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Juvenile Salmonid presence in the Mendenhall River, Juneau, Alaska

By

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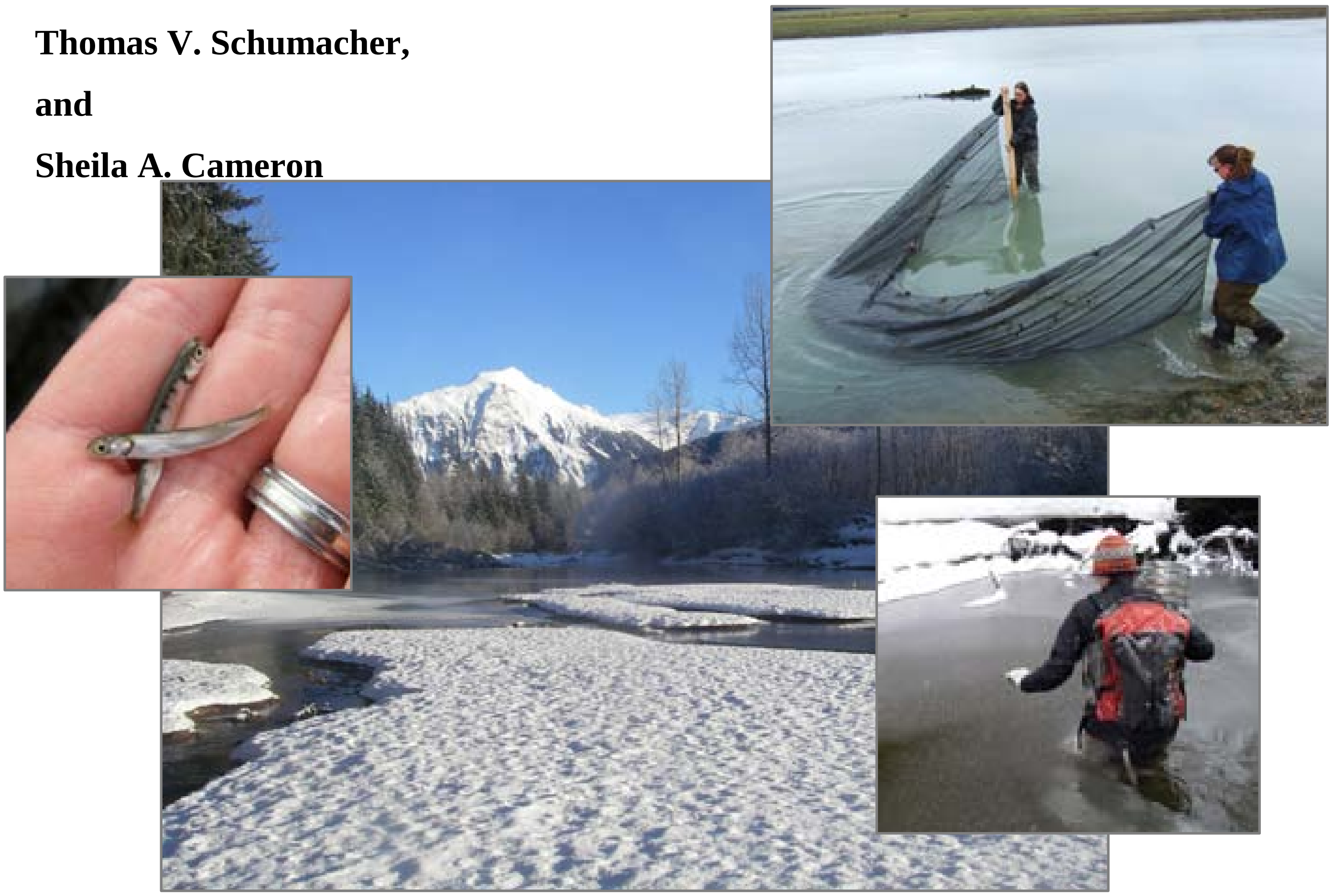

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Alaska Department of Fish and Game **Division of Habitat**

Symbols and Abbreviations

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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)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

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

The Alaska Department of Fish and Game, Division of Habitat has the statutory authority to permit activities that may impede fish passage and for activities that occur below ordinary high water in streams designated as being important to the spawning, rearing, or migration of anadromous fishes. The Mendenhall River has been designated as being important to anadomous fishes.

In 2007, the Division of Habitat initiated a systematic sampling effort to document fish use of the Mendenhall River. The Mendenhall River was divided into four reaches, with an additional reference reach in Montana Creek, a clear water tributary to the Mendenhall River. Each reach was minnow trapped for one 24-hour period during the winter, spring, summer, and for two separate periods in the fall during 2007 and 2008. The mouth of the Mendenhall was beach seined from mid-March through mid-June to identify salmonid outmigration timing. For juvenile salmonid minnow trap capture rates, the geometric mean was estimated across and within season using a generalized linear model. Juvenile salmonids were caught in all reaches of the Mendenhall River with the majority of salmonid captures occurring in Reach A, the upper most reach. The upper portions of the Mendenhall River support the largest number of rearing salmonids with lower reaches appearing to have lower value as rearing habitat. These findings support characterizing the lower reach of the Mendenhall River primarily as a migratory corridor for salmonids entering and leaving the system. Result from the beach seining effort support a mid-April through mid-June in-water work timing restriction on the Mendenhall River. The information gathered from this study will be used by the Division of Habitat to make permitting decisions on the Mendenhall River.

Key words: Mendenhall River, Montana Creek, Juneau, minnow trapping, beach seining, juvenile salmonid, rearing habitat, glacial

INTRODUCTION

Many of the important salmon producing rivers in southeastern Alaska and British Columbia are glacial or partially glacial in origin (Meehan and Siniff 1962, Eiler et al. 1992, Eiler 1995). The salmonid habitat provided by these rivers is often thought of as habitat patches used during fish migrations (Stanford and Ward 1992). In these systems, upper and lower river habitats serve different functions. Upriver habitats with suitable substrates and upwelling groundwater provide spawning habitats while lower-river areas with low gradients provide substantial rearing habitat (Murphy et al. 1989, Eiler et al. 1992).

The Mendenhall River is included in the Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (Catalog) as Stream No. 111-50-10500, and is cataloged for the presence of chum salmon *Oncorhynchus keta*, coho salmon *O. kisutch*, pink salmon *O. gorbuscha*, sockeye salmon *O. nerka*, cutthroat trout *O. clarkia*, steelhead trout *O. mykiss*, and Dolly Varden char *Salvelinus malma* (Johnson and Klein 2010). Adult salmonids, which enter the river in late summer and fall, primarily use the lower habitats as a migration corridor as they return to spawn in clear water tributary and headwater streams. It has been estimated that as many as 15,000 adult salmon migrate up the river each year (Bethers et al. 1993). Juvenile salmonids outmigrate from clear water tributary and headwater streams during spring. Several species, including chum and pink salmon, outmigrate directly to salt water following emergence while coho and sockeye salmon, as well as anadromous cutthroat and steelhead trout, and Dolly Varden char may spend multiple years rearing in freshwater. Bethers et al. (1993) reported that the river provides a significant amount of rearing habitat for juvenile coho salmon and that Dolly Varden char could be found in glacial sloughs and near the mouths of clear water tributaries. Although eulachon *Thaleichthys pacificus* presence in the lower Mendenhall River during the spring has been reported (Bethers et al. 1993), the river is not listed as supporting eulachon in the Catalog (Johnson and Klein 2010).

The Mendenhall River flows about 8 km through the center of the Mendenhall Valley in Juneau, Alaska. It is a large glacial river which supports several salmonid species and multiple habitat types. The Mendenhall River headwaters are in undeveloped National Forest land surrounding Mendenhall Lake. The Mendenhall River then flows through increasingly dense residential, commercial, and light industrial development until reaching the Mendenhall Wetlands State Game Refuge. Development on the Mendenhall River includes three bridges, one on Glacier Highway, another on Mendenhall Loop Road, and a pedestrian bridge between the two. The east side of the river is heavily developed while the area immediately to the west of the river is protected by a largely undisturbed buffer area, dedicated by the City and Borough of Juneau as a green belt (Bucy 1994). The Mendenhall Wastewater Treatment Plant has an outfall and the City and Borough disposes of excess snow in the lower river.

There have been numerous efforts to control erosion along these residential and commercial sections of the river. Erosion control efforts range from unpermitted placement of junk vehicles to riprap to a single engineered log revetment. Inwater construction and bank stabilization projects associated with private residences and public infrastructure are commonly proposed activities.

The Alaska Department of Fish and Game (ADF&G), Division of Habitat (Habitat) has the statutory authority to permit activities that may impede fish passage (AS 16.05.841) and those below ordinary high water (AS 16.05.871) in specified waters such as the Mendenhall River. Several activities require review under Habitat's authorities including bank stabilization and in-water construction projects. Residential and public infrastructure projects are commonly proposed below the ordinary high water line of the Mendenhall. This study was conducted to provide data on specific habitats used by juvenile salmonids to make better decisions on permit actions.

OBJECTIVES

In 2007, Habitat initiated a systematic year-round effort to document use of the Mendenhall River by juvenile anadromous fish. The goals of this study were to (1) document the species present and the relative abundance of juvenile salmonid in each reach of the river and a reference reach in Montana Creek, and (2) verify outmigration periods for pink slamon *O. gorbuscha* and chum salmon *O. keta*. This work was funded by the Alaska Department of Natural Resources and ADF&G.

METHODS

STUDY AREA

The Mendenhall River in Juneau, Alaska, is a glacially influenced river running about 8 km from its source at Mendenhall Lake to tide water in Fritz Cove (Figure 1). Tidal influence extends about 4 km upriver from Fritz Cove to near the confluence with Montana Creek. The river drains a watershed of approximately 220.4 km^2 with elevations ranging from sea level to over 2,100 m (Jackson et al. 2006, Neal 2007). Mean annual precipitation in the Mendenhall basin is about 457 cm with peak precipitation occurring in the fall (Jones and Fahl 1994).

Nearly two-thirds of the upper Mendenhall basin is covered by the glaciers of the Juneau Ice Field which contributes to large seasonal variations in discharge (Neal 2007). Flows typically increase in late April and May, as warmer temperatures melt the snow and ice in the Juneau Ice Field, and remain high through September. Flows decline through the fall and winter as temperatures drop and the ice field freezes. From 1965 through 2005, the mean annual discharge was 33.5 m^3/s at the Mendenhall Lake gauging station with a minimum monthly mean of 2.6 m^3/s in February and a maximum monthly mean of 95.4 m^3/s in August (Jackson et al. 2006).

As a glacial system, the Mendenhall River differs in temperature and turbidity from its clearwater tributaries, such as Montana Creek. In 2004, both water bodies reached annual low temperatures near 0°C in late January (Hood and Byers 2004). Water temperature increased with warmer weather in April. However, as runoff from the ice field increased in May, the temperature of the Mendenhall River declined from nearly 6°C in mid-May to 4°C in mid-June while the temperature of Montana Creek increased to about 7.5°C (Hood and Byers 2004). Turbidity in the Mendenhall River is higher than in Montana Creek, but the difference is most pronounced in summer and early fall during peak glacial melt. From December 2003 through June 2004, turbidity in the Mendenhall River averaged 75.2 NTU while turbidity in Montana Creek averaged 1.2 NTU (Hood and Byers 2004).

Sampling reaches were designated by dividing the river from the outlet of Mendenhall Lake to tidewater near Fritz Cove into 4 reaches, each about 2 km long. A reference reach was established in Montana Creek from the bridge on Back Loop Road to its confluence with the Mendenhall River, also about 2 km long.

Reach A was established from the outlet of Mendenhall Lake downstream to the Back Loop Road Bridge and included a large slough extending westward from the main channel. This reach is characterized by the presence of large boulders and a steeper average gradient than other reaches (Neal and Host 1999). The western bank is bordered by a seasonal U.S. Forest Service campground and low density residential development. The eastern bank is undeveloped.

Reach B was established from the Back Loop Road Bridge downstream to approximately 400 m above the confluence of Montana Creek. The upper 500 m of this reach, where the river cut through a terminal moraine, is the steepest on the river with a slope of 0.012. The slope declines in the lower section of Reach B remaining consistent to tidewater (Neal and Host 1999). The western bank has some low density residential development along the upper 600 m, but the remainder is undeveloped city park land. The eastern bank is entirely bounded by development including a school and residential neighborhoods.

Reach C was established from about 400 m upstream of the Montana Creek confluence downstream to the Brotherhood Bridge on Glacier Highway. The western bank is entirely undeveloped land, while the eastern bank has been developed for residential, recreational, and commercial uses. The majority of this reach is tidally influenced.

Reach D was established from the downstream side of Brotherhood Bridge to about 400 m below the Juneau Airport float pond. About half of the western bank has been developed for commercial and light industrial uses, while an estimated two-thirds of the eastern bank has been developed primarily for residential use. Reach D includes a sewage treatment plant and outfall, as well as the western end of the Juneau International Airport. The lower third of this reach is within the Mendenhall Wetlands State Game Refuge. This reach is tidally influenced.

Montana Creek is the largest tributary of the Mendenhall River with a watershed of approximately 40.1 km^2 (Neal and Host 1999). Mean annual flow for Montana Creek is 2.95 m^3/s and ranges from a mean monthly low of 1.19 m^3/s in January to a monthly high of 4.73 m^3/s in June (USGS 1972-1975, USGS 1976-1999). Montana Creek is sourced through groundwater and surface runoff from largely undeveloped U.S. Forest Service and city park land. Montana Creek runs about 13 km from its headwaters in the Tongass National Forest through undeveloped land to its confluence with the Mendenhall River (Figure 1). The Montana Creek reference reach is low gradient with a meandering course and high accumulation of large coarse woody debris.

MINNOW TRAPPING

Twenty trap sites were established in each of the established reaches, 10 trap sites on each bank, with the exception of Reach B which only received 19 traps due to access issues. A large portion of the uplands within the reference reach in Montana Creek are privately owned. Access to the established trap sites in privately owned areas was accessed by wading across the creek. In times of high water, 6 of the 10 trap sites within the privately owned area were inaccessible. When access was unavailable, an additional 6 traps were placed opportunistically on the side of the creek with public access. Actual trap placement within established trap sites varied due to changes in water levels resulting from precipitation, tides, and seasonal runoff.

Each reach was trapped opportunistically for one 24-hour period during winter (December–February), spring (March–May), and summer (June–August), and for two separate 24-hour periods during Fall A (September) and Fall B (October). The fall trapping period was sampled twice because it was a time when it could be assured that captured juvenile salmonids were indeed rearing in the system (Appendix A). Trapping methods were based on the methods established in Magnus et al. (2006). Salmonids were captured using two-piece galvanized steel minnow traps (42×23 cm, 22 mm openings, 6.4 mm mesh; Aquatic Eco-Systems Apopka, FL[1]). Traps were baited with cured salmon eggs contained in a punctured or opened plastic bag (118 ml Whirl-Pak; Nasco, Fort Atkinson, WI[1]). During the 2008 field season, traps were weighted with stones to provide refuge for captured individuals and to keep traps from migrating down river. At each trap site the date and time were recorded as well as several habitat characteristics. Habitat characteristics were not standardized therefore they were not quantitatively evaluated.

Captured fish were transferred into water-filled buckets or plastic bags. Salmonids were identified to species using the key and descriptions in Pollard et al. (1997); length was recorded to the nearest mm. Nonsalmonids were identified to genus; length was not collected. Captured fish that were identified in the field were returned to the stream at the capture site. Individuals that were not identifiable in the field were taken to the lab for microscopic examination.

BEACH SEINING

A beach seine (2×6m, 0.6 cm mesh; Nylon Net Company Memphis, TN[1]) was used during low tide at the mouth of the river for weekly sampling of outmigrating pink and chum salmon from mid-March through mid-June. When water levels permitted crossing the river, both banks were sampled; when water levels prevented crossing, the accessible bank was sampled twice. The seine was held in the river perpendicular to the bank for 5 minutes. The seine was closed by sweeping the outer end upriver and back to the bank. Captured salmonids were identified using the key and description in Pollard et al. (1997) and the length was recorded to the nearest mm. Captures of nontarget species were recorded to genus in 2008; the length was not recorded. Captured fish that were identified in the field were returned to the stream at the trap site.

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[1] Product names used in this publication are included for completeness but do not constitute product endorsement.

Individuals that were not identifiable in the field were taken to the lab for microscopic examination.

QUANTITATIVE ANALYSIS

The length of each captured salmonid was placed into one of three categories, less than 60 mm, 60 to 120 mm, and greater than 120 mm by species. Mean length was calculated for all captured salmonid species within trapping sessions. Assuming lengths were normally distributed, 95% confidence intervals were calculated around the mean length for each species during each trapping session.

The geometric mean was estimated for the juvenile salmonid catch rate for each reach across seasons as well as within seasons using a generalized linear model (Littell et al. 2006). The number of salmonids caught in each trap was modeled using a log link function, assuming a negative binomial distribution. The negative binomial distribution is appropriate for highly skewed data where there are a few large values but mostly small ones; the log link function is standard for a generalized linear model with negative binomial data (Littell et al. 2006). Geometric means are appropriate to represent skewed data because they are less influenced by extreme values and better summarize the bulk of the data. Means were calculated using SAS least-squares means which adjusts for other factors in the model (Littell et al. 2006). R^2_G, a generalized version of R^2, was calculated to describe the proportion of variability accounted for by the model (VerHoef 2003). Due to an unbalanced sample design, two sets of estimates were produced—one omitting all Fall B samples and the other including only Reach A and Montana Creek where there was Fall B data for both years. Geometric means were considered significant if the 95% confidence intervals did not overlap.

RESULTS

MINNOW TRAPPING

Across 10 trapping sessions, six species of salmonids were captured as well as several non-salmonid species. Ten trapping sessions were completed in each reach except B and C where, due to conflicts, a second session during fall 2008 was not completed. Results are reported as the number of fish caught and not CPUE since trapping effort was constant across all reaches. A total of 1,827 juvenile salmonids were captured in the Mendenhall River and Montana Creek (Table 1). Approximately 98% the captured salmonids were either coho salmon (60.3%) or Dolly Varden char (37.5%). Additional species captured include Chinook salmon *O. tshawytscha*, sockeye and pink salmon, and rainbow trout. Salmonid species that were not detected in either water body included chum salmon and cutthroat trout. Nonsalmonid captures included numerous sculpin species *Cottus* sp. and the occasional three-spined stickleback *Gasterosteus aculeatus*. The species of nonsalmonid captures were not consistently recorded; as a result, nonsalmonid capture results are grouped and not separated by species. Anecdotally, the majority of the 1,444 nonsalmonids captured appeared to be sculpins. Of the total nonsalmonid capture 53% were caught in Montana Creek (Table 1).

Over the course of the study, juvenile salmonids were caught in each of the reaches as well as in each of the trapping periods, although salmonids were not caught in each reach during each trapping period. The greatest number of salmonids were caught in Montana Creek (n=946) followed by Reach A (n=595), Reach B (n=154), Reach C (n=114), and lastly Reach D (n=18) (Table 1). In 7 of the 10 trapping periods, more salmonids were caught in Montana Creek than in any of the other sampled reaches. However, during spring 2007 and 2008 and during Fall 2008 B the majority of salmonids were caught in Reach A (Figure 2). Salmonid captures in Reach B equaled or exceeded those in Reach A during 2007 and winter 2008 (Figure 2). Across reaches, the majority of salmonids were caught during summer (n=669) and early fall (n=427) (Figure 3).

Geometric means for the number of juvenile salmonids captured per trap in each reach across all trapping sessions were significantly different with Montana Creek having the highest catch rate followed by Reaches A, then B, and then C (Table 2). The model resulting from this analysis produced an R^2_G of 0.37. Reach D could not be included in this analysis due to the low sample size.

Geometric means for each reach within seasons were not consistently significantly different (Table 2, Figure 4). Mean catch rates in Montana Creek and Reach A were only significantly different during summer and early fall (Table 2, Figure 4). Mean catch rates in Reach B and C were only significantly different during early fall (Table 2, Figure 4). The model resulting from this analysis produced an R^2_G of 0.17, the inclusion of a variable for season did not improve the predictive ability of the model. Reach D could not be included in this analysis due to the low sample size.

Mean length with 95% confidence intervals were only evaluated for coho salmon and Dolly Varden char due to the low sample sizes for the other species captured. Mean lengths were not significantly different between seasons or species (Figure 5).

BEACH SEINING

Beach seine sampling in the mouth of the Mendenhall River occurred 13 times (24 sets) between March 13 and June 19, 2007 and 10 times (20 sets) between March 26 and June 10, 2008 (Table 3). Twenty five salmonids were caught in 2007 and 13 in 2008. All captured juvenile salmonids were between 25 and 40 mm in length. Pink salmon were caught from mid-April to early May and chum salmon were caught from late April until the end of trapping in mid-June. Additional salmonid captures included one Dolly Varden char and a sockeye salmon.

The most numerous nonsalmonid species caught in 2008 were krill *Euphausia* sp. and amphipods *Amphipoda sp*. Additional captures included sculpin, capelin *Mallotus villosus*, and one starry flounder *Platichthys stellatus* (Table 3). Eulachon were not captured during beach seining efforts.

DISCUSSION

Juvenile salmonids were caught in all reaches of the Mendenhall River. Significantly more fish were caught in Reach A than any of the other reaches during all seasons except winter 2008 where Reach B had equivalent captures and early fall 2008 where Reach B had more captures. Assuming that the capture rate was positively correlated with the quality of rearing habitat, we conclude that Reach A offered the best rearing habitat in the Mendenhall River. Across all seasons rearing habitat quality declined the closer the reach was to the mouth of the river with Reach D offering the lowest habitat value for rearing salmonids. Although not quantifiable with this study, the varying habitats available in each of the sampled reaches may have played a large role in the juvenile salmonids abundance. Anecdotally, Reach A had a greater habitat diversity and complexity than did other reaches including areas of slow current, coarse woody debris, and large boulders near the bank. The upper portion of Reach A included a large backwater slough and several small tributary streams where many fish were caught.

Based on the models generated, the number of salmonids caught in any given trap depended most on reach, with season having little explanatory value. In Montana Creek, the greatest total catch within seasons occurred consistently during the summer and early fall. However, the sampled reaches in the Mendenhall River did not exhibit a consistent pattern among seasons or years. In 2007, 575 juvenile salmonids were captured while in 2008, only 360 juvenile salmonids were caught despite similar trapping efforts. Year class strength may have influenced the capture totals.

More salmonids were caught in Montana Creek than in all of the Mendenhall River reaches combined. Anecdotally, the higher quality rearing habitats in Montana Creek results, in part, from generally warmer water temperatures, lower turbidity, an abundance of coarse woody debris, and the lack of development along its banks. Nevertheless, our findings also indicate that the mainstem of the Mendenhall River, especially Reach A, does provide quality rearing habitat and likely makes an important contribution toward the total number of salmonids produced by this watershed.

Approximately 98% of the total salmonid capture was either coho salmon or Dolly Varden char, although the proportion of coho salmon to Dolly Varden char differed between reaches. In Reach A, the proportions of both species were about equal. In Reach B and Montana Creek, a higher proportion of coho salmon were caught than Dolly Varden char. However, a higher proportion of Dolly Varden char were caught in the Reaches C (62%) and D (89%). These capture proportions may indicate that habitat quality for rearing coho salmon declines below Reach B.

The diversity of salmonid species caught also declined from Reach A to Reach D. In Reach A five species were caught, and we found a similar diversity in Montana Creek. In Reaches B and C four species were caught, while only two species were caught in Reach D. It is unclear why there were fewer fish with a lower diversity of species in Reach D when compared to the other reaches. The use of minnow traps biased sampling efforts against catching juvenile pink and chum salmon due to their small size and more limited seasonal presence in the river. In addition, minnow traps may have been ineffective for capturing sockeye salmon as they are not commonly attracted to egg baits. However, if significant numbers of those species were rearing in Reach D, they would have likely been more prevalent in the beach seine captures. One notable difference between Reach D and the rest of the river is that the entire reach is tidally influenced; this results in the intrusion of saltwater and widely fluctuating water levels. The tidal influence in Reach D may result in unfavorable rearing conditions for juvenile salmonids.

MANAGEMENT IMPLICATIONS

We documented that juvenile salmonids use the periphery of all of the Mendenhall River as rearing habitat, but that lower reaches appear to have lower value rearing habitat. These findings support characterizing Reach D primarily as a migratory corridor for salmonids entering and leaving the system with limited potential as rearing habitat. With this information in hand, Habitat may permit projects or techniques in this reach of the river that would be inappropriate in other reaches with higher value as rearing habitat. These findings support the use of fish-friendly bank revetments in the reaches with higher value as rearing habitat.

A total of six juvenile Chinook salmon were caught in Reaches A, B, and C as well as one Chinook salmon in Montana Creek. At the time of this study these water bodies were not cataloged as supporting Chinook salmon, but these findings indicated this species uses this system for rearing. Habitat has nominated the Mendenhall River to include Chinook salmon rearing.

To avoid impacts to outmigrating juvenile salmonids Habitat commonly imposes inwater work timing restrictions on proposed projects. When possible, Habitat prefers to tailor timing windows based on data for specific water bodies. The earliest outmigrating salmonids caught in beach seine samples on the Mendenhall River was May 3 in 2007 and April 15 in 2008, while the latest capture was June 19, the last day sampled in 2007 and June 2 in 2008. The most abundant captures were on May 17 in 2007 (n=14) and April 22 in 2008 (n=4). These results support careful consideration of an inwater work timing restriction on the Mendenhall River. However, only 38 presumably outmigrating salmonids were caught over two years. Refining timing windows will require additional work, possibly employing different sampling techniques.

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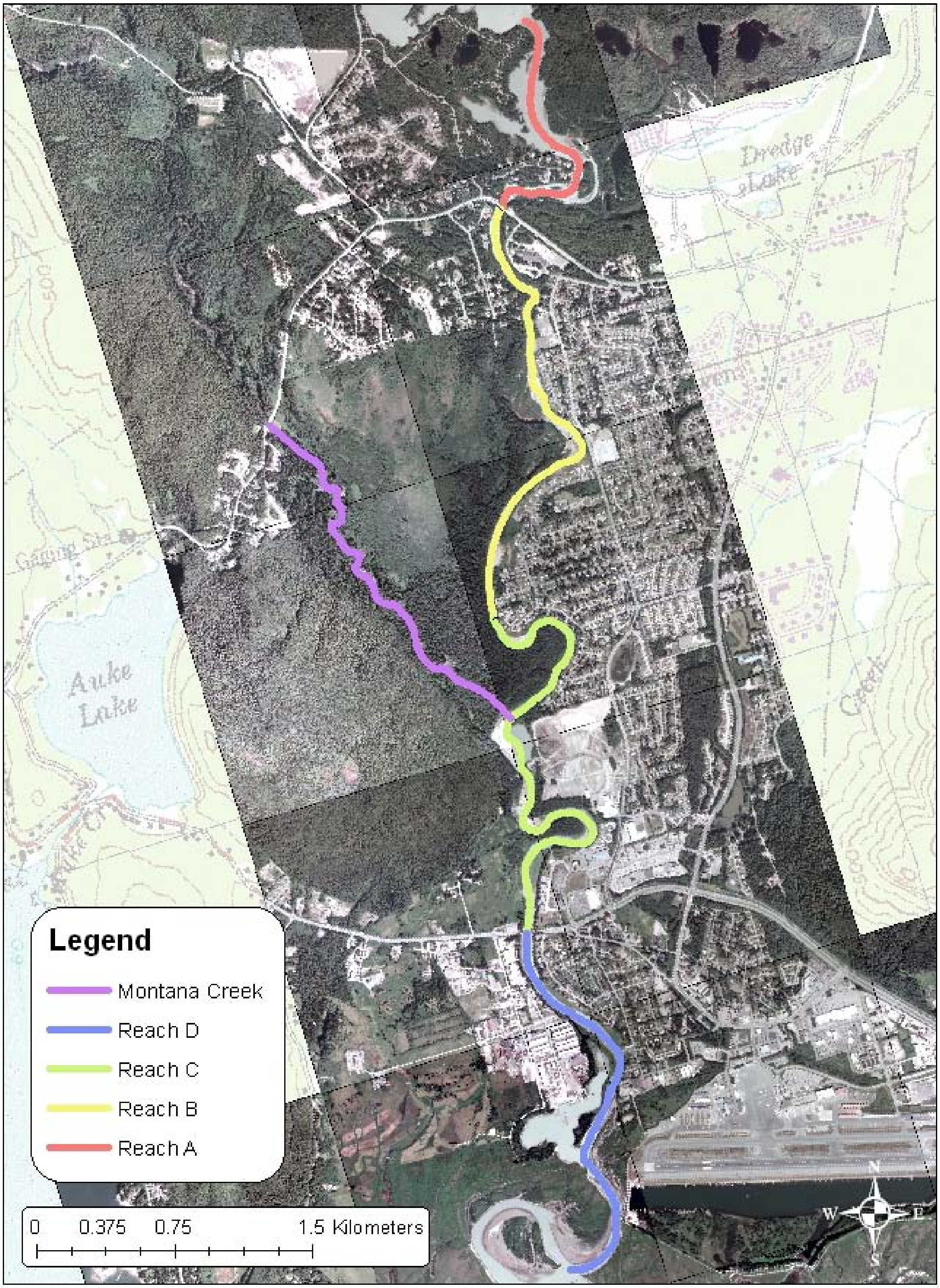

Figure 1.- Map of four reaches in the Mendenhall River and one in Montana Creek in Juneau, Alaska sampled for juvenile salmonid presence in 2007 and 2008.

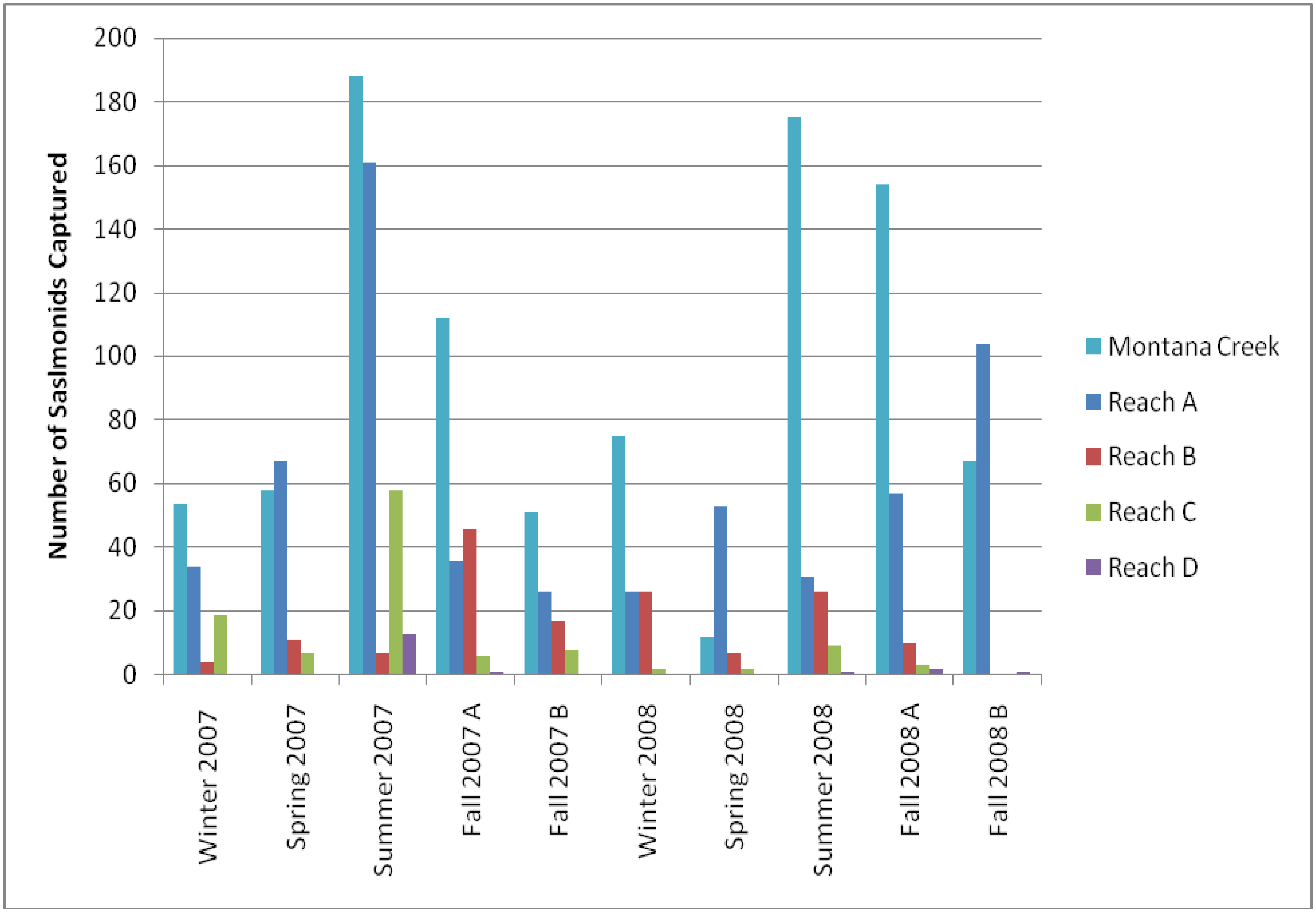

Figure 2.- Minnow trap salmonid captures in four reaches of the Mendenhall River and one in Montana Creek in Juneau, Alaska, during 2007 and 2008. Reaches B and C were not trapped during the Fall 2008 B trapping session.

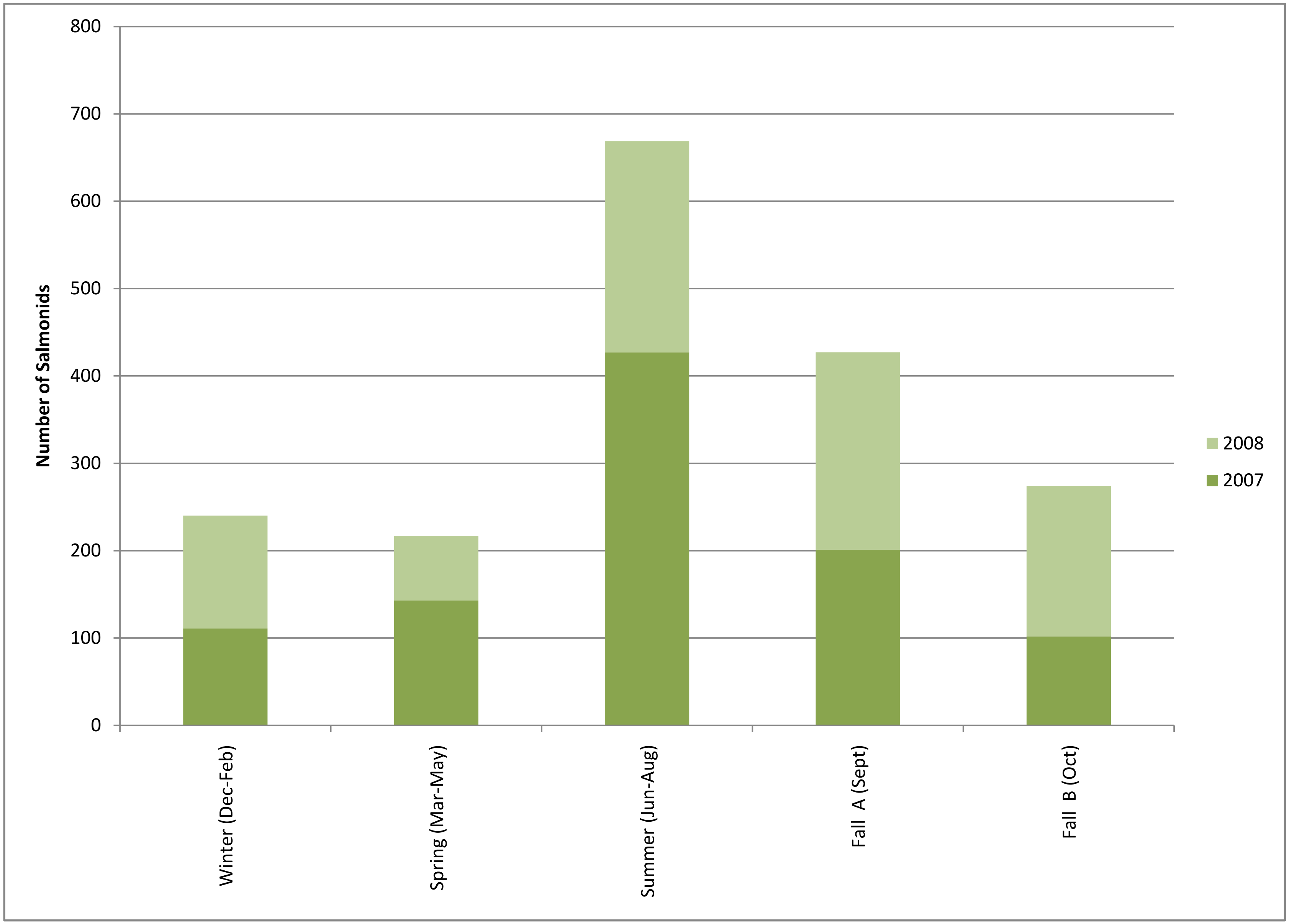

Figure 3.- Seasonal salmonid capture totals for the Mendenhall River and Montana Creek in Juneau, Alaska, during 2007 and 2008.

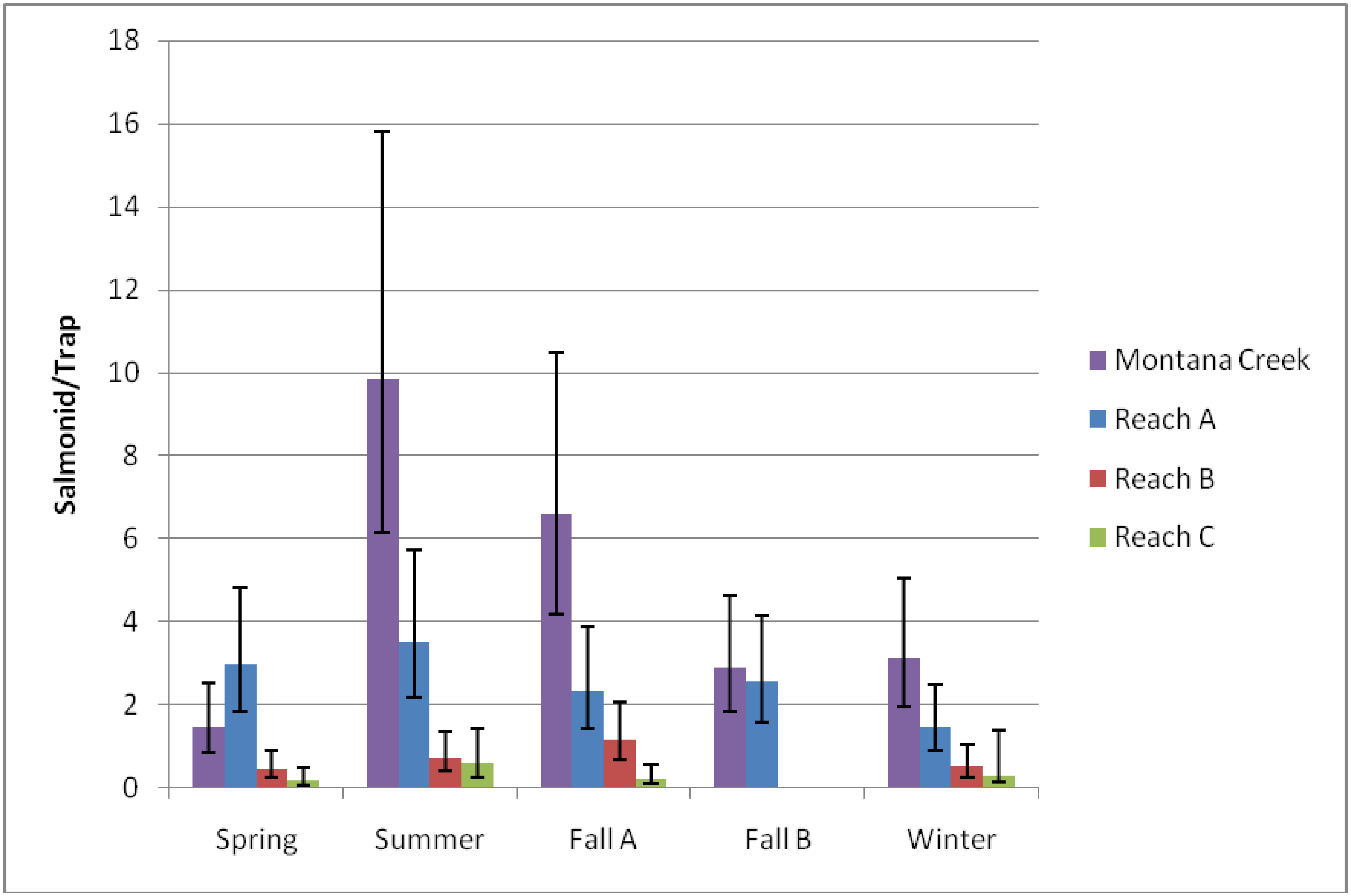

Figure 4.- Geometric mean number of salmonids caught per minnow trap in three reaches of the Mendenhall River and one in Montana Creek in Juneau, Alaska, during 2007 and 2008. Error bars represent 95% confidence intervals around each mean. Reach D was not included in this analysis due to small sample size.

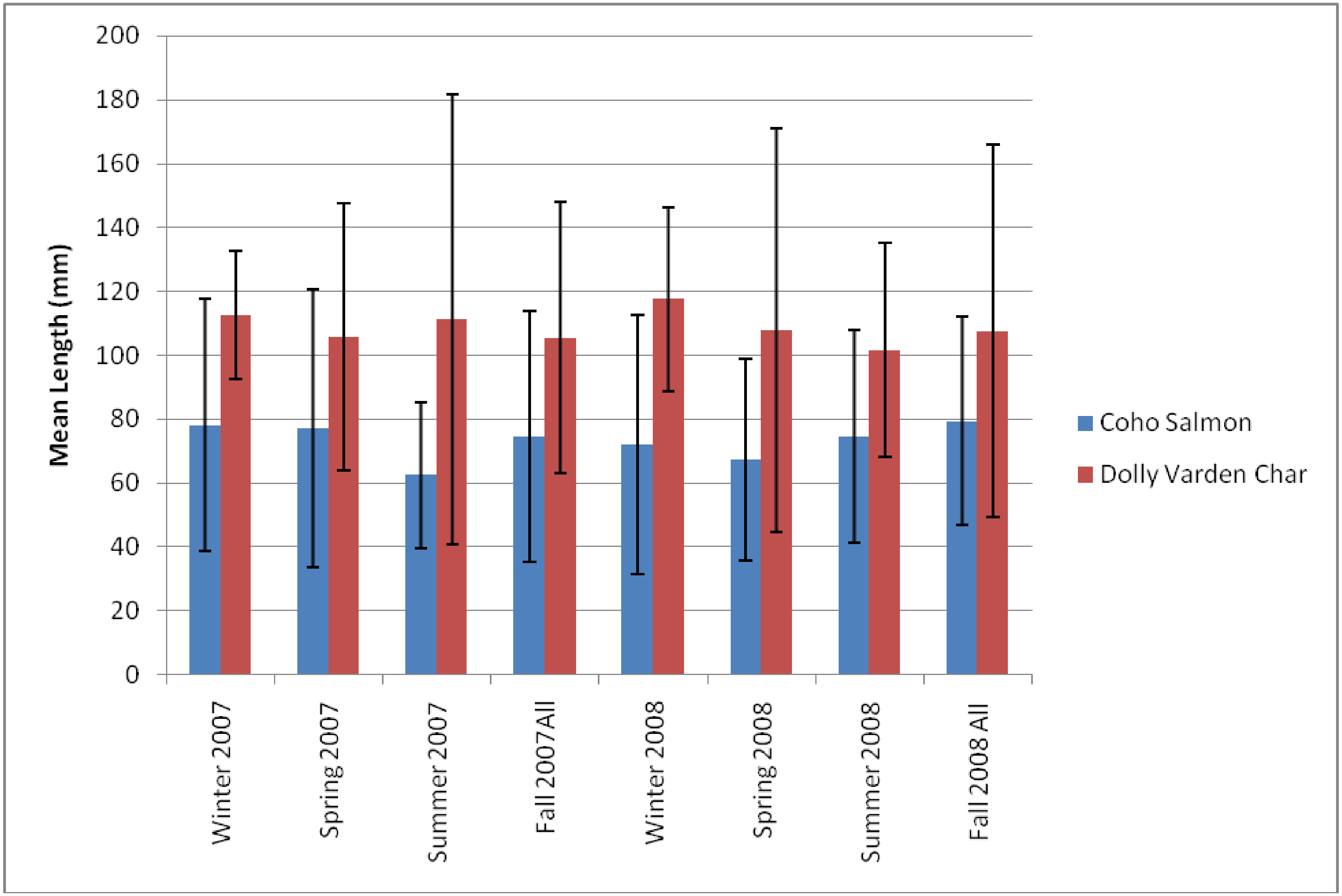

Figure 5.- Mean lengths of coho salmon and Dolly Varden char captured in the Mendenhall River and Montana Creek in Juneau, Alaska, during 2007 and 2008. Error bars represent 95% confidence intervals around each mean. Other species were not included in this analysis due to small sample size.

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Table 1. Number and proportion of fish species caught in minnow traps in four reaches of the Mendenhall River and one in Montana Creek, Juneau, Alaska, in 2007 and 2008.

	Reach A		Reach B		Reach C		Reach D		Montana Creek		Total	
Species	n	(%)	n	(%)	n	%	n	%	n	%	n	%
Coho	286	(48.1)	90	(58.4)	40	(35.1)	2	(11.1)	683	(72.2)	1101	(60.3)
Dolly Varden	293	(49.2)	58	(37.7)	71	(62.3)	16	(88.9)	247	(26.1)	685	(37.5)
Chinook	3	(0.5)	1	(0.6)	2	(1.8)	0		1	(0.1)	7	(0.4)
Rainbow Trout	7	(1.2)	5	(3.2)	1	(0.9)	0		14	(1.5)	27	(1.5)
Pink	0		0		0		0		1	(0.1)	1	(0.1)
Sockeye	6	(1.0)	0		0		0		0		6	(0.3)
Total Salmonid	595	(32.6)	154	(8.4)	114	(6.2)	18	(1.0)	946	(51.8)	1827	
Other Species[a]	217	(15.0)	73	(5.1)	193	(13.4)	195	(13.5)	766	(53.0)	1444	
Total	812		227		307		213		1712		3271	

[a] Fish in "Other Species" category were almost entirely sculpin *Cottus* sp.

Table 2. Geometric mean number of juvenile salmonids caught per minnow trap session in the Mendenhall River and Montana Creek in Juneau, Alaska, in 2007 and 2008. Significant differences between reaches are indicated by different letters in the "Significant Difference" column. Reaches with the same letters in this column are not significantly different.

Trapping Sessions	Reach	Mean	L 95% CI	U 95% CI	Significant Difference
All Seasons[a]	Reach A	2.462	1.925	3.149	W
	Reach B	0.672	0.488	0.925	X
	Reach C	0.301	0.196	0.464	Y
	Montana Cr	4.151	3.253	5.298	Z
Spring	Reach A	2.979	1.845	4.810	W
	Reach B	0.461	0.239	0.890	X
	Reach C	0.187	0.075	0.461	X
	Montana Cr	1.461	0.855	2.498	W
Summer	Reach A	3.521	2.171	5.711	W
	Reach B	0.729	0.391	1.359	X
	Reach C	0.607	0.260	1.416	X
	Montana Cr	9.836	6.122	15.804	Y
Fall A	Reach A	2.355	1.436	3.864	W
	Reach B	1.159	0.652	2.059	W
	Reach C	0.237	0.102	0.548	X
	Montana Cr	6.617	4.177	10.482	Y
Fall B	Reach A	2.549	1.577	4.121	W
	Montana Cr	2.900	1.821	4.619	W
Winter	Reach A	1.486	0.891	2.480	W, X
	Reach B	0.523	0.261	1.045	W
	Reach C	0.308	0.131	1.382	W
	Montana Cr	3.122	1.936	5.034	X

[a] Fall B does not included analysis for reaches B and C due to a lack of trap effort during the 2008 season.

Table 3. Summary of species captured in a beach seine at the mouth of the Mendenhall River in Juneau, Alaska, during the spring of 2007 and 2008.

		Species Captured					
		Oncorhynchus gorbuscha	*Oncorhynchus keta*	*Cottus* sp.	*Pandalus* sp.	*Mallotus villosus*	Amphipoda sp.
Date	No. Sets						
2007							
Mar. 13	1						
Mar. 28	1						
2-Apr	2						
9-Apr	2						
16-Apr	2						
3-May	2	1					
7-May	2		5				
17-May	2		14				
23-May	2		3				
1-Jun	2						
4-Jun	2		1				
15-Jun	2						
19-Jun	2		1				
Subtotal	24	1	24				
2008[a]							
Mar. 26	2				70		
1-Apr	2			1	49	6	
7-Apr	2			2	17		
15-Apr	1	3			50	1	
22-Apr	2	4			160		
29-Apr	2	1	2		55	1	
15-May	1						1000
21-May	2		1	1			
28-May	2					1	80
5-Jun	2		2				20
10-Jun	2						1
Subtotal	20	8	5	4	401	9	1101
Total	44	9	29	4	401	9	1101

[a] In 2008 captures also included one starry flounder *Platichthys stellatus* on April 29, one juvenile sockeye salmon on June 5, and one Dolly Varden char on June 10.

APPENDIX

Appendix A. Juvenile salmonid minnow trapping dates on the Mendenhall River and Montana Creek, Juneau, Alaska, in 2007 and 2008.

Reach	Session	Dates Trapped	Session	Dates Trapped
A	Winter 2007	Feb. 5-6	Winter 2008	Feb. 26-27
B		Feb. 26-27		Jan. 23-24
C		Feb. 7-8		Jan. 15-16
D		Feb. 13-14		Feb. 14-15
Montana		Feb. 8-9		Feb. 27-28
A	Spring 2007	May 3-4	Spring 2008	April 21-22
B		April 17-18		April 2-3
C		April 10-11		May 21-22
D		April 2-3		April 8-9
Montana		May 17-18		May 15-16
A	Summer 2007	June 28-29	Summer 2008	July 15-16
B		Aug. 16-17		Aug. 5-6
C		July 30-31		Aug. 20-21
D		July 2-3		July 21-22
Montana		July 16-17		Aug. 27-28
A	Fall 2007 A	Sept. 10-11	Fall 2008 A	Sept. 3-4
B		Sept. 17-18		Sept. 24-25
C		Sept. 26-27		Sept. 8-9
D		Sept. 6-7		Sept. 17-18
Montana		Sept. 24-25		Sept. 29-30
A	Fall 2007 B	Oct. 11-12	Fall 2008 [a]	Oct. 9-10
B		Nov. 7-8		
C		Nov. 13-14		
D		Nov. 28-29		Oct. 6-7
Montana		Oct. 24-25		Oct. 14-15

[a] Reaches B and C were not trapped during this session.