0	0	0	2	5	[c]
24-May	0	1	3	0	0	0	2	7	
25-May	0	6	9	0	0	0	1	8	
26-May	3	1	13	0	0	0	0	8	
27-May	3	5	21	0	0	0	0	8	
28-May	0	7	28	0	0	0	0	8	
29-May	1	27	56	0	0	0	0	8	
30-May	3	1	60	0	0	0	5	13	
31-May	13	24	97	0	0	0	4	17	
1-Jun	17	8	122	0	0	0	6	23	
2-Jun	19	16	157	0	0	0	3	26	
3-Jun	42	12	211	0	0	0	3	29	
4-Jun	28	26	265	0	0	0	6	35	
5-Jun	15	17	297	0	0	0	6	41	
6-Jun	1	2	300	0	0	0	7	48	
7-Jun	-4	5	301	0	0	0	5	53	
8-Jun	3	7	311	0	0	0	5	58	
9-Jun	3	11	325	0	0	0	5	63	
10-Jun	5	13	343	0	0	0	4	67	
11-Jun	0	7	350	0	0	0	1	68	
12-Jun	-5	4	349	0	0	0	6	74	
13-Jun	53	28	430	0	0	0	4	78	
14-Jun	67	12	509	0	0	0	1	79	
15-Jun	0	26	535	0	0	0	3	82	
16-Jun	118	176	829	0	0	0	7	89	[d]
17-Jun	53	32	914	0	0	0	0	89	
18-Jun	10	3	927	0	0	0	2	91	
19-Jun	-2	80	1,005	0	0	0	0	91	
20-Jun	7	181	1,193	0	0	0	7	98	
21-Jun	26	102	1,321	0	0	0	16	114	
22-Jun	28	33	1,382	0	0	0	12	126	
23-Jun	11	14	1,407	0	0	0	0	126	
24-Jun	2	5	1,414	0	0	0	0	126	
25-Jun	7	2	1,423	0	0	0	2	128	
26-Jun	2	4	1,429	0	0	0	1	129	
27-Jun	1	2	1,432	0	0	0	0	129	
28-Jun	4	1	1,437	0	0	0	2	131	
29-Jun	3	4	1,444	0	0	0	3	134	
30-Jun	-3	3	1,444	0	0	0	1	135	
1-Jul	2	1	1,447	0	0	0	0	135	
2-Jul	1	2	1,450	0	0	0	2	137	
3-Jul	4	6	1,460	0	0	0	0	137	
4-Jul	-5	4	1,459	0	0	0	1	138	
5-Jul	4	3	1,466	0	0	0	1	139	

-continued-

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Table 1.–Page 2 of 4.

Date		Sockeye salmon			Coho salmon			Dolly Varden[a]	
		Day	Night	Cumul-ative	Day	Night	Cumul-ative	Daily	Cumul-ative
6-Jul		1	4	1,471	0	0	0	0	139
7-Jul		-3	0	1,468	0	0	0	1	140
8-Jul		0	2	1,470	0	0	0	0	140
9-Jul		2	0	1,472	0	0	0	0	140
10-Jul		0	0	1,472	0	0	0	0	140
11-Jul		2	2	1,476	0	0	0	0	140
12-Jul		0	0	1,476	0	0	0	3	143
13-Jul		0	0	1,476	0	0	0	0	143
14-Jul		0	0	1,476	0	0	0	0	143
15-Jul		0	1	1,477	0	0	0	0	143
16-Jul		0	2	1,479	0	0	0	0	143
17-Jul		0	2	1,481	0	0	0	0	143
18-Jul		0	2	1,483	0	0	0	0	143
19-Jul		1	0	1,484	0	0	0	0	143
20-Jul		0	0	1,484	0	0	0	0	143
21-Jul		0	1	1,485	0	0	0	0	143
22-Jul		0	0	1,485	0	0	0	0	143
23-Jul		0	1	1,486	0	0	0	0	143
24-Jul		0	1	1,487	0	0	0	0	143
25-Jul		0	1	1,488	0	0	0	0	143 [e]
26-Jul	*	0	0	1,488	0	0	0	0	143
27-Jul	*	0	0	1,488	0	0	0	0	143
28-Jul	*	0	0	1,488	0	0	0	0	143
29-Jul	*	0	0	1,488	0	0	0	0	143
30-Jul	*	0	0	1,488	0	0	0	0	143
31-Jul	*	0	0	1,488	0	0	0	0	143
1-Aug	*	0	2	1,490	0	0	0	0	143
2-Aug	*	0	1	1,491	0	0	0	0	143
3-Aug	*	0	0	1,491	0	0	0	0	143
4-Aug	*	0	0	1,491	0	0	0	0	143
5-Aug	*	0	0	1,491	0	0	0	0	143
6-Aug	*	0	0	1,491	0	0	0	0	143
7-Aug	*	0	0	1,491	0	0	0	0	143
8-Aug	*	0	0	1,491	0	0	0	0	143
9-Aug	*	0	0	1,491	0	0	0	0	143
10-Aug	*	0	0	1,491	0	0	0	0	143
11-Aug	*	0	1	1,492	0	0	0	0	143
12-Aug	*	0	0	1,492	0	0	0	0	143
13-Aug	*	0	0	1,492	0	0	0	0	143
14-Aug	*	0	0	1,492	0	0	0	0	143
15-Aug	*	0	-1	1,491	0	0	0	0	143
16-Aug	*	0	0	1,491	0	0	0	0	143
17-Aug	*	0	3	1,494	0	0	0	0	143
18-Aug	*	0	1	1,495	0	0	0	0	143
19-Aug	*	0	0	1,495	0	0	0	0	143
20-Aug	*	0	0	1,495	0	0	0	0	143
21-Aug	*	0	2	1,497	0	0	0	0	143
22-Aug	*	0	2	1,499	0	0	0	0	143
23-Aug	*	0	0	1,499	0	0	0	0	143
24-Aug	*	0	0	1,499	0	0	0	0	143

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Table 1.–Page 3 of 4.

Date		Sockeye salmon			Coho salmon			Dolly Varden[a]		
		Day	Night	Cumul-ative	Day	Night	Cumul-ative	Daily	Cumul-ative	
25-Aug	*	0	0	1,499	0	0	0	0	143	
26-Aug	*	0	0	1,499	0	0	0	0	143	
27-Aug	*	0	0	1,499	0	0	0	0	143	
28-Aug	*	0	1	1,500	0	0	0	0	143	f
29-Aug	*	0	0	1,500	0	0	0	0	143	
30-Aug	*	0	0	1,500	0	0	0	0	143	
31-Aug	*	0	0	1,500	0	0	0	0	143	
1-Sep	*	0	0	1,500	0	0	0	0	143	
2-Sep	*	0	0	1,500	0	0	0	0	143	
3-Sep	*	0	0	1,500	0	0	0	1	144	
4-Sep	*	0	0	1,500	0	0	0	5	149	
5-Sep	*	0	0	1,500	0	0	0	5	154	
6-Sep	*	0	0	1,500	0	0	0	0	154	
7-Sep	*	0	0	1,500	0	0	0	0	154	g
8-Sep	*	–	–	1,500	–	–	0	–	154	h
9-Sep	*	–	–	1,500	–	–	0	–	154	h
10-Sep	*	–	–	1,500	–	–	0	–	154	h
11-Sep	*	–	–	1,500	–	–	0	–	154	h
12-Sep	*	0	0	1,500	0	0	0	1	155	i
13-Sep	*	0	0	1,500	0	0	0	1	156	
14-Sep	*	0	0	1,500	0	0	0	3	159	
15-Sep	*	0	0	1,500	0	0	0	2	161	
16-Sep	*	0	0	1,500	0	0	0	6	167	
17-Sep	*	0	0	1,500	0	0	0	50	217	
18-Sep	*	0	0	1,500	0	0	0	23	240	
19-Sep	*	0	0	1,500	0	0	0	2	242	
20-Sep	*	0	0	1,500	0	0	0	3	245	
21-Sep	*	0	0	1,500	0	0	0	3	248	
22-Sep	*	0	0	1,500	0	0	0	8	256	
23-Sep	*	0	0	1,500	0	0	0	54	310	
24-Sep	*	0	0	1,500	0	0	0	52	362	
25-Sep	*	0	0	1,500	0	0	0	15	377	
26-Sep	*	0	0	1,500	0	0	0	59	436	
27-Sep	*	0	0	1,500	0	1	1	130	566	j
28-Sep	*	0	0	1,500	0	14	15	175	741	
29-Sep	*	0	0	1,500	0	17	32	92	833	
30-Sep	*	0	0	1,500	0	26	58	22	855	k
1-Oct	*	0	0	1,500	0	3	61	NC	855	
2-Oct	*	0	0	1,500	-1	3	63	NC	855	
3-Oct	*	0	0	1,500	0	5	68	NC	855	
4-Oct	*	0	0	1,500	0	13	81	NC	855	
5-Oct	*	0	0	1,500	-2	10	89	NC	855	
6-Oct	*	0	0	1,500	0	4	93	NC	855	
7-Oct	*	0	0	1,500	-1	0	92	NC	855	
8-Oct	*	0	0	1,500	0	5	97	NC	855	
9-Oct	*	0	0	1,500	0	11	108	NC	855	
10-Oct	*	0	0	1,500	7	31	146	NC	855	l
11-Oct	*	0	0	1,500	0	21	167	NC	855	
12-Oct	*	0	0	1,500	0	23	190	NC	855	
13-Oct	*	0	0	1,500	0	2	192	NC	855	

-continued-

Table 1.–Page 4 of 4.

Date		Sockeye salmon			Coho salmon			Dolly Varden[a]		
		Day	Night	Cumul-ative	Day	Night	Cumul-ative	Daily	Cumul-ative	
14-Oct	*	0	0	1,500	0	6	198	NC	855	
15-Oct	*	0	0	1,500	0	8	206	NC	855	
16-Oct	*	0	0	1,500	0	-1	205	NC	855	
17-Oct	*	0	0	1,500	1	-1	205	NC	855	
18-Oct	*	0	0	1,500	0	-2	203	NC	855	
19-Oct	*	0	0	1,500	2	1	206	NC	855	
20-Oct	*	0	0	1,500	1	-2	205	NC	855	
21-Oct	*	0	0	1,500	0	0	205	NC	855	
22-Oct	*	0	0	1,500	2	-3	204	NC	855	
23-Oct	*	0	0	1,500	0	0	204	NC	855	
24-Oct	*	0	0	1,500	0	0	204	NC	855	
25-Oct	*	0	0	1,500	1	-2	203	NC	855	
26-Oct	*	0	0	1,500	0	4	207	NC	855	
27-Oct	*	0	0	1,500	2	0	209	NC	855	
28-Oct	*	0	0	1,500	-1	6	214	NC	855	
29-Oct	*	0	0	1,500	0	0	214	NC	855	
30-Oct	*	0	0	1,500	0	-3	211	NC	855	
31-Oct	*	0	0	1,500	0	-1	210	NC	855	
1-Nov	*	0	0	1,500	0	0	210	NC	855	
2-Nov	*	0	0	1,500	0	4	214	NC	855	
3-Nov	*	0	0	1,500	0	2	216	NC	855	
4-Nov	*	0	0	1,500	0	-2	214	NC	855	[m]
Total		545	955	1,500	11	203	214		855	
Percent		36.3%	63.7%		5.1%	94.9%				

Note: Asterisks (*) represent nights the underwater light was not on for the entire night, en dashes (–) represent days when no video was recorded due to the hard drive being full, and NC means not counted, for reasons explained in footnote a.

[a] Dolly Varden total counts represent the escapement counted through 30 September, when Dolly Varden enumeration methods transitioned from census-level counts to qualitative estimates (e.g., >100) in October (discussed further in "Results - Adult Salmonid Enumeration" section).

[b] Video on at 16:56.

[c] First sockeye salmon observed.

[d] Peak sockeye salmon escapement; HD swap: video lost at 10:01, regained at 10:05.

[e] HD swap: video lost at 09:31, regained at 09:33.

[f] Last sockeye salmon observed.

[g] HD full: video quit recording at 13:56.

[h] HD full: no video recorded.

[i] Video regained at 15:00.

[j] First coho salmon observed.

[k] Dolly Varden enumeration method transitioned; HD swap: video lost at 09:57, regained at 10:03.

[l] Peak coho salmon escapement.

[m] Video off at 11:44.

Table 2.–Duration of darkness (hh:min), hours with underwater lighting, and effective sampling rate (percent of night surveyed) at the AVCT at Red Lake from 26 July–04 November 2025.

Date[a]	Dusk (of previous day)	Dawn	Light off	Darkness time surveyed	Darkness time unsurveyed	Percent of night surveyed
26-Jul	23:32	5:08	4:26	4:53	0:42	87.4%
27-Jul	23:34	5:02	4:26	4:51	0:36	88.8%
28-Jul	23:31	5:04	4:26	4:54	0:38	88.5%
29-Jul	23:30	5:10	4:26	4:55	0:44	87.1%
30-Jul	23:11	5:18	4:26	5:14	0:52	85.8%
31-Jul	23:10	5:20	4:26	5:15	0:54	85.4%
1-Aug	23:05	5:29	4:26	5:20	1:03	83.6%
2-Aug	23:06	5:30	4:26	5:19	1:04	83.3%
3-Aug	23:00	5:22	4:26	5:25	0:56	85.3%
4-Aug	23:00	5:24	4:26	5:25	0:58	84.9%
5-Aug	23:01	5:18	4:26	5:24	0:52	86.2%
6-Aug	22:57	5:22	4:26	5:28	0:56	85.5%
7-Aug	22:40	5:40	4:26	5:45	1:14	82.4%
8-Aug	22:40	5:40	4:26	5:45	1:14	82.4%
9-Aug	22:37	5:31	4:26	5:48	1:05	84.3%
10-Aug	22:42	5:35	4:26	5:43	1:09	83.3%
11-Aug	22:40	5:32	4:26	5:45	1:06	84.0%
12-Aug	22:30	5:40	4:26	5:55	1:14	82.8%
13-Aug	22:29	5:47	4:26	5:56	1:21	81.5%
14-Aug	22:29	5:47	4:26	5:56	1:21	81.5%
15-Aug	22:30	5:48	4:26	5:55	1:22	81.3%
16-Aug	22:29	5:49	4:26	5:56	1:23	81.1%
17-Aug	22:30	5:48	4:26	5:55	1:22	81.3%
18-Aug	22:22	5:56	4:26	6:03	1:30	80.2%
19-Aug	22:18	6:05	4:26	6:07	1:39	78.8%
20-Aug	22:15	6:10	4:26	6:10	1:44	78.1%
21-Aug	22:06	6:12	4:26	6:19	1:46	78.2%
22-Aug	22:00	6:14	4:26	6:25	1:48	78.1%
23-Aug	21:58	6:18	4:26	6:27	1:52	77.6%
24-Aug	21:50	6:20	4:26	6:35	1:54	77.6%
25-Aug	21:45	6:26	4:26	6:40	2:00	77.0%
26-Aug	21:50	6:30	4:26	6:35	2:04	76.2%
27-Aug	21:43	6:32	4:26	6:42	2:06	76.2%
28-Aug	21:33	6:38	4:26	6:52	2:12	75.8%
29-Aug	21:28	6:45	4:26	6:57	2:19	75.0%
30-Aug	21:33	6:47	4:26	6:52	2:21	74.5%
31-Aug	21:25	6:42	4:26	7:00	2:16	75.6%
1-Sep	21:21	6:56	4:26	7:04	2:30	73.9%
2-Sep	21:19	7:10	4:26	7:06	2:44	72.2%
3-Sep	21:17	6:51	4:26	7:08	2:25	74.7%
4-Sep	21:30	6:52	4:26	6:55	2:26	74.0%

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Table 2.–Page 2 of 3.

Date[a]		Dusk (of previous day)	Dawn	Light off	Darkness time surveyed	Darkness time unsurveyed	Percent of night surveyed
5-Sep		21:20	6:53	4:26	7:05	2:27	74.3%
6-Sep		21:16	7:00	4:26	7:09	2:34	73.6%
7-Sep		21:10	7:00	4:26	7:15	2:34	73.9%
8-Sep	*	ND	ND	ND	ND	ND	ND
9-Sep	*	ND	ND	ND	ND	ND	ND
10-Sep	*	ND	ND	ND	ND	ND	ND
11-Sep	*	ND	ND	ND	ND	ND	ND
12-Sep	*	ND	ND	ND	ND	ND	ND
13-Sep		21:00	7:00	6:25	9:24	0:35	94.2%
14-Sep		20:58	7:07	6:25	9:26	0:42	93.1%
15-Sep		20:54	7:03	6:25	9:30	0:38	93.8%
16-Sep		20:43	7:07	6:25	9:41	0:42	93.3%
17-Sep		20:41	7:17	6:25	9:43	0:52	91.8%
18-Sep		20:37	7:22	6:25	9:47	0:57	91.1%
19-Sep		20:33	7:26	6:25	9:51	1:01	90.6%
20-Sep		20:28	7:27	6:25	9:56	1:02	90.6%
21-Sep		20:30	7:30	6:25	9:54	1:05	90.2%
22-Sep		20:21	7:38	6:25	10:03	1:13	89.2%
23-Sep		20:21	7:33	6:25	10:03	1:08	89.9%
24-Sep		20:18	7:45	6:25	10:06	1:20	88.3%
25-Sep		20:12	7:42	6:25	10:12	1:17	88.8%
26-Sep		20:00	8:02	6:25	10:24	1:37	86.6%
27-Sep		19:40	7:55	6:25	10:44	1:30	87.8%
28-Sep		20:11	7:52	6:25	10:13	1:27	87.6%
29-Sep		20:05	7:47	6:25	10:19	1:22	88.3%
30-Sep		20:02	7:49	6:25	10:22	1:24	88.1%
1-Oct		20:00	7:55	7:40	11:39	0:15	97.9%
2-Oct		19:46	7:58	7:40	11:53	0:18	97.5%
3-Oct		19:50	7:58	7:40	11:49	0:18	97.5%
4-Oct		19:48	8:03	7:40	11:51	0:23	96.9%
5-Oct		19:44	8:00	7:40	11:55	0:20	97.3%
6-Oct		19:40	8:02	7:40	11:59	0:22	97.0%
7-Oct		19:36	8:05	7:40	12:03	0:25	96.7%
8-Oct		19:30	8:11	7:40	12:09	0:31	95.9%
9-Oct		19:28	8:09	7:40	12:11	0:29	96.2%
10-Oct		19:30	8:00	7:40	12:09	0:20	97.3%
11-Oct		19:36	8:08	7:40	12:03	0:28	96.3%
12-Oct		19:30	8:12	7:40	12:09	0:32	95.8%
13-Oct		19:24	8:06	7:40	12:15	0:26	96.6%
14-Oct		19:22	8:14	7:40	12:17	0:34	95.6%
15-Oct		19:20	8:28	7:40	12:19	0:48	93.9%
16-Oct		19:14	8:20	7:40	12:25	0:40	94.9%
17-Oct		19:14	8:18	7:40	12:25	0:38	95.2%

-continued-

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Table 2.–Page 3 of 3.

Date[a]	Dusk (of previous day)	Dawn	Light off	Darkness time surveyed	Darkness time unsurveyed	Percent of night surveyed
18-Oct	19:11	8:24	7:40	12:28	0:44	94.5%
19-Oct	19:12	8:26	7:40	12:27	0:46	94.2%
20-Oct	19:07	8:29	7:40	12:32	0:49	93.9%
21-Oct	19:09	8:30	7:40	12:30	0:50	93.8%
22-Oct	19:00	8:32	7:40	12:39	0:52	93.6%
23-Oct	19:01	8:33	7:40	12:38	0:53	93.5%
24-Oct	18:55	8:33	7:40	12:44	0:53	93.5%
25-Oct	18:58	8:39	7:40	12:41	0:59	92.8%
26-Oct	18:57	8:38	7:40	12:42	0:58	92.9%
27-Oct	18:55	8:43	7:40	12:44	1:03	92.4%
28-Oct	18:52	8:48	7:40	12:47	1:08	91.9%
29-Oct	18:51	8:50	7:40	12:48	1:10	91.7%
30-Oct	18:45	8:59	7:40	12:54	1:19	90.7%
31-Oct	18:40	8:56	7:40	12:59	1:16	91.1%
1-Nov	18:41	9:00	7:40	12:58	1:20	90.7%
2-Nov	18:36	9:00	7:40	13:03	1:20	90.7%
3-Nov	18:33	9:04	7:40	13:06	1:24	90.4%
4-Nov	18:29	9:05	7:40	13:10	1:25	90.3%
					Mean:	87.2%
					Minimum:	72.2%

Note: Coho salmon were present from 27 September–4 November. ND means no data were available for reasons explained in footnote a.

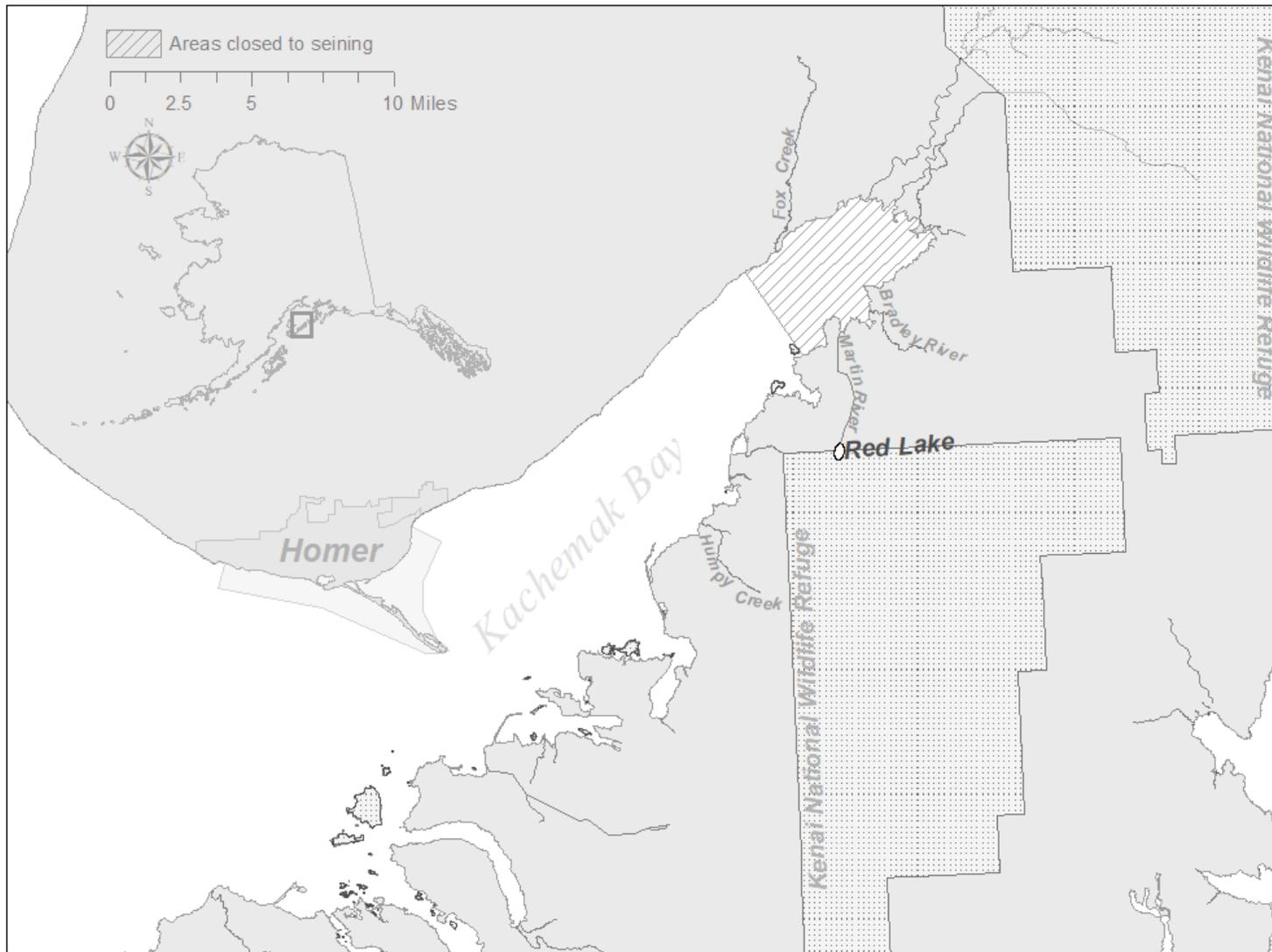[a] Asterisks (*) represents days when no video was recorded due to the hard drive being full.

Figure 1.–Map of the Southern District of Lower Cook Inlet showing location of Martin River and Red Lake.
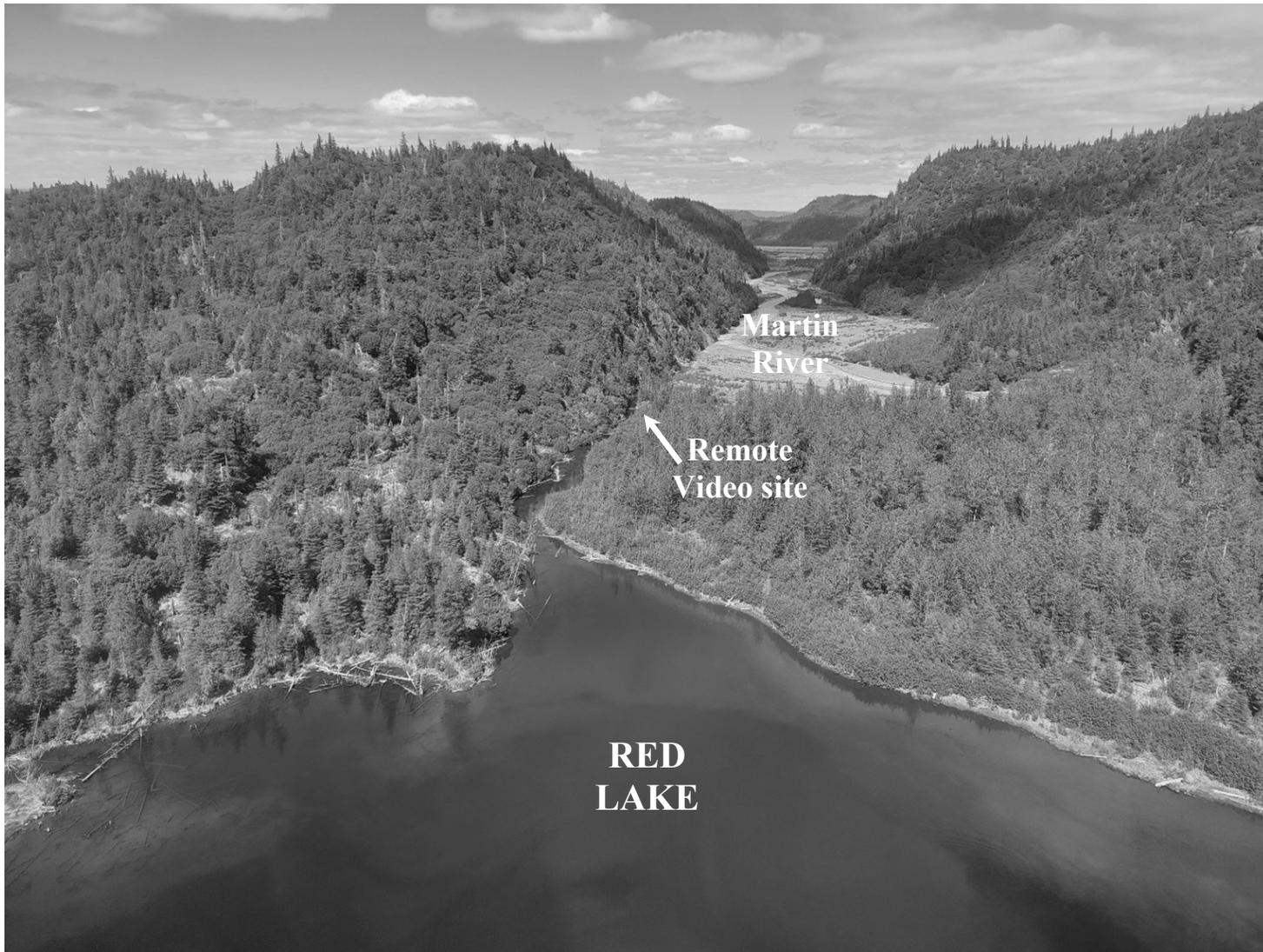
Figure 2.–Photograph illustrating the location of the Red Lake remote video salmon escapement project.

Figure 3.–Photographs of AVCT system at Red Lake showing (A) the tower, camera, and aluminum strongbox, and (B) the solar panels and high contrast substrate panel across the stream bottom to enhance the contrast of fish swimming past the camera.
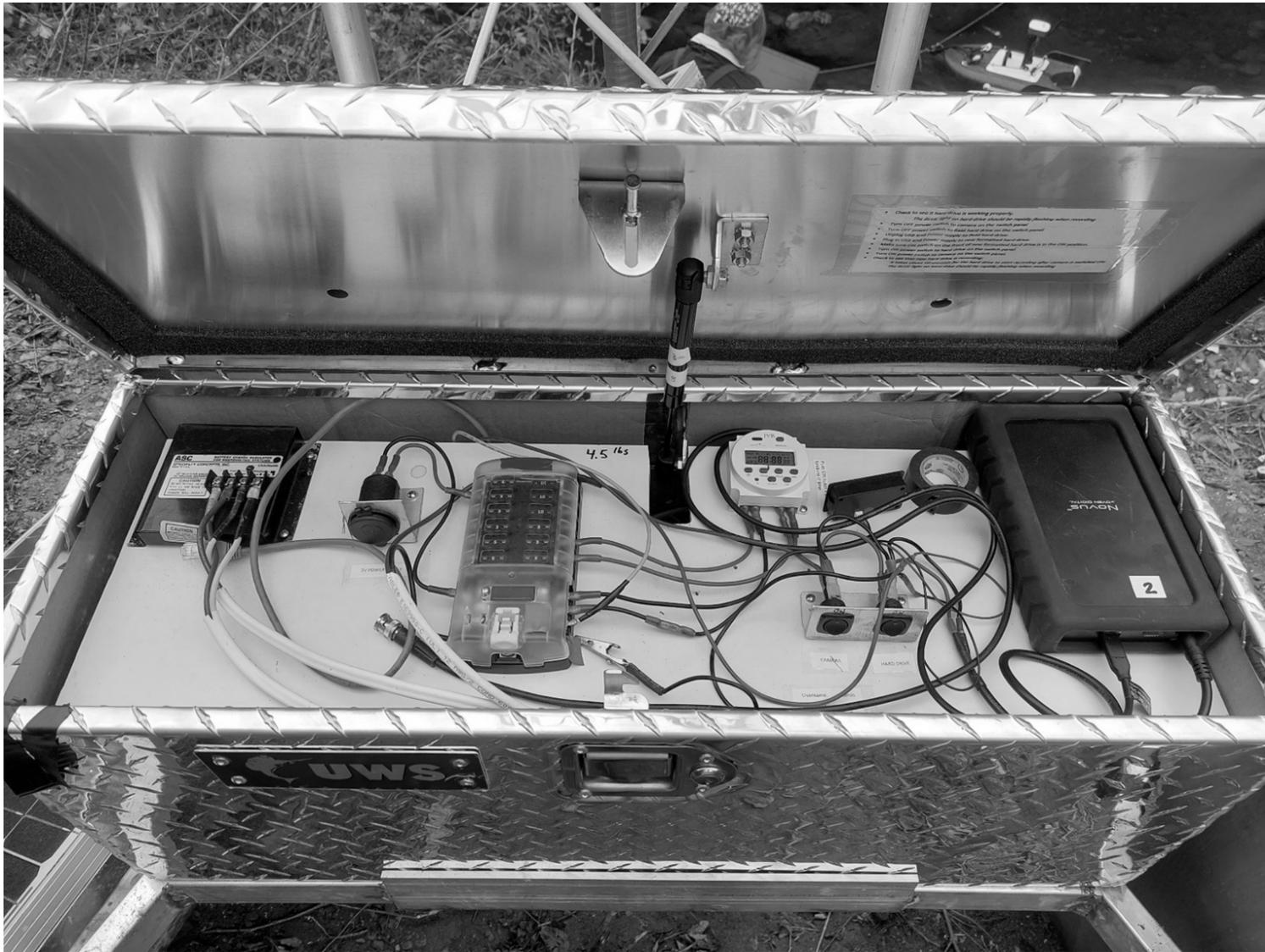
Figure 4.–Photograph illustrating the inside of the aluminum strongbox housing various electronic components and 2 Group 31 12V batteries (underneath the dash panel) that were connected in parallel to make a single 220-amp hour battery bank outputting 12VDC.

Figure 5.–Photograph illustrating the underwater lighting system, including the solar panels, a strongbox containing the battery, solar charging regulator, and other sensitive electronic components.
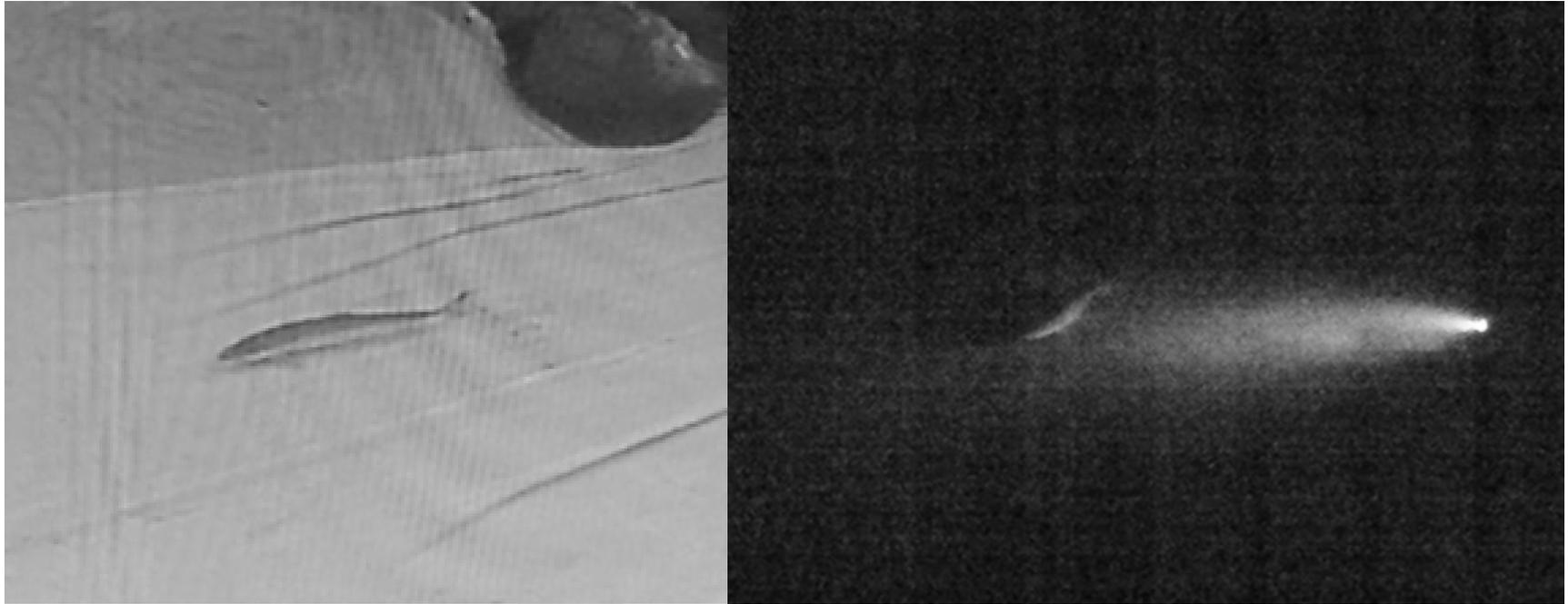
Figure 6.–Screen grab images of adult sockeye salmon migrating upstream, as documented by the AVCT system at Red Lake during hours of daylight (left) and darkness (right).
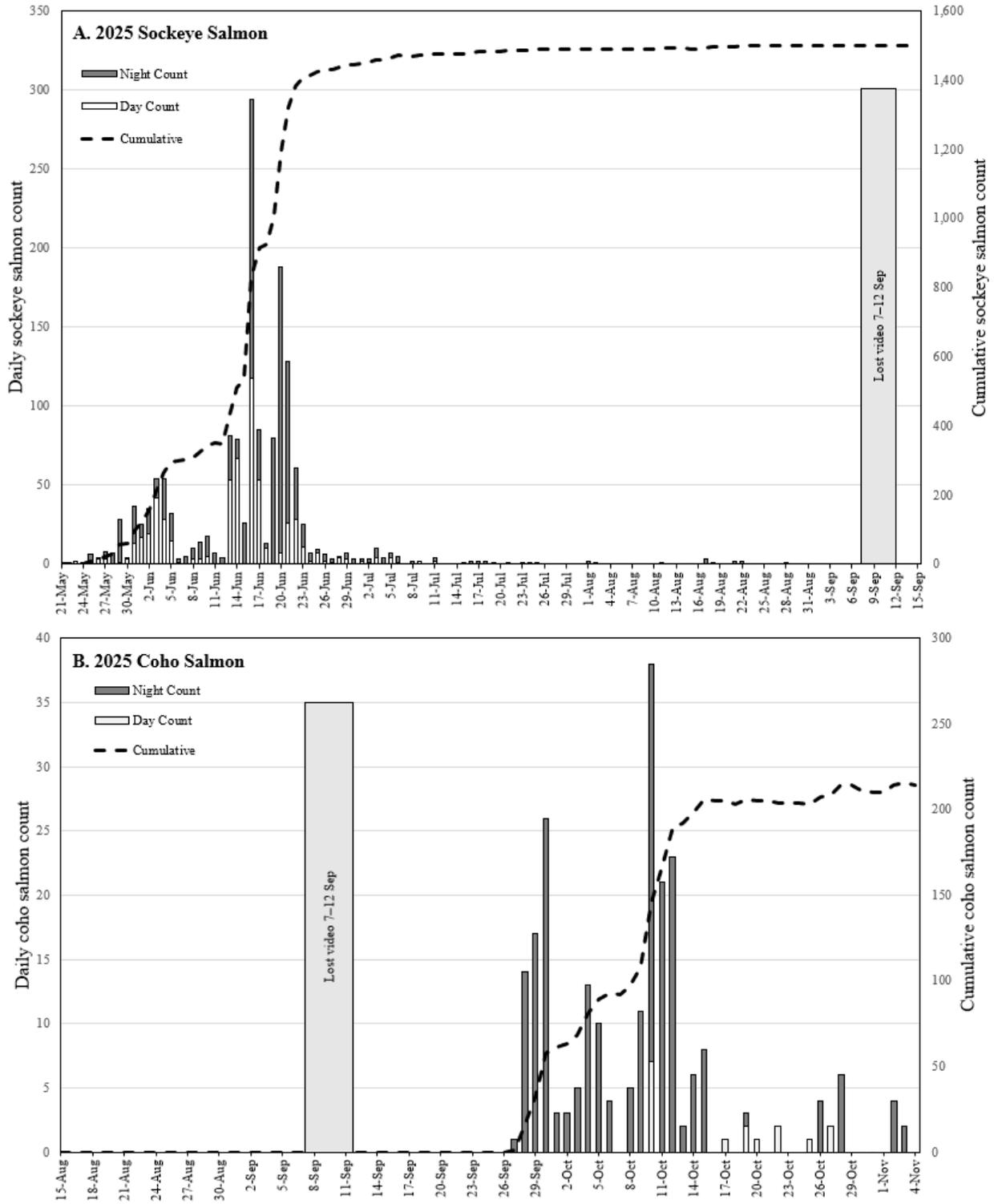
Figure 7.–Chart of daily (day+night) and cumulative sockeye (A) and coho (B) salmon escapement to Red Lake in 2025. Note that underwater lighting was used to facilitate nocturnal counts in 2025.

Note: Dates on the x-axis are not aligned across plots A and B.