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**Mikfik Lake Sockeye Salmon Stock Status and Action  
Plan, 2023**

by  
**Glenn Hollowell**  
and  
**Edward O. Otis**

DRAFT

November 2023

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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

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Division of Sport Fish, Research and Technical Services  
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## ABSTRACT

In response to guidelines established in the *Policy for Management of Sustainable Fisheries* (SSFP), the Alaska Department of Fish and Game (department) recommended that Mikfik Lake sockeye salmon (*Oncorhynchus nerka*) be designated as a “stock of management concern”. A “management concern” is defined as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for salmon stocks within the bounds of the sustainable escapement goal (SEG), biological escapement goal (BEG), optimum escapement goal (OEG), or other specific management objectives for the fishery.” Escapement of sockeye salmon has fallen below the lower end of the existing SEG range for Mikfik Lake in 5 consecutive years (2019–2023). Since 1997 the department has consistently issued emergency order closures of the McNeil River Subdistrict in mid to late June to minimize harvest of chum salmon returning to the neighboring McNeil River and increase escapement of that stock. Given the close proximity of Mikfik Lake to the McNeil River, this action also reduced harvest opportunity for Mikfik sockeye salmon. Since 2014 there have been no sockeye salmon harvested from the McNeil Subdistrict. These management actions have thus far proven insufficient to consistently achieve the SEG for sockeye salmon in Mikfik Lake.

Key words: Mikfik Lake, sockeye salmon, *Oncorhynchus nerka*, stock of concern, commercial, fishing, sustainable salmon fisheries policy, Alaska Board of Fisheries, Lower Cook Inlet, Alaska

## INTRODUCTION

The *Policy for Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (department) to provide the Alaska Board of Fisheries (board) with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation during regularly scheduled board meetings. This action plan provides the department’s assessment of Mikfik Lake sockeye salmon (*Oncorhynchus nerka*) as a stock of management concern, summarizes historical assessments of annual run sizes, and describes the existing regulations and emergency order (EO) authority that the department follows to manage Mikfik Lake sockeye salmon. Options are then presented for potential management actions for the commercial and sport fisheries, and research projects for this sockeye salmon stock.

In September 2023, the department recommended Mikfik Lake sockeye salmon to be classified as a stock of management concern at the board meeting for the Lower Cook Inlet (LCI) in November of 2023<sup>1</sup>. This recommendation was based on guidelines established in the SSFP, which states that a “management concern means a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the sustainable escapement goal (SEG), biological escapement goal (BEG), optimum escapement goal (OEG), or other specific management objectives for the fishery”. Chronic inability is further defined in the SSFP as “the continuing or anticipated inability to meet escapement thresholds over a 4 to 5 year period” based on the generation time of most salmon species. The Mikfik Lake sockeye salmon stock failed to meet its escapement goal during 5 consecutive years (2019–2023).

There are three natural conditions unique to Mikfik Lake and its outlet creek likely contribute to the weak sockeye salmon production status are: 1) physical obstacles (Upper and Lower Mikfik falls) located low in the drainage impede upriver migration; 2) reduced outflow from Mifik Lake during summers of reduced rainfall causing flow in Mikfik Creek to drop below what is needed for sockeye salmon passage, and 3) a high density of brown bears aggregated in lower Mikfik Creek to feed on sockeye salmon made more vulnerable by low water, or the falls. The latter is

very similar to the situation with McNeil River chum salmon at McNeil Falls (Otis and Szarzi 2007, Otis et al. 2016a). Management of this stock is also affected by a special area designation. Mikfik Lake resides within the boundaries of the *McNeil River State Game Sanctuary* (sanctuary) and is bordered on the north by the *McNeil River State Game Refuge* (refuge; Figure 1). The sanctuary and refuge were created by the Alaska Legislature in 1967 and 1991, respectively, for the following purposes (Schempf and Meehan 2008):

1. The permanent protection of brown bear and other fish and wildlife populations for scientific, aesthetic, and educational purposes;
2. To manage human use and activities in a way that is compatible with that purpose and to maintain and enhance unique bear viewing opportunities in the sanctuary;
3. To provide compatible opportunities for wildlife viewing, fisheries enhancement, fishing, temporary safe anchorage, and other activities in both the sanctuary and refuge, and, in the refuge, for hunting and trapping opportunities if compatible with sanctuary management objectives.

Alaska statutes that specifically pertain to the establishment and management of the McNeil River State Game Refuge and Sanctuary are codified as AS 16.20. The refuge statute first became law in 1991 (§ 2 ch 56 SLA 1991), and was amended in 1995 and 1999 (am § 21 ch 21 SLA 1995; am § 2 ch 59 SLA 1999). The sanctuary statutes were first adopted in 1967 (§ 2 ch 108 SLA 1967), and were amended in 1972, 1991, 1995, and 1999 (am § 15 ch 71 SLA 1972; am § 3 and 4 ch 56 SLA 1991; am § 22 ch 21 SLA 1995; am § 3 ch 59 SLA 1999). The department adopted the *McNeil River State Game Refuge and State Game Sanctuary Management Plan* (plan) in 1996 and revised it in 2008 (Schempf and Meehan 2008).

## **STOCK ASSESSMENT BACKGROUND**

Department staff have flown aerial surveys of Mikfik Lake since statehood to index spawning escapement of sockeye salmon. From 1976 to 1997, multiple surveys were flown annually, and the peak count (stream-wide) was used as that year's escapement index (Table 1). In 1998, the department began using time-lapse remote video equipment to assess spawning escapement into Mikfik Lake. The current SEG range (3,400–11,000) was established on this remote video monitoring method (Otis et al. 2013, Otis et al. 2016b).

Until 2014, Mikfik Lake sockeye salmon were periodically harvested by the LCI purse seine commercial salmon fishery. No commercial harvest of sockeye salmon has occurred in the McNeil River Subdistrict since 2014. Minor sport harvest of this stock also occurs but is limited to irregular effort by the relatively few members of the public who receive permits to view bears at the sanctuary.

### **ESCAPEMENT**

The current SEG for Mikfik Lake salmon is 3,400–11,000 fish. This goal was established in 2016 and implemented in 2017 (Otis et al. 2016b). The average Mikfik Lake sockeye salmon escapement from 1998–2023, the period remote video has been used for stock assessment, was 8,500 fish (Table 1; Figure 2). The most recent 10-year average (2014–2023) was 5,730 fish, 27% lower than the recent 20-year average (2014–2023: 7,540) and 32% lower than the average for all



years where remote video was used (1998–2023). Despite no commercial harvest, sockeye salmon escapements to this system in 5 of the past 5 years (2019–2023) were below the SEG, averaging 2,260 fish annually. A trend for weak returns has been present for some time with 9 of the last 14 years (2010–2023) failing to achieve the SEG (Table 1, Figure 2). Although aerial surveys are no longer used to monitor escapement to Mikfik Lake, it is apparent from historical data that Mikfik Lake experienced relatively strong sockeye salmon runs, including large commercial harvests, during the 1980s and early 90s (Table 1).

## ESCAPEMENT GOAL EVALUATION

### ESCAPEMENT GOAL HISTORY

The *Salmon Escapement Goal Policy*, adopted by the department in 1992, established a formal process for setting escapement goals and required publication of the goals (Fried 1994). However, unpublished escapement goals existed for Mikfik Lake sockeye salmon prior to the policy being adopted. A goal of 5,000 sockeye salmon appears to be the first goal used by managers, beginning in 1982 (Fried 1994). The goal transitioned to a range (5,000–7,000) in 1988 when the *Mikfik Creek – McNeil Lagoon Management Plan* was created (Appendix A in Bucher et al. 1993). Methods and rationales for early goals were not well documented (Fried 1994), but the 5,000–7,000 fish goal enacted in 1988 was reportedly based on a subjective assessment of spawning area and commercial harvests resulting from various levels of escapement (Bucher et al. 1993; Fried 1994). In 2001, a new method based on select percentiles (15<sup>th</sup>–85<sup>th</sup>) of observed escapements to Mikfik Lake was adopted and the SEG range was increased to 6,300–12,150 (Otis 2001). All the Mikfik Lake sockeye salmon escapement goals to this point were based on aerial survey data. Once a long enough time series of remote video-based escapement data were available (1998–2013), the goal was re-calibrated to this monitoring method and the SEG range became 3,400–13,000 fish in 2014 (Otis et al. 2013). Following an evaluation and revision of the percentile approach used for establishing sustainable escapement goals (Clark et al. 2014), the Mikfik Lake sockeye salmon SEG was again revised to an SEG range of 3,400–11,000 in 2017 (Otis et al. 2016b). The escapement goal history for Mikfik Lake sockeye salmon is summarized in Table 1 and Figure 2.

### SPAWNER DATA AND SEG ANALYSIS

During 2000 and 2001, the board adopted two policies that established definitions and guidelines governing the establishment and use of escapement goals: 5 AAC 39.222. *Policy for the Management of Sustainable Salmon Fisheries* (SSFP) and 5 AAC 39.223. *Policy for Statewide Salmon Escapement Goals* (PSSEG). Two key terms defined in section (f)(3) of the SSFP are:

*biological escapement goal (BEG)*: the escapement that provides the greatest potential for maximum sustained yield (MSY), and

*sustainable escapement goal (SEG)*: a level of escapement, indicated by an index or escapement estimate, that is known to provide for sustained yield over a 5- to 10-year period, used in situations where a BEG cannot be estimated or managed for.

The SEG was intended for use in situations where the department lacks sufficient data to use spawner-recruit analyses (e.g., Ricker 1975) to estimate MSY and set a BEG. SEGs are also more appropriate for stocks monitored by methods that produce a relative abundance index with no quantifiable measurement error (e.g., aerial and/or ground survey) rather than an absolute

abundance estimate (e.g., weir count, sonar count, mark-recapture), because the lack of accurate and precise measures of spawner abundance can have a profound effect on assessing stock-recruit relationships and lead to over-exploitation (Walters and Ludwig 1981).

Adoption of the SSFP and PSSEG necessitated the development of a formal approach for estimating SEG ranges for data-limited stocks. In 2001, the department's Salmon Escapement Goal Interdivisional Review Team (team) developed a method that came to be known as the Percentile Approach. The basis of this approach was a relatively simple algorithm that uses a stock's escapement contrast and estimated exploitation rate to determine which of 4 tiers of percentiles should be used to develop the SEG for that stock based on observed escapements that have been shown to be sustainable (Bue and Hasbrouck<sup>2</sup>). The Percentile Approach was used to develop and/or revise SEGs for all LCI chum (*O. keta*), pink (*O. gorbuscha*) and sockeye salmon stocks in LCI from 2001 through 2013 (Otis 2001, Otis and Hasbrouck 2004, Otis and Szarzi 2007, Otis et al. 2013). The revised percentile approach, with its 3 tiers of adjusted percentiles based on a comprehensive evaluation of over 60 salmon stocks in Alaska (Clark et al. 2014), was used to develop the current Mikfik Lake sockeye salmon SEG range of 3,400–11,000 fish based on the 15th and 65th percentiles of observed escapements from 1998–2015 (Otis et al. 2016b). This was the range of years where remote video-based escapement data were available to calculate an SEG range that's calibrated to the current monitoring method.

## **ESCAPEMENT GOAL RECOMMENDATION**

The department reviewed the Mikfik Lake sockeye salmon escapement goal in 2023 and recommended no change at that time (Otis et al. 2023).

## **STOCK OF CONCERN RECOMMENDATION**

Escapement of Mikfik Lake sockeye salmon has fallen below the lower end of the SEG range for 5 consecutive years (2019–2023). Since 1997, the department has consistently issued EO closures of the McNeil River Subdistrict in mid to late June to avoid harvest of McNeil River chum salmon and increase escapement of that stock. Given the close proximity of Mikfik Lake to the McNeil River, this action also reduced harvest opportunity on Mikfik sockeye salmon. Since 2014 there have been no sockeye salmon harvested from the McNeil Subdistrict. In spite of this in recent years, the SEG has not been consistently achieved for sockeye salmon in Mikfik Lake (Table 2). Therefore, in September 2023, the department recommended Mikfik Lake sockeye salmon be classified as a stock of management concern at the November 2023 LCI board meeting.

## **OUTLOOK**

The department does not develop a formal preseason forecast for Mikfik Lake sockeye salmon. However, based on parent year run strength and recent escapements, the 2023 run was considered to have a relatively low chance of achieving the SEG. Most sockeye salmon returning to Mikfik Lake are 4 (29%) and 5 (62%) years old so the parent years contributing most to the 2023 return are 2018 and 2019. The escapement index in 2018 was relatively strong (4,966), but the index was weak (2,901) in 2019. Four-year-olds from the 2018 brood year returned to Mikfik Lake in 2022,

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<sup>2</sup> Bue, B. G. and J. J. Hasbrouck. *Unpublished*. Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Board of Fisheries, November 2001 (and February 2002), Anchorage.

a year with fair escapement (2,870), but not enough to meet the low end of the SEG. Thus, it was considered likely that 2023 would continue the recent trend of Mikfik Lake sockeye salmon escapement falling short of the goal. However, the preliminary 2023 Mikfik Lake sockeye salmon escapement index of 2,917 fish did not achieve the minimum SEG value of 3,400 fish (Table 1).

## HABITAT ASSESSMENT

Mikfik Lake is a remote, pristine watershed on the west side of Lower Cook Inlet. The drainage falls within the boundaries of the McNeil River State Game Sanctuary, a designation that affords additional regulatory protections to fish and wildlife resources in the area (Schempf and Meehan 2008). Land development activities negatively affecting fish habitat in the McNeil River drainage have been virtually non-existent and there are no known upcoming development projects that would have significant negative habitat impacts on this watershed.

A formal assessment of fish habitat at Mikfik Lake and its outlet creek has not been conducted to date, likely due to the lack of any development or habitat destruction in the drainage that would negatively impact fish. However, it appears some pre-statehood efforts were made by US Bureau of Fisheries staff to improve sockeye migration up Mikfik Creek by modifying the upper falls in 1932:

*“Stream Improvement: Fishway blasted out of solid conglomerate rock (Upper Falls in McNeil Creek). Cut made in rock 3.5 feet wide averaging 30 inches deep by 15 feet in length, with drop about 20 percent. Reds passed to the spawning grounds of the lake situated about 3 miles from the mouth of the stream.”<sup>2</sup>*

Although their notes reference “McNeil Creek”, it is clear from their description of the stream elsewhere in the report, and their reference to sockeye salmon ascending to the lake 3 miles upstream, that their modifications were made to what is today known as Mikfik Creek. McNeil River does not have a sockeye salmon stock and there isn’t a lake 3 miles up McNeil River. Mikfik Lake is 3 miles upstream from the mouth of Mikfik Creek, where it flows into McNeil Lagoon (Figures 3 and 4).

Since statehood, department staff have periodically breached beaver dams in Mikfik Creek that would otherwise have completely blocked passage of adult sockeye salmon back to spawning areas in and around Mikfik Lake. These are the only habitat alterations known to exist for the Mikfik Lake drainage, all of which have improved fish habitat, not degraded it. But despite the pre-statehood modifications, the upper and lower falls at Mikfik Creek still represent difficult obstacles for the upstream migration of sockeye salmon, making them relatively easy prey for the high density of brown bears that annually frequent the area. Additionally, in years of reduced precipitation in the Kamishak Bay area, waterflow in Mikfik Creek has diminished to the point of impeding salmon passage. This can occur either as a result of water temperature and oxygen levels negatively impacting the fish’s ability to swim upstream, the creek completely drying up, or diminishing to the point where they become easy prey for bears, eagles and other predators (Figure 5).

# FISHERIES MANAGEMENT OVERVIEW AND BACKGROUND

## COMMERCIAL FISHERIES

The *Lower Cook Inlet Seine Fishery Management Plan* (5 AAC 21.369) directs the department to manage the commercial fishery seine fleet to target LCI salmon stocks. Fishery management strategy is to use narrowly focused time and area openings to target harvest on discrete stocks relatively close to the mouths of rivers and streams. Harvest of Mikfik Lake sockeye salmon occurs primarily in the McNeil River Subdistrict (249-50) in Kamishak Bay District (Figure 1). The average annual sockeye salmon commercial harvest in this subdistrict from 1976–2014 was 9,600 fish. The commercial fishery targeting the Mikfik Lake stock has been closed since 2014 by EO and no commercial harvest from McNeil River Subdistrict has occurred (Table 2). Illegal harvest and/or interception of Mikfik Lake sockeye salmon outside the subdistrict are not considered to be significant factors affecting the status of this stock.

Commercial harvest of sockeye salmon bound for the McNeil River occurs primarily in the McNeil River Subdistrict (249-50) but may also occur in the Kamishak (249-45) and Douglas River (249-40) subdistricts to the south, and the Paint River Subdistrict (249-52) to the north (Figure 3). The current regulatory management plan specifically relevant to commercial salmon fishing in the McNeil River Subdistrict is the *Mikfik Creek – McNeil Lagoon Salmon Fishery Management Plan* approved by the Commissioner in 1988 (Bucher et al. 1993).

The Kamishak District commercial seine fishing season is open from June 1 until closed by EO (5 AAC 21.310(5)). Individual subdistricts within the district are opened and closed by EO based on inseason harvest and escapement information. Prior to 1989, McNeil River was a popular chum salmon commercial fishery in Kamishak District, likely contributing to the larger sockeye salmon harvests from this district during the 1980s. From 1976–2023, the commercial harvest of sockeye salmon from the McNeil River Subdistrict ranged from 0–66,800, with an average harvest of 4,606 fish (Table 1). However, since the year 2000, there have only been 3 years with commercial harvests of sockeye salmon (2001, 2006, 2014; Table 1).

### Regulatory History for McNeil River and Mikfik Lake Fisheries

The *Mikfik Creek – McNeil Lagoon Salmon Fishery Management Plan* (Mikfik Plan) was approved by the department Commissioner in 1988 and the *McNeil River Chum Salmon Fishery Management Plan* (McNeil Plan) was subsequently adopted in 1993 (Bucher et al. 1993). Both plans formally recognized the need to provide adequate fish for consumption by bears while also attempting to provide opportunity for commercial fisherman to harvest fish that were surplus to the escapement goals for Mikfik Lake sockeye and McNeil River chum salmon. The Mikfik Plan states:

“Management of the sockeye salmon return to Mikfik Creek will be carried out to allow adequate escapement and to provide fish for bear consumption throughout the course of the run. In an attempt to fully utilize this run, commercial fisherman will have the opportunity to harvest large surpluses of sockeye occurring in the lagoon.”

Similarly, the stated goal of the McNeil Plan is to:

“...maintain a healthy chum salmon population returning to McNeil River in sufficient numbers to provide fish for bear consumption within the sanctuary as well as providing

for the established commercial purse seine fishery in Lower Cook Inlet. Simply put, the goal of this plan is to manage the chum salmon runs to McNeil River for maximum sustained yield.”

To minimize potentially negative interactions between commercial fishing operations, bears, and the bear viewing program at the sanctuary, the Mikfik Plan provides the following guidelines for managing the commercial fishery targeting the Mikfik Lake sockeye run:

The commercial fishery will take place outside the lagoon to the maximum extent possible. Fishing outside the lagoon will be carried out as follows:

- (a) Standard fishing periods (two 48-hour periods per week) will begin June 1;
- (b) Fishing time will be adjusted by EO depending on the run strength and escapement into Mikfik Lake;
- (c) The inside marker defining the boundary for legal fishing will be located at the end of the spit;
- (d) Vessels will be allowed to anchor inside the spit as in the past.

If the run is large enough to exceed the escapement goal and a significant surplus of fish is confirmed inside McNeil Lagoon, the lagoon may be opened to commercial fishing under the following guidelines:

- (a) Openings in the lagoon will occur for a 2-hour period starting 1 hour before high tide and ending 1 hour after high tide;
- (b) Nets must be fished from the boat and may not be fished from the beach;
- (c) Fisherman will remain in their boats as much as possible while fishing.

These provisions of the plan are intended to reduce the potential for boats and nets containing fish going dry and getting stranded in the lagoon when the tide goes out, making them accessible to bears.

### **Past Commercial Fisheries Management Actions**

While the Mikfik and McNeil Plans provide general guidance for management of the commercial fisheries targeting these stocks, inseason management actions are implemented through EOs. In accordance with the Mikfik Plan, commercial fishing typically opened in the McNeil Subdistrict to around June 1 to target early returning Mikfik Lake sockeye salmon outside McNeil Lagoon. However, when necessary to protect the McNeil River chum or Mikfik Lake sockeye stocks when runs were weak, the McNeil and Paint River subdistricts were closed to fishing at the appropriate time, depending on which stock was being protected (Table 2). In some years, the area the McNeil River Subdistrict was not specifically closed due to knowledge that the seine fleet did not plan on fishing that area.

### **SPORT FISHERIES**

The Alaska Statewide Sport Fish Harvest Survey (SWHS) is designed to estimate sport fishing effort and harvest by location (e.g., Romberg 2015). There have been no SWHS reports of effort in Mikfik Creek or Mikfik Lake since 1999. Due to these low number of respondents, the SWHS cannot provide accurate, reasonably precise estimates of the sport harvest on the Mikfik Lake sockeye salmon stock.

Based on personal observations of Sanctuary staff, sport fishing effort at McNeil River/Mikfik Lake is very low, in part due to remoteness of the area. Only 10 visitors per day receive permits to view bears at the sanctuary and 3 department staff are assigned to the McNeil Camp. Sanctuary staff estimated that the total sport harvest by staff and visitors in 2013 was 5 sockeye salmon and 1 chum salmon (Griffin and Weiss 2014). This inconsequential sport harvest appears representative of recent years (personal communication with B. Rosenberg, McNeil River State Game Sanctuary manager, August 2023).

### **Regulatory History for McNeil River/Mikfik Lake Sport Fishery**

The general regulations for sport fishing in the West Cook Inlet area apply to McNeil River and Mikfik Creek. In this area, anglers are allowed to harvest 3 sockeye salmon 16 inches or longer per day, with no more than 6 in possession. However, in the interest of visitor safety, sanctuary staff request that sport fishing activities be confined to an area directly in front of camp along the spit that separates McNeil Lagoon from McNeil Cove and that the only fish retained are those that can be consumed that day (Figure 4).

### **Past Sport Fisheries Management Actions**

There are no recent management actions affecting the McNeil River sport fishery. However, the commissioner may, by EO, change bag and possession limits and annual limits, and alter methods and means in sport fisheries (5 AAC 75.003).

### **SUBSISTENCE AND PERSONAL USE FISHERIES**

Mikfik Lake lies within the State of Alaska Joint Board of Fisheries and Game's Anchorage-Matsu-Kenai Peninsula Nonsubsistence Area; therefore, Mikfik Lake sockeye salmon are not targeted in any state subsistence fisheries. Furthermore, although Katmai National Park and Preserve is located in the vicinity of McNeil River, subsistence fishing is prohibited by federal regulation in all waters of the park. There are no personal use fisheries in the area.

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

### **ACTION PLAN GOAL**

To rebuild and maintain the Mikfik Lake sockeye salmon run to levels that consistently achieve the SEG range.

### **Action Plan Alternatives**

Most of the potential management actions listed below are allocative and do not necessarily reflect endorsement by the department. Alternatives include options that may not be practical but are intended to be a comprehensive and objective list of actions that should lead to rebuilding sockeye salmon to levels that consistently meet the Mikfik Lake sockeye salmon SEG.

#### ***Action #1–Commercial Fisheries***

#### **Objective: Reduce harvest of Mikfik Lake sockeye salmon.**

Because sport harvest of Mikfik Lake sockeye salmon appears inconsequential, even during years of high abundance, the following options focus on restricting commercial harvest. However, the Department can exercise EO authority to close the inriver sport fishery if deemed necessary.

**Option A.–Status Quo. Department will continue to use EO authority to manage Mikfik Lake sockeye salmon run**

Until recently, past commercial fishing EO management actions have focused on closing the McNeil River (249-50) and Paint River (249-52) subdistricts specifically during the McNeil River chum salmon run.

**Specific Action to Implement the Objective:** Department would continue to use its EO authority to close the McNeil River (249-50) and Paint River (249-52) subdistricts during the Mikfik Lake sockeye salmon run beginning June 1.

**Benefits:** Allowing the department to continue to use its EO authority to manage the Mikfik Lake sockeye salmon run provides flexibility the department needs to meet escapement objectives and respond to changes in productivity in the future. Continuing to reduce harvest will maximize spawning escapement and help aid recovery.

**Detriments:** The department will continue to issue EOs to close commercial fisheries in the McNeil River and Paint River Districts during the Mikfik Lake sockeye salmon run. This may preclude seine permit-holders from having reasonable opportunity to harvest surplus sockeye salmon. Because commercial harvest is not currently a factor limiting escapement at Mikfik Lake, this action may not be a long-term solution to stock/escapement recovery.

**Option B.–Close McNeil River and/or Paint River subdistricts by regulation**

**Specific Action to Implement the Objective:** The board takes regulatory action to close the McNeil River (249-50) and/or Paint River (249-52) subdistricts during the Mikfik Lake sockeye salmon run.

**Benefits:** The department would not have to use its EO authority annually to manage Mikfik Lake sockeye salmon . Reducing harvest would allow more Mikfik Lake sockeye salmon to enter the river and help aid recovery.

**Detriments:** This may reduce the ability to respond to changes in productivity in the future between regular Lower Cook Inlet Board meetings. This may preclude seine permit-holders from having reasonable opportunity to harvest surplus sockeye salmon. Because commercial harvest is not currently a factor in limiting escapement at Mikfik Lake, this action may not be a long-term solution to stock/escapement recovery.

**Option C.–Close specific fishing areas during the Mikfik Lake sockeye salmon run**

Past commercial fishing EO management actions have focused on closing the McNeil River (249-50) and Paint River (249-52) subdistricts during the Mikfik Lake sockeye salmon run. However, other subdistricts may also harvest sockeye salmon bound for Mikfik Lake (e.g., Kamishak [249-45] and Douglas River [249-40] subdistricts to the south).

**Specific Action to Implement the Objective:** Take board or EO action to further reduce areas open to commercial salmon fishing in Kamishak District during the Mikfik Lake sockeye salmon run, June 1 to August 6 (e.g., Kamishak [249-45] and Douglas River [249-40] subdistricts to the south).

**Benefits:** Reducing the areas open to commercial fishing in Kamishak District during the Mikfik Lake sockeye salmon run may increase sockeye salmon escapements to Mikfik Lake by an unknown amount.

**Detriments:** Commercially exploitable sockeye salmon stocks exist in the Douglas and Kamishak rivers. Closing the Douglas and Kamishak subdistricts to commercial harvest during the Mikfik Lake sockeye salmon run will preclude seine permit-holders from having reasonable opportunity to harvest surplus sockeye (and chum) salmon returning to the Douglas and Kamishak rivers. Because commercial harvest is a small factor in limiting escapement at Mikfik Lake, this action may not be a long-term solution to stock/escapement recovery.

**Option D.–Close All commercial fishing in Kamishak District during the Mikfik Lake sockeye salmon run**

The entire Kamishak District would be closed during the Mikfik Lake sockeye salmon run from June 1 until August 6.

**Specific Action to Implement the Objective:** Take board or EO action to close commercial fishing in the Kamishak District from June 1 until August 6.

**Benefits:** Closing commercial fishing in Kamishak District from June 1 until August 6 may increase sockeye salmon escapements to Mikfik Lake by an unknown amount.

**Detriments:** Several commercially exploitable chum and sockeye salmon stocks exist in Kamishak District with run timing that overlaps with Mikfik Lake sockeye salmon. Closing the Kamishak District to commercial harvest from June 1 until August 6 may limit the department's ability to manage these stocks to not exceed their respective escapement goals. In addition, it would likely preclude seine permit-holders from having reasonable opportunity to harvest surplus chum and sockeye salmon returning to Kamishak District streams. Because commercial harvest is not currently factor in limiting escapement at Mikfik Lake, this action may not be a long-term solution to stock/escapement recovery.

***Action #2–Habitat Modifications***

**Objective: Increase sockeye salmon escapement in Mikfik Lake through habitat modification.**

**Option A.–Modify sections of the Mikfik Creek channel to facilitate easier upstream migration.**

The lower and upper falls on Mikfik Creek represent significant physical obstacles to the upstream migration of sockeye salmon and likely contributes to the limited use of high-quality spawning habitat available above the falls. The falls on Mikfik Creek were modified in the 1930s with sections of rock removed to increase fish passage.

**Specific Action to Implement the Objective:** Seek required permits (e.g., Fish Habitat Permit, ADF&G Special Area Permit, US Army Corps of Engineers permit) to modify select sections of Mikfik Creek in a manner that provides easier upstream migration by sockeye salmon.

**Benefits:** Modifying The Mikfik Creek channel may increase sockeye salmon escapements Mikfik Lake during years of increased brown bear density in this area as well as in years of decreased water flow when fish are more exposed due to reduced water levels.

**Detriments:** Modifying the Mikfik Creek channel may make it more difficult for bears to successfully prey on sockeye salmon, potentially leading bears to forage elsewhere, which could



negatively impact the bear viewing program at McNeil River. This may also lead to increased predation during the early portion of the McNeil River chum salmon return.

**Option B.–Manage the abundance of brown bears in the area of Mikfik Creek.**

The regular presence of brown bears during the Mikfik Lake sockeye salmon return may be limiting fish production through predation of pre-spawning fish and impeding upstream migration to Mikfik Lake.

**Specific Action to Implement the Objective:** Seek permission from the Alaska State Legislature, the Board of Game, and the department’s Division of Wildlife Conservation to manage the number of brown bears in the Mikfik Creek area through hazing or other action.

**Benefits:** Managing the abundance of brown bears at Mikfik Creek may increase the number of sockeye salmon spawning in Mikfik Lake, potentially increasing natural production and future escapement levels.

**Detriments:** Managing the abundance of brown bears in the Mikfik Creek and McNeil Falls area contradicts the purpose of the legislation designating the sanctuary and may directly impact the quality of the associated bear viewing program run by the department. In addition, if predation by bears and hindering of migration to Mikfik Lake are not major factors limiting sockeye salmon production at Mikfik Lake, this action may not be a long-term solution.

*Action #3–Natural Recovery*

**Objective: Allow the Mikfik Lake sockeye salmon stock to recover naturally.**

**Background:** Since 1985, Mikfik Lake has had a number of years where large numbers of sockeye salmon were documented in Mikfik Lake followed by several years of reduced escapement to this lake (see Hollowell et al 2022).

**Option A.–No action.**

No action is needed to mitigate the effects of brown bear predation on sockeye salmon migrating in Mikfik Creek, or the effects of reduced water flow in this system. This option would likely result in periods of higher sockeye salmon runs during eras where waterflow is adequate, followed by periods of diminished escapements when decreased precipitation makes transiting the creek in presence of brown bears more challenging.

**Specific Action to Implement the Objective:** No action.

**Benefits:** Allowing Mikfik Lake sockeye salmon to fluctuate naturally is consistent with the statutory goals associated with the designations of the McNeil River sanctuary and refuge.

**Detriments:** Allowing Mikfik Lake sockeye salmon to fluctuate naturally would likely result in periods of low sockeye salmon productivity where the current escapement goal will not be met.

## **CONDITIONS FOR DELISTING A STOCK OF CONCERN**

The *Policy for the Management of Sustainable Salmon Fisheries* defines “management concern” as “a concern arising from a chronic inability, despite the use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, OEG, or other specified management objectives for the fishery.”

The stock of management concern for this stock is based on failure to achieve the SEG established by the department. Recommendations for delisting Mikfik Lake sockeye salmon as a stock of management concern will be based on the ability to achieve the SEG.

1. Delisting - If the lower bound of the SEG is met or exceeded in three consecutive years and is expected to be met in the future years or is met in three out of five consecutive years and is expected to be met in future years, the department will recommend removing Mikfik Lake sockeye salmon as a stock of management concern at the first Lower Cook Inlet board meeting after this condition is met.
2. Management Restrictions - Management restrictions may be relaxed if inseason assessment of sockeye salmon abundance indicates restrictions are no longer needed to ensure the escapement goal is met. This may only occur if both SOC stocks, Mikfik Lake sockeye salmon and McNiel River chum salmon, escapement goals are projected to be met.

Stock status, action plan performance (including information on harvest rate, distribution, and timing in fisheries), and the results of the escapement goal review will be updated in a report to the board at the next Lower Cook Inlet BOF meeting.

## **2023 ALASKA BOARD OF FISHERIES REGULATORY PROPOSALS AFFECTING MIKFIK LAKE**

There are two proposals before the board that affect Mikfik Lake sockeye salmon. Proposal HQ-F23-350 would define waters closed to commercial salmon fishing in the vicinity of McNeil Lagoon. Proposal 117 would create the Kamishak Bay Purse Seine Fishery Management Plan that would structure broad guidelines affecting hatchery releases as well as wild stock management in this area.

### **RESEARCH PLAN**

To date there has been considerable research and monitoring directed at better understanding various aspects of sockeye salmon life history and productivity in Mikfik Lake. A comprehensive list of past, current, and desired future research is provided below.

### **PAST RESEARCH PROJECTS**

The following research and monitoring projects have been conducted to gather fisheries-related information on Mikfik Lake sockeye salmon:

1. AWL Sampling (1975–1999): Periodic sampling to characterize the age, sex, and size composition of the escapement and/or commercial harvest of Mikfik Lake sockeye salmon. Mikfik Lake sockeye salmon range in age from 3 (0.2%) to 7 (0.1%), with age 5 (61.9%) consistently predominating, followed by age 4 (29.0%) and age 6 (8.9%). Mikfik sockeye salmon typically rear for 1 (75.1%) or 2 (24.8%) years in Mikfik Lake before beginning the ocean phase of their life history (ADF&G, unpublished sample data, 5,809 fish collected over 17 years during 1972–2006).

2. Aerial Surveys (1959–1997): Periodic aerial surveys to estimate sockeye salmon run timing, spawning distribution, and escapement (Otis and Hollowell 2022). The entire drainage was flown from tidewater up to Mikfik Lake (Figure 4), typically from late May through August. The peak count was used as an index of that year’s escapement, however, bears prey on salmon in Mikfik Creek, many of which were counted during aerial surveys. The number of pre-spawning sockeye salmon killed by bears on Mikfik Creek is not known, however, a radio telemetry project conducted by the department on chum salmon in McNeil River estimated 59% of the chums below McNeil Falls were killed prior to spawning (Peirce et al. 2013). Aerial survey-based escapement indices for sockeye salmon in Mikfik Creek are provided in Table 1 of this report, and in department annual management reports (e.g., Bucher et al. 1998, Appendix 23).
3. Baseline Genetic Sampling (2014): Collected tissue samples from 235 adult sockeye salmon immediately below Mikfik Lake to contribute to the genetic baseline for Cook Inlet fish stocks. Once processed, these data will be available for such purposes as determining stock composition of mixed stock commercial harvests (tissues samples archived at the ADF&G Gene Conservation Lab; unpublished sample data on file with Lower Cook Inlet Research Group, contact Ted Otis, ADF&G Division of Commercial Fisheries, Homer).

## **CURRENT RESEARCH PROJECTS**

1. Remote Video Monitoring (1998–present): Using video cameras and time-lapse recording technology to assess sockeye salmon escapement into Mikfik Lake since 1998 (Otis 2023; Figures 4 and 6). This method provides a better assessment of true spawning escapement because it occurs above the point where in-river predation by bears occurs. However, it is not a complete census of escapement because limited solar/wind power precludes the use of auxiliary lights to monitor nocturnal migration. Video-based escapement indices for sockeye salmon in Mikfik Lake are provided in Table 1 of this report, and in department annual management reports (e.g., Hollowell et al. 2022, Appendix D4, D5, D6).
2. Water Level and Water Temperature Monitoring (2009–present): Using remote data loggers to record hourly water pressure (proxy for water depth) and water temperature data at the outlet of Mikfik Lake. This baseline monitoring produces a time series of annual water level and temperature conditions at Mikfik Lake that can be used to evaluate their respective relationships to run timing and future returns. For example, persistent low water and/or high temperatures may impede migration to the lake and/or reduce spawning success. Heat stress has been shown to impact spawning success of Pacific salmon and can even result in early mortality (von Biela et al. 2020). Water level and temperature data for Mikfik Lake are unpublished data on file with Lower Cook Inlet Research Group, contact Ted Otis, ADF&G Division of Commercial Fisheries, Homer.
3. Bear Abundance in the Sanctuary (1976–present): Since 1976, McNeil staff has tallied the number of individually recognizable bears (adults, sub-adults, cubs) observed in the sanctuary by staff over the course of the season. These values are used as a measure of bear use and bear viewing quality in the sanctuary. Since 1976, this count has ranged from a low of 58 in 1976 and 1979 to a high of 144 in 1997. The most recent published count was 115 bears in 2020 (Griffin et al. 2020).
4. Bear Abundance at Mikfik Creek (1993–present): Since 1993, McNeil staff has used a second method to assess bear use and bear viewing quality in the sanctuary- bear use days, or the sum

of individual bears (including cubs) observed daily throughout the season (June-August). This index is used to monitor trends in bear use and the quality of the bear viewing experience at each of four primary bear viewing areas in the sanctuary (e.g., McNeil Falls, Lower McNeil River, Mikfik Creek, and “other areas”). Since 1993, the Mikfik Creek bear use day index has ranged from a low of 113 in 2016 to a high of 780 in 2007. The most recent published count was 338 in 2020 (Griffin et al. 2020)..

## DESIRED FUTURE RESEARCH PROJECTS

1. Improved Escapement Monitoring: Remote video/time-lapse recording is an effective method for acquiring run timing and robust relative abundance indices, but it does not provide accurate, precise absolute abundance estimates if auxiliary lights aren’t used to monitor nocturnal migration. To census the entire spawning escapement into Mikfik Lake, department staff would like to begin using underwater lights with low-wattage LED bulbs to illuminate fish migrating at night. Staff experimented successfully with underwater lights at nearby Chenik Creek in 2023 and plans to do the same on Mikfik Lake in 2024 if funding for additional equipment is identified (e.g., lights, batteries, solar panels, charge controller).
2. Predation Study: Since 2011, department staff have used remote video to monitor bear predation on pre-spawning chum salmon at McNeil Falls. During 2011–2015, we estimated bears killed an average of 10,518 chum salmon per year (range: 6,663–16,494), which equates to 59% of the average annual escapement index (range: 52%–84%; unpublished data on file with Lower Cook Inlet Research Group, contact Ted Otis, ADF&G Division of Commercial Fisheries, Homer). It would be more challenging to implement a similar project at Mikfik Creek due to the need to monitor 3 major predation areas (the upper and lower falls and the intertidal riffle area). However, knowing how many pre-spawning sockeye salmon are killed by bears below Mikfik Lake, and particularly at the upper and lower falls, may help determine if further modification of the falls could result in more fish escaping predation to successfully reach Mikfik Lake to spawn.
3. Limnology Study: Mapping the bathymetry of Mikfik Lake and conducting a limnology study to better understand primary and secondary production could help determine how many sockeye salmon fry the lake is capable of rearing annually. This information, along with a robust spawner-recruit analysis, could ensure that the Mikfik Lake sockeye salmon SEG range is set appropriately.

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**TABLES AND FIGURES**

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Table 1.—Annual escapement index, method used, commercial harvest, and total run of sockeye salmon to Mikfik Lake, relative to the escapement goal in place at the time, 1976–2023.

Year	Esc. index <sup>1</sup>	Method <sup>2</sup>	Esc. goal range		Commercial harvest <sup>3</sup>	Total run <sup>4</sup>
			Low	High		
1976	10,000	PAS	No Goal		3,800	13,800
1977	9,800	PAS	No Goal		2,100	11,900
1978	12,000	PAS	No Goal		0	12,000
1979	6,000	PAS	No Goal		1,200	7,200
1980	6,500	PAS	No Goal		3,900	10,400
1981	5,300	PAS	No Goal		0	5,300
1982	35,000	PAS	5,000		17,800	52,800
1983	7,000	PAS	5,000		5,800	12,800
1984	6,000	PAS	5,000		10,700	16,700
1985	20,000	PAS	5,000		66,800	86,800
1986	7,800	PAS	5,000		27,500	35,300
1987	9,000	PAS	5,000		21,200	30,200
1988	10,100	PAS	5,000	7,000	15,200	25,300
1989	11,500	PAS	5,000	7,000	7,000	18,500
1990	8,800	PAS	5,000	7,000	9,100	17,900
1991	9,700	PAS	5,000	7,000	13,300	23,000
1992	7,800	PAS	5,000	7,000	4,000	11,800
1993	6,400	PAS	5,000	7,000	900	7,300
1994	9,500	PAS	5,000	7,000	0	9,500
1995	10,100	PAS	5,000	7,000	100	10,200
1996	6,500	PAS	5,000	7,000	0	6,500
1997	8,500	PAS	5,000	7,000	200	8,700
1998	9,500	Video	5,000	7,000	0	9,500
1999	20,000	Video	5,000	7,000	7,200	27,200
2000	10,400	Video	5,000	7,000	0	10,400
2001	3,300	Video	6,300	12,150	300	3,600
2002		ND	6,300	12,150	0	ND
2003	11,000	Video	6,300	12,150	0	11,000
2004	16,000	Video	6,300	12,150	0	16,000
2005	6,500	Video	6,300	12,150	0	6,500
2006	15,000	Video	6,300	12,150	1,300	16,300
2007	11,000	Video	6,300	12,150	0	11,000
2008	10,000	Video	6,300	12,150	0	10,000

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Table 1.–Page 2 of 2.

Year	Esc. index <sup>1</sup>	Method <sup>2</sup>	Esc. goal range		Commercial harvest <sup>3</sup>	Total run <sup>4</sup>
			Low	High		
2009	21,000	Video	6,300	12,150	0	21,000
2010	<b>5,200</b>	Video	6,300	12,150	0	5,200
2011	<b>400</b>	Video	6,300	12,150	0	400
2012	<b>3,100</b>	Video	6,300	12,150	0	3,100
2013	<b>4,000</b>	Video	6,300	12,150	0	4,000
2014	18,100	Video	3,400	13,000	1,700	19,800
2015	3,500	Video	3,400	13,000	0	3,500
2016	10,200	Video	3,400	13,000	0	10,200
2017	7,500	Video	3,400	11,000	0	7,500
2018	5,000	Video	3,400	11,000	0	5,000
2019	<b>2,900</b>	Video	3,400	11,000	0	2,900
2020	<b>300</b>	Video	3,400	11,000	0	300
2021	<b>2,300</b>	Video	3,400	11,000	0	2,300
2022	<b>2,900</b>	Video	3,400	11,000	0	2,900
2023	2,900	Video	3,400	11,000	0	2,900

18	1976–2022	9,183	All years		4,606	13,753
	1976–1997	10,150	All PAS years		9,573	19,723
	1998–2023	7,468	All Video years		404	7,872
	2013–2023	5,316	Last 10 years		170	5,486
	2003–2023	7,621	Last 20 years		150	7,771

<sup>1</sup>Peak aerial survey index of sockeye salmon counted from tidewater to Mikfik Lake

<sup>2</sup>PAS=peak aerial survey count from tidewater to Mikfik Lake, ND=No data; Video=census of escapement into Mikfik Lake during daylight hours

<sup>3</sup>Commercial purse seine harvest from the McNeil River Subdistrict

<sup>4</sup>Total Run equals the escapement index plus the commercial harvest





Table 2.–Emergency orders (EO) issued since 2009 that affect the commercial harvest of sockeye salmon in the McNeil River Subdistrict of Kamishak Bay.

Year	EO Number	Emergency Order Action
2009	2-F-H-007-09	Closes waters of McNeil River and Paint River subdistricts on June 26.
2010	2-F-H-007-10	Closes waters of McNeil and Paint River subdistricts on June 26.
2011	2-F-H-16-11	Closes waters of McNeil and Paint River subdistricts on June 26.
2012	2-F-H-03-12	Opens Kamishak District excluding McNeil and Paint River subdistricts on June 1,
2013	2-F-H-04-13	Opens Kamishak District excluding McNeil and Paint River subdistricts on June 1.
2014	2-F-H-02-14	Opens Kamishak District excluding McNeil and Paint River subdistricts on June 1.
" "	2-F-H-03-14	Opens McNeil and Paint River subdistricts for two (2) hour commercial purse seine fishing periods on June 15 and 16.
2015	2-F-H-06-15	Closes waters of McNeil and Paint River subdistricts to commercial salmon harvest effective Monday, June 22.
2016	2-F-H-02-16	Closes waters of McNeil Subdistrict to commercial salmon harvest after June 20.
" "	2-F-H-03-16	Closes the Paint River Subdistrict to common property salmon harvest on June 20.
2017	2-F-H-001-17	Closes waters of the McNeil and Paint River subdistricts to commercial salmon harvest effective June 18.
2018	2-F-H-001-18	Closes waters of the McNeil and Paint River subdistricts to commercial salmon harvest effective June 19.
2019	2-F-LCI-001-19	Closes waters of the McNeil and Paint River subdistricts to commercial salmon harvest effective June 17.
2020	2-F-LCI-001-20	Closes waters of the McNeil and Paint River subdistricts to commercial salmon harvest effective June 15.
2021	2-F-LCI-001-21	Closes waters of the McNeil and Paint River subdistricts to commercial salmon harvest effective June 14.
2022	2-F-LCI-001-22	Opens Kamishak District excluding McNeil and Paint River subdistricts on June 1.
2023	2-F-LCI-001-23	Opens Kamishak District excluding McNeil and Paint River subdistricts on June 1,



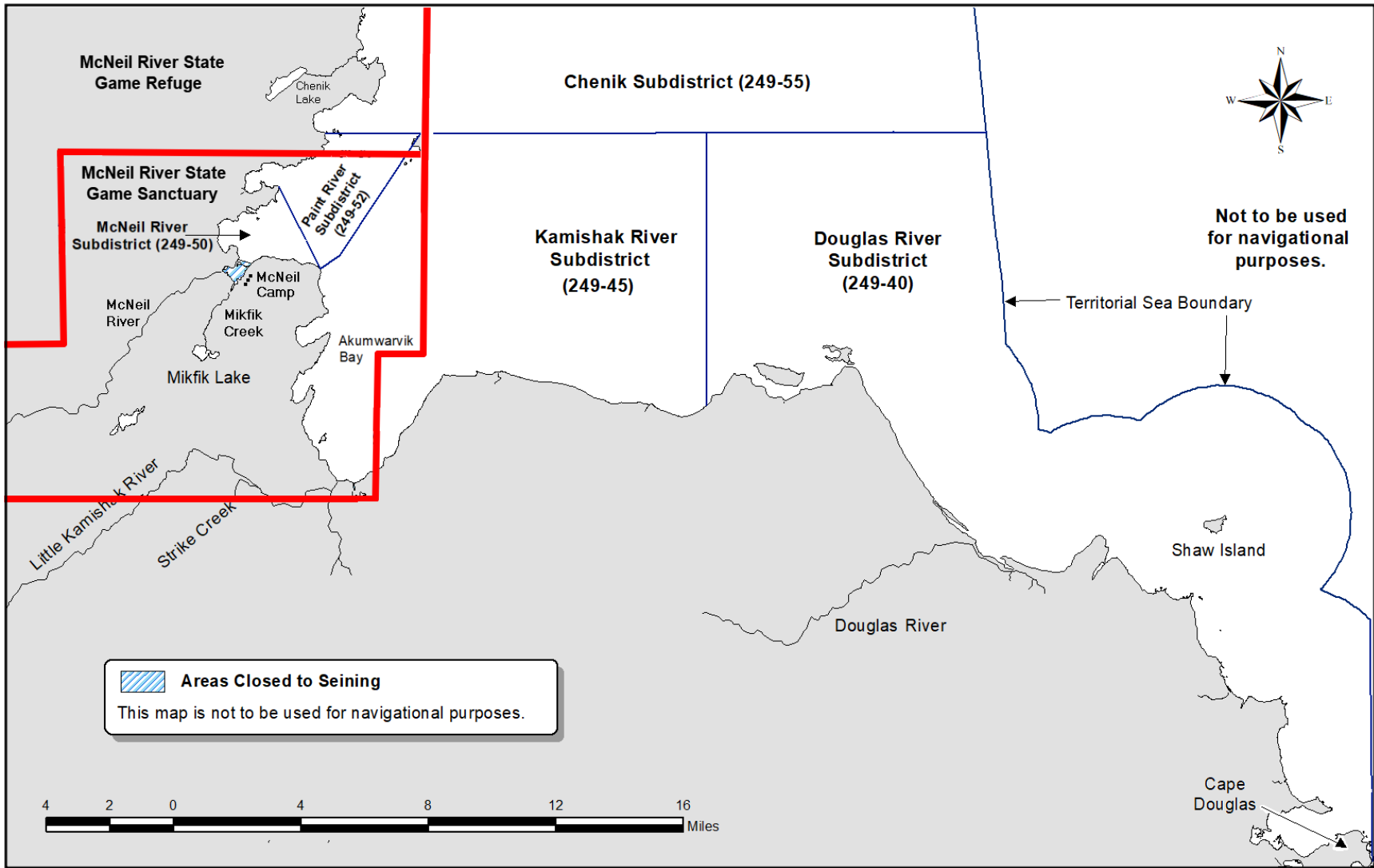


Figure 1.— Kamishak Bay District of Lower Cook Inlet management area showing commercial fishing districts and reporting subdistricts, Chenik Lake to Cape Douglas. Note the locations of Mikfik Creek and Mikfik Lake. These are within the boundaries of the McNeil River State Game Sanctuary (bordered in red). Shown also is McNeil Camp, from which the department operates a bear viewing program.

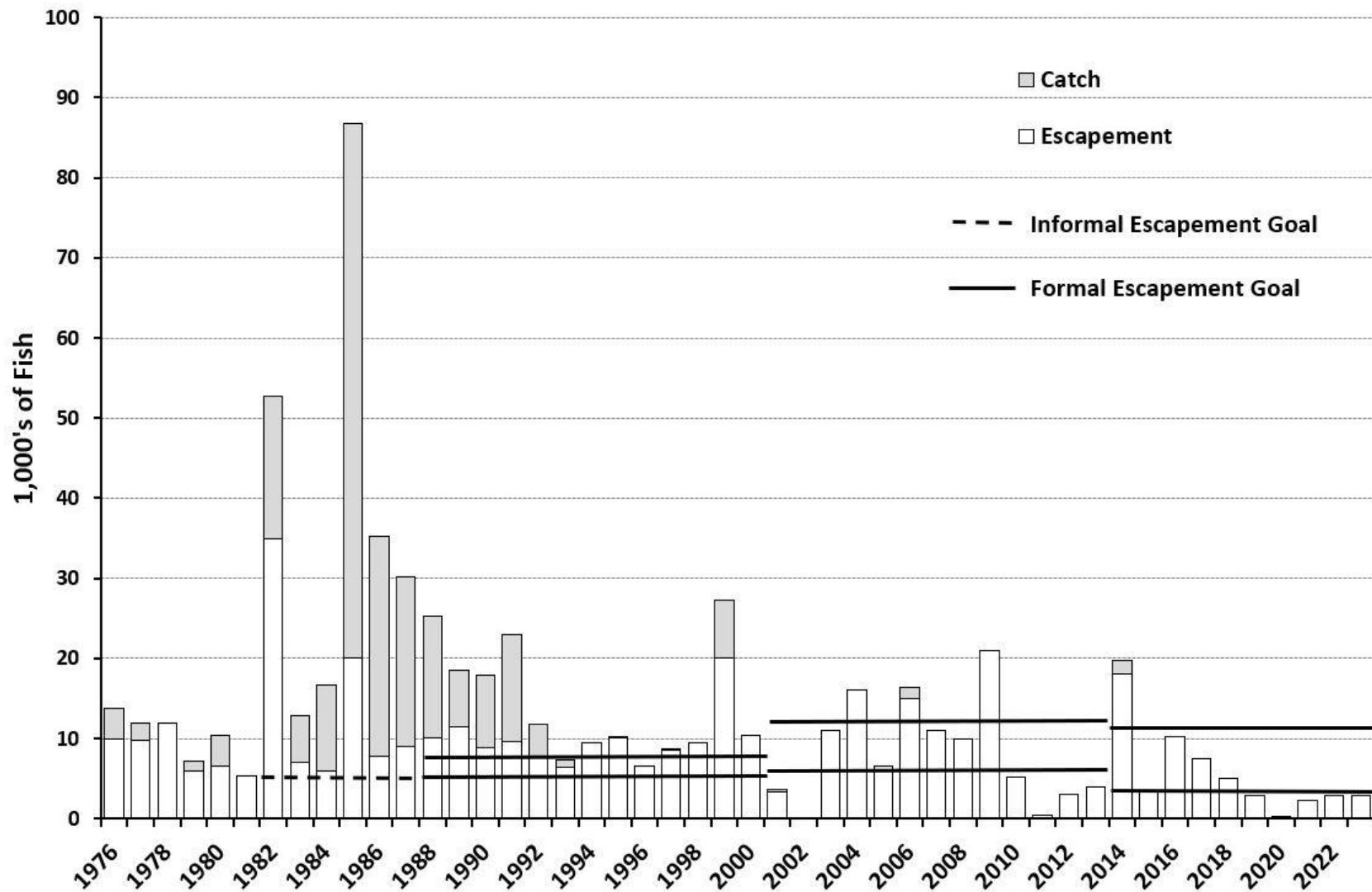


Figure 2.—Histogram of annual catch, escapement, and total run indices (thousands of fish) for Mikfik Lake sockeye salmon 1976–2023, with lines representing the escapement goal range that was in place at the time.

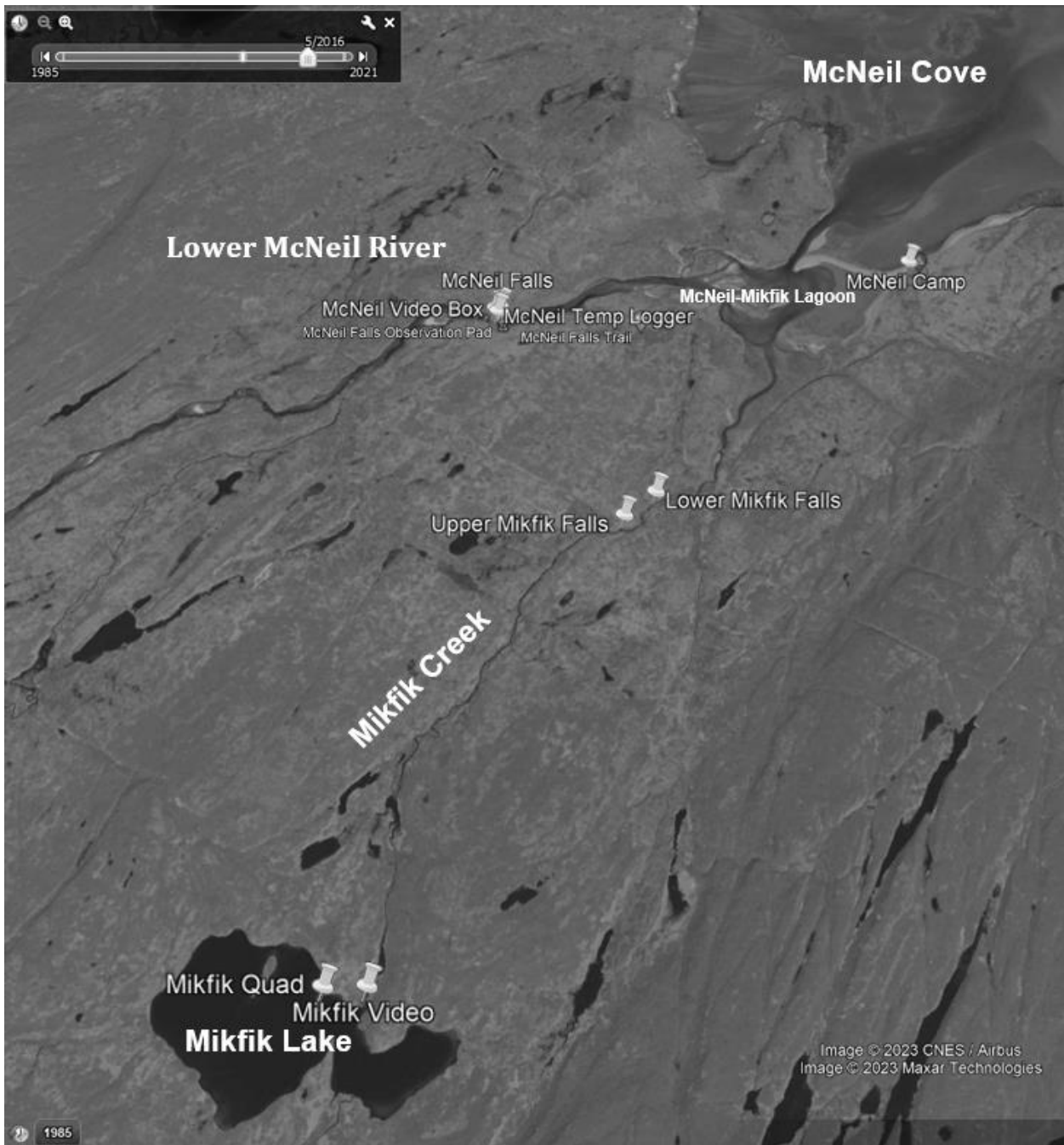


Figure 3.—Satellite image showing features of Mikfik Lake, Mikfik Creek, Upper and Lower Mikfik Falls, McNeil-Mikfik Lagoon, McNeil Cove, and the location of McNeil Camp, base of operations for the state’s McNeil River bear viewing program.

a.



23

b.



Figure 4.—Photographs illustrating upper (a) and lower (b) Mikfik Falls and the high density of brown bears that aggregate there seasonally to prey on sockeye salmon returning to Mikfik Lake. The lower and upper falls are about 1.5 and 1.7 km upstream from the mouth, respectively.

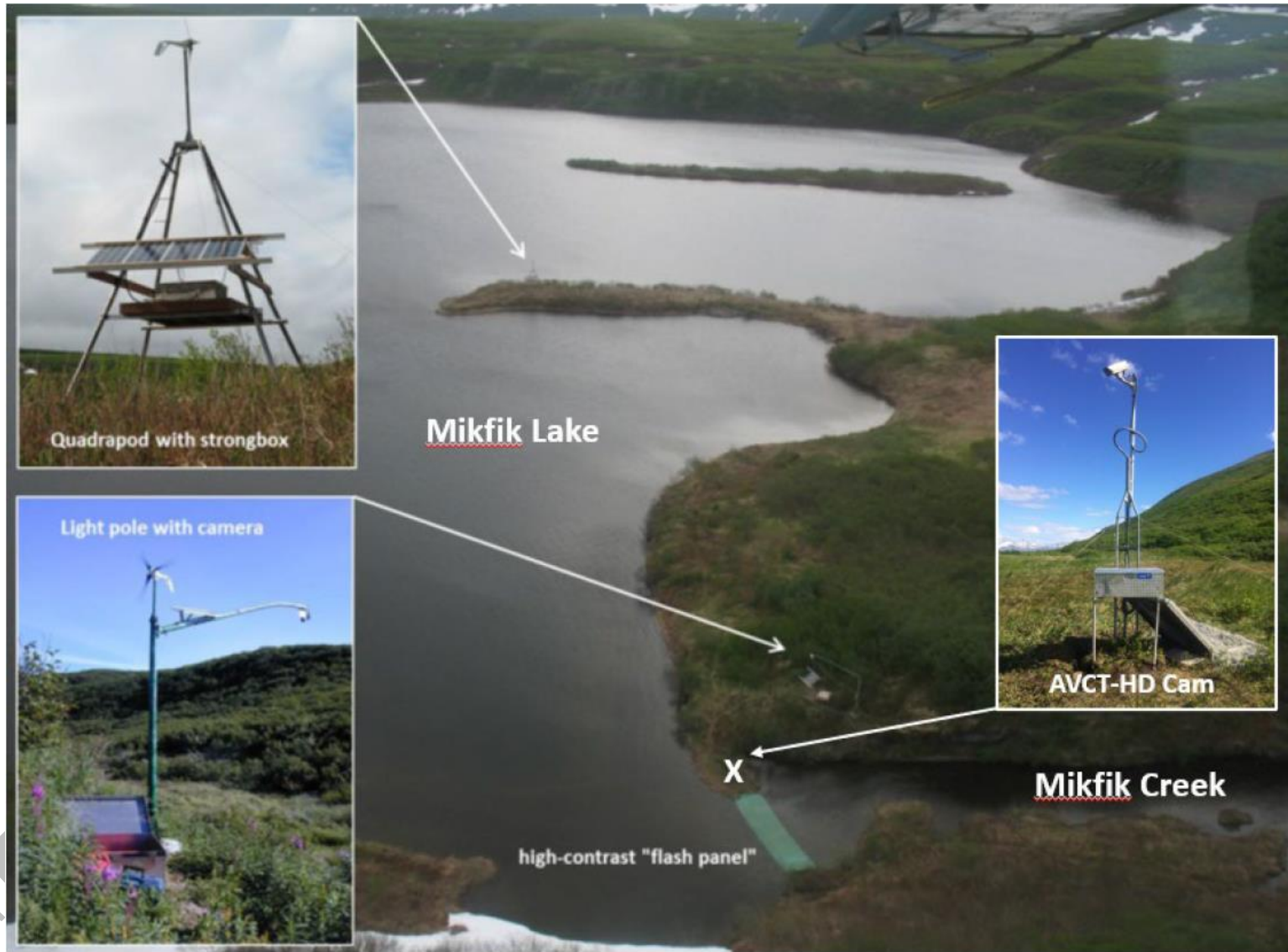


Figure 5.—Photographs illustrating components of the Mikfik Lake remote video monitoring system the department has used to monitor sockeye salmon escapement into Mikfik Lake since 1998.

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