Comparison of Site Fidelity and Growth Rates of Juvenile Salmon between two Stream Types—A Pilot Study

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Abstract

A pilot study was conducted to evaluate the use of PIT tags and underwater antennas to measure juvenile salmon growth rates and site fidelity. Juvenile coho (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytsha*) growth rates and site fidelity were compared between two streams within the Susitna River drainage in Southcentral Alaska. The two study streams were selected to represent a low-sloped wetland stream which is common on the west side of the drainage and a moderate sloped upland stream that drains the Talkeetna mountains which is common on the east side of the drainage. Comparisons of growth rates and site fidelity within these two streams were used to test for the differences in the habitat quality between stream types. Juvenile salmon were captured in mid August 2009 from two 100-m reaches in each stream. Positive integrated transponder tags were inserted into all coho and Chinook salmon greater than 55 mm in fork length. Fish were released to the site of capture. Surveys were conducted using a submersible antenna and reader on 4 occasions in each stream until late September, and again the following spring to locate tagged fish. Sampling was conducted in late September to recapture tagged fish. Site fidelity was determined as the portion of tagged fish that remained within the stream reach in which they originated. Growth rates were determined by the change in weight and length of recaptured fish over time.

Chinook and coho salmon were tagged in the upland stream, but only coho salmon were captured and tagged in the wetland stream. Site fidelity was highest for Chinook salmon followed by coho salmon in the wetland stream and then coho salmon in the upland stream. By the end of September 23% of the tagged Chinook salmon were still present in the upland stream, 7.4% of the coho in the wetland stream, and 5% of the coho in the upland stream. Growth rates were significantly higher in the wetland stream. The average coho salmon growth rate in the wetland stream was 1.39 g/g/d and 0.32 mm/d. Average growth in the upland stream (coho and Chinook salmon) was 0.5 g/g/d and 0.06 mm/d. Two coho salmon were recaptured in the wetland stream the following spring. Winter growth rates for these fish were 0.22 g/g/d and 0.09 mm/d. Wetland streams of the western Susitna River drainage provide quality rearing habitat for juvenile coho salmon. Growth rates in the wetland stream were higher than most other published values.

Introduction

Juvenile salmon are found in streams and rivers throughout Southcentral Alaska and within the Susitna River drainage. Rearing streams within the Susitna River drainage vary in their physical and chemical characteristics. In general, streams along the west side of the Susitna River drain low lying areas of the Cook Inlet Ecoregion that support wet graminoid and herbaceous plant communities often composed of *Calamagrostis canadensis* and black spruce forests (Gallant et al. 1995). Rivers and streams on the northern and eastern side of the Susitna River drain out of the Alaska Range and the Talkeetna mountains (Alaska Range Ecoregion) and at lower elevations are surrounded by mixed spruce and birch forests. Streams draining the wetlands to the west of the Susitna River (wetland streams) have low conductivity, low amounts of nitrogen and phosphorus, low slopes, high dissolved carbon concentrations, and low pH, and are warm and open to solar radiation. Streams along the eastern side of the Susitna River have higher conductivity, nutrient concentration, slopes, and pH, and are cooler and shaded by riparian vegetation.

Freshwater and tidal wetlands have been found to provide important juvenile salmon rearing and overwintering habitat, and loss of these habitats has been responsible for the reduction of salmon smolt production (Beechie et al. 1994). Juvenile salmon that occupy low velocity off-channel or estuarine habitats tend to grow faster than fish that rear or overwinter in other habitats. For example, Bennett (2006), in comparing coho salmon smolt from two different stream reaches, found that those emigrating from a low sloped wetland stream were relatively larger than those from the higher velocity and steeper reach within the same stream system. Dolloff (1987), in comparing coho production among different stream types found streams flowing through meadows to be more productive than forested streams or streams with an open canopy following forest harvest. Larger size leads to increased overwinter and marine survival of juvenile anadromous salmon. For example, juvenile salmon that were larger (based on fork length) or had a higher condition factor (length:weight relationship) in the fall had higher winter survival rates in an Oregon tributary stream (Ebersole et al. 2006). Similarly, Henning et al. (2006) found high growth and survival rates for juvenile coho salmon rearing in emergent floodplain wetlands.

Juvenile salmon migrate from spawning areas to rearing and overwintering habitats. Juvenile salmon within the Taku River migrate from spawning reaches within the upper watershed to rearing and overwintering streams in the lower river and estuary (Murphy et al. 1997). Brown and Hartman (1988) documented the movement of coho salmon to off-channel habitats coincidental with high fall flows in Southeast Alaska. Other studies also have documented the use of these habitats for rearing and overwintering of juvenile coho salmon (Bell 2001, Bennett 2006, Brown and Hartman 1988).

Variability in growth rates among stream types may be due to differences in physical conditions or food resources. Low water velocity in rearing and overwintering habitats may provide an advantage due to the reduced amount of energy needed to maintain position in the water column; however, other studies have identified increased stream algal and macroinvertebrate production resulting in increased juvenile fish growth rates. Ebersole et al. (2006) hypothesized that the energy derived from adult salmon carcasses and eggs resulted in higher growth rates for juvenile salmon rearing in a spawning tributary. However, others have linked increased growth rates to increases in primary production, potentially related to changes in sunlight following the removal of the riparian canopy (Dolhoff 1987; Bjornn and Reiser 2001). Sommer et al. (2001) reported higher growth rates and survival for Chinook salmon that migrated through a wetland side channel of the Sacramento River which was correlated with greater food resources.

Wetland stream systems are ubiquitous within the Susitna River drainage, Kenai Peninsula and throughout Southcentral Alaska. Urban and rural development, along with resource extraction industries (i.e. Forestry and Mining), have resulted in the loss of these habitats in other areas (Beechie et al. 1994), and can be expected to threaten similar habitats within Southcentral Alaska. However, the importance of freshwater wetland streams in Southcentral Alaska to juvenile salmon rearing and overwintering has not been evaluated. If these wetland streams provide high quality rearing habitat, growth rates should be higher relative to growth rates in other adjacent stream types. Also, if these wetland streams are areas where rearing salmon overwinter, than site fidelity should be greater than in locations that provide lower quality overwintering habitats. This study is designed to test the use of tracking fish tagged with passive integrated transponders (PIT) to compare growth rates and site fidelity between two common stream types.

The project objectives are to (1) investigate the feasibility of recapturing PIT tagged fish released within a sampling reach to test for the differences in growth rates of individual juvenile salmon rearing in a low-sloped small wetland stream and those rearing in a small moderate-sloped upland stream; and (2) to use the relocation of PIT tagged fish to test for differences in site fidelity among juvenile salmon rearing in a low-sloped small wetland stream and those rearing in a small moderate-sloped upland stream.

Methods

<u>Site Descriptions</u>

The growth rate of individual juvenile coho salmon was compared between two distinct streams located in the Upper Susitna River drainage, in Southcentral Alaska (Figure 1). Sawyer Creek, is a 2nd order tributary to Montana Creek near Mile 90 of the Parks Highway (150.0731°N), which flows into the Susitna River. Water surface slope is 1.5%, channel width is about 5.0m, and substrate median diameter is 45mm. The riparian vegetation is composed of 2-10m of closed alder scrub lateral to the stream channel followed by a closed birch-spruce forest. Large woody debris is common with 11 pieces and 8 debris dams occurring within a 100-m sampling reach. The second stream, Queer Creek (62.1776°N x 150.21988°W), is a 2nd order tributary to Rabideux Creek which flows into the Susitna River near Mile 104 of the Parks Highway. Queer Creek water surface slope is below 1%, average channel width is 3.3 m and substrate median diameter is 32mm. The riparian vegetation is dominated by *Calamagrostis* and is open to solar radiation. Large woody debris is less common, occurring mainly as active or abandoned beaver dams[1]. Both streams support coho salmon spawning and Montana Creek and Rabideux Creek also support spawning Chinook salmon.

[1] Site characteristics from unpublished data collected in 2008.

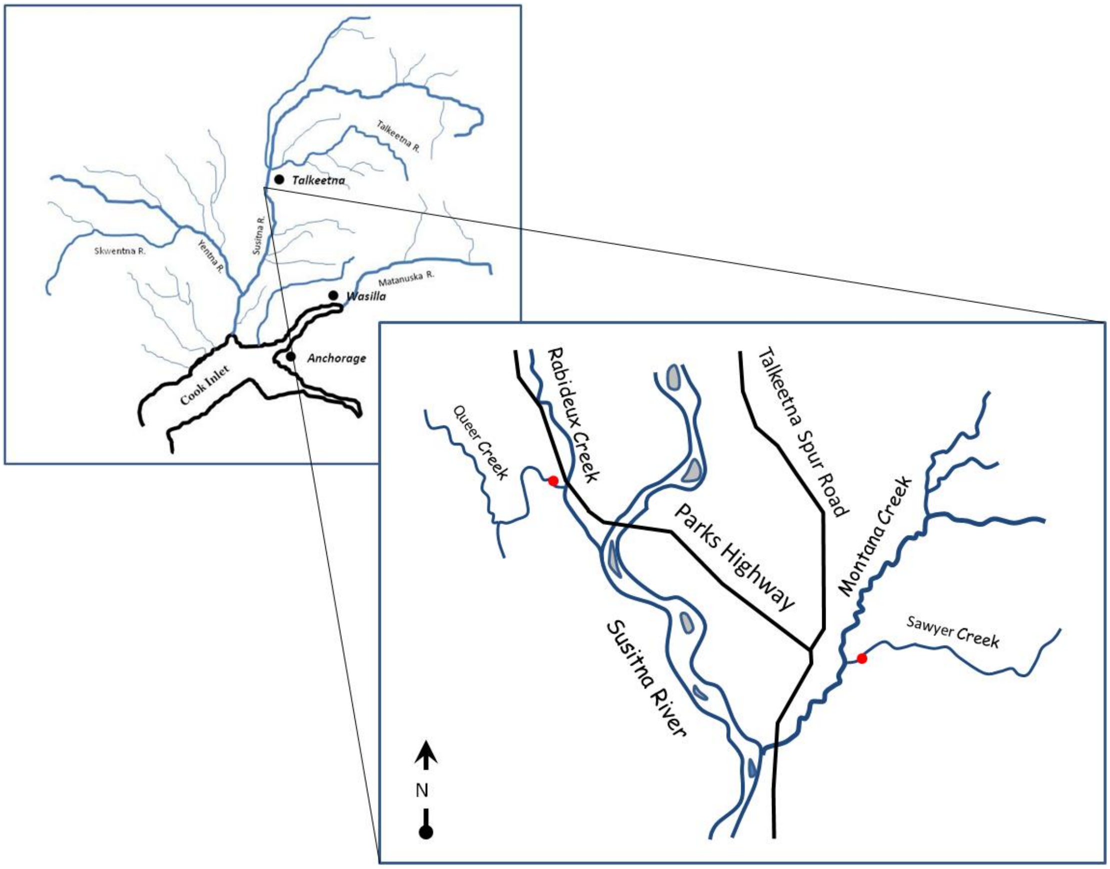

Figure 1. Location of Queer Creek and Sawyer Creek sampling sites (red dots) in Southcentral Alaska.

Juvenile salmon were sampled from two, 200 m stream reaches in each stream. Sampling reaches were located upstream and downstream from a road crossing (ATV ford in Queer Creek and a road bridge in Sawyer Creek). Fish were sampled from each reach using baited (salmon roe) traps fished for 20 hours. Sampling effort was based on attempting to capture and tag a minimum 200 fish from each stream. In Queer Creek 20 traps were fished for 20 hours; however, only 121 coho salmon > 55 mm were captured and tagged. Additional traps were set and fished for approximately 1 hour resulting in an additional 14 fish. In Sawyer Creek 37 traps were fished yielding 152 fish >55 mm. No additional Traps were set in Sawyer Creek. The catch from each trap was processed individually. Fish were transferred from the trap into a 5-gallon bucket and anesthetized with MS222. Fish from each trap were identified to species, measured to fork length, and weighed to the nearest 0.01 gram, and recorded by trap number, stream, and reach (upstream or downstream). All juvenile coho and Chinook salmon greater than 55 mm in fork length were inserted with PIT tags (12 mm) and held in recovery buckets for 2 hours to ensure recovery from anesthesia and to check for tag retention and tagging mortality. Upon recovery, fish were released to their capture location. Tagging was conducted on August 12, 2009 in Queer Creek and August 20, 2009 in Sawyer Creek.

Site Fidelity

Stream surveys for tagged fish were conducted to relocate tagged fish using hand-held submersible antennas and receivers. Surveys were conducted 9, 15, 26, and 42 days (Sept 23) following tagging in Queer Creek and again the following spring (May 20, 2010). In Sawyer Creek, surveys were conducted 5, 12, 22, and 37 days (Sept 26) after tagging and the next spring (May 19, 2009). Surveys were conducted by two-person crews. One person carried the receiver and battery and took notes, and the second person surveyed for fish with the submersible antenna. The crew worked from downstream to upstream. The antenna was moved across the stream bed, within the water column and probed under streambanks, logs, and debris dams. All tagged fish identified were recorded on the receiver and in data books to record fish tag number and location (upstream or downstream). We noted if the tagged fish remained stationary or not. If stationary, we looked for possible dead fish or shed tags; however, we did not assume that stationary readings were due to dead fish or shed tags, as juvenile fish could instead be hiding within the stream substrate. The ability to locate surrogate tagged fish was used to test survey efficiency. For surrogates we attached PIT tags to stream cobbles. Five tagged cobbles were placed within the sampling reach at locations under banks, the substrate, or beneath debris dams. Survey efficiency, as the ability to locate surrogate fish, was compared between streams and stream reaches to determine whether survey results should be corrected for differences in efficiency.

Site fidelity was determined as the percent of tagged fish that were identified in subsequent surveys, or percent fish remaining. The percent fish remaining was determined for each species (coho and Chinook salmon) and by size (55 to 75 mm and > 75mm). The number and percent of fish identified in surveys that moved from one reach to the other (up to down or down to up) also was determined. Differences in percent fish remaining were tested using two-way ANOVA without replication for each species (Sawyer coho, Sawyer Chinook, Queer coho) and each survey date. Two-way ANOVA with replication was used to test for differences in percent fish remaining by size and by stream, and the natural log transformed portion of fish that moved upstream or downstream.

Growth Rates

The fish community was sampled a second time on Sept 23 (Queer Creek) and Sept 26 (Sawyer Creek), and the following spring (May 19 and 20, 2010). Fish trapping and processing was conducted using the same methods as the initial sampling effort. All captured fish were scanned for PIT tags and growth rates were calculated for all recaptured fish. Growth rates were calculated as the change in weight divided by the time interval between sampling events.

$$GR = 100x(LnW_2 - LnW_1)(\Delta T)^{-1}$$

Where GR (ln(g)/day) is growth rate, W_1 and W_2 are weights during initial capture and at recapture, respectively, and delta T is time in days between initial marking and recapture. The null hypothesis, that there is no significant difference in juvenile coho salmon growth rates between these two streams, were tested using two sample parametric tests (t-tests) (alpha = 0.05).

Stream temperature was measured at each site using an Onset Water Temp ProV2 temperature logger recording every 30 minutes. Temperature loggers were placed within the flowing channel and secured to the bank using plastic-coated cable.

Results

The tagging objective of 200 juvenile salmon in both streams was not achieved. A total of 369 juvenile salmonids were captured in Sawyer Creek; 188 coho and 181, Chinook. Of these, 110 (61%) of the Chinook, and 63 (34%) of the coho, were greater than 55 mm in fork length. Therefore, only 164 fish were large enough for tag insertion, and following mortalities, 61 coho and 91 Chinook salmon juveniles were tagged (Table 1). In Queer Creek, 169 coho salmon were captured through initial trapping, 121 (72%) of these were greater than 55 mm in fork length. An additional 21 coho greater than 55-mm fork length were added through supplemental trapping. A total of 135 coho salmon were tagged and released in Queer Creek. In Sawyer Creek, the total number of captured fish was greater than our tagging objective of 200 fish; however, because a large portion of the captured fish were less than 55-mm in fork length, we did not meet our tagging objective. In Queer Creek, while a larger portion of the captured fish were greater than 55-mm in fork length, the total number of captured fish was less than our tagging objective.

The length-frequency distribution of juvenile salmonids is shown in Figure 2. The length-frequency distribution suggested one age class of Chinook salmon in Sawyer Creek, but at least two age classes of coho salmon in both streams. In Sawyer Creek tagged coho (juveniles >55 mm) represented the upper end of the length-frequency distribution. Therefore, results are for the larger age-0 and older fish. For Sawyer Creek Chinook tagged fish were representative of the larger portion of age-0 fish. Similarly for Queer Creek, tagged fish represented the larger age-0 and older rearing juvenile coho salmon.

Table 1. Summary of the number of fish tagged and observed in at least one subsequent survey by stream, stream reach, and species.

	Queer Creek*	Sawyer Creek
Total Tagged	135	152
Upstream Reach	65	61
Downstream Reach	50	91
Coho salmon	135	61
Chinook salmon	0	91
Percent Identified in Surveys		
Total	46%	55%
Upstream Reach	40%	69%
Downstream Reach	58%	45%
Coho salmon	46%	26%
Chinook salmon	N/A	74%

* 20 additional tagged fish were released without documenting the release location.

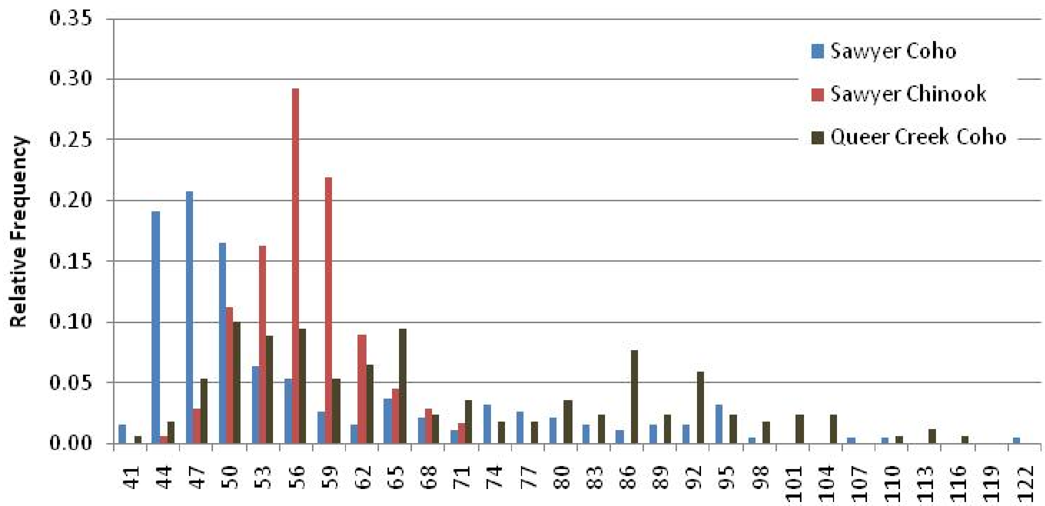

Figure 2. Length frequency distribution (3 mm intervals) for tagged fish.

<u>Sampling Efficiency</u>

On all sampling dates and in both streams 90 to 100% of the surrogate fish were located. There was no consistent difference in the location of surrogates between streams or between sampling reaches within each stream. Therefore, the number of tagged fish identified in surveys was not corrected based on the ability to detect surrogates.

All of the fish tagged in Queer Creek were coho salmon. Of the 135 tagged juvenile coho salmon in Queer Creek, 62 fish (46%) were identified in at least one subsequent survey. Of the fish released in the downstream reach 58% were identified in subsequent surveys and 40% of those released upstream. Both coho (61) and Chinook (91) salmon were tagged in Sawyer Creek. Within Sawyer Creek 55% of the tagged fish were identified in the following surveys, 68% of those released upstream, and 45% of those released downstream. Of the 61 tagged coho salmon in Sawyer Creek 26% were found at least once in subsequent surveys, and 75% of the tagged Chinook salmon were resurveyed (Table 1).

<u>Site Fidelity</u>

The portion of tagged fish identified in subsequent surveys is shown in Figure 3. Site fidelity among these two sites was significantly different ($p = 0.0028$) and among species Sawyer Creek coho, Queer Creek coho, and Sawyer Creek Chinook ($p = 0.0029$). The percent fish remaining was highest for Chinook salmon. More juvenile coho salmon remained in Queer Creek compared to rearing coho salmon in Sawyer Creek. The portion of tagged fish identified in surveys declined over time in both streams. Chinook salmon declined from 52% of those originally tagged after 5 days to 23% after 37 days. Over this same time period coho salmon in Sawyer Creek declined from 18% to 5% of those initially tagged, and in Queer Creek from 34% to 10%. The following spring, 4% and 5% of the tagged coho were relocated in Queer and Sawyer Creeks, respectively, while 12% of the tagged Chinook were found in Sawyer Creek.

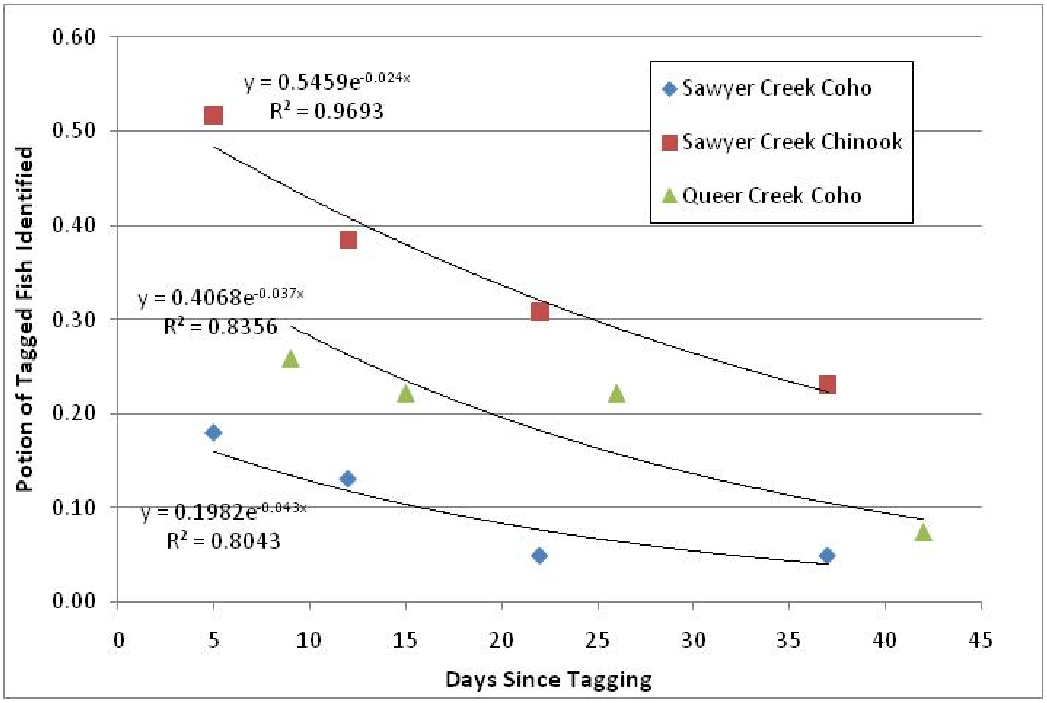

Figure 3. Portion of tagged fish identified by the submersible antenna and reader on subsequent surveys by stream and species.

There was no significant difference ($p = 0.21$) in the portion of tagged fish that had moved from the downstream to upstream reach and those that had moved from the upstream to the downstream reach (Table 2). In Queer Creek the maximum percent of tagged fish that moved was 13% moving downstream on August 27. In Sawyer Creek the maximum percent of tagged fish that moved was 8% downstream on September 26.

Table 2. Percent of tagged fish that were identified in surveys having moved upstream or downstream by date for each stream.

	Percent Up	Percent Down
Queer Creek		
8/21/2010	2.9	2.9
8/27/2009	0.0	13.3
9/7/2009	6.7	6.7
9/23/2009	0.0	0.0
Average	2.4	5.7
Sawyer Creek		
8/25/2009	5.2	0.0
9/1/2009	2.2	4.3
9/11/2009	0.0	3.2
9/26/2009	0.0	8.3
Average	1.8	4.0

Growth Rates

Three coho salmon were recaptured in Queer Creek 42 days after tagging, and 2 coho were captured the following spring 282 days after tagging. In Sawyer Creek, 5 Chinook and 1 coho were captured 37 days after tagging, but no tagged fish were captured during spring sampling. Average fall growth by length within each stream including both species was 0.32 mm/d in Queer Creek and 0.07 mm/d in Sawyer Creek. Differences in fall growth rates between these streams were statistically significant ($p = 0.034$). The fall growth rate of the one coho salmon recaptured in Sawyer Creek was 0.11 mm/d and 0.06 mm/d on average for the Chinook salmon. Maximum growth was 0.55 mm/day for the coho salmon and 0.11 mm/ day for the Chinook.

Growth rates by weight also were significantly higher ($p = 0.016$) in Queer Creek. Average fall growth rate in Queer Creek was 1.39 g/g/d and 0.53 g/g/day and Sawyer Creek (Figure 4). The fall growth rate for the single coho salmon in Sawyer Creek was 0.66 g/g/day, and average growth rate for the Chinook salmon was 0.50 g/g/day.

Two coho salmon tagged in Queer Creek that measured 63 mm and 85 mm on August 12, were recaptured on May 15, 2010. Fall growth rates for these two fish were 0.12, and 0.12 mm/d, respectively. Growth rates by weight were 0.42 and 0.37 g/g/day. Using the average growth rates for Queer Creek coho in the fall, we calculated overwinter growth of these two fish. The coho salmon that was 63 mm on August 12, would be an estimated 76 mm on September 23, and was 97 mm on May 15, 2010, resulting in a winter growth rate of 0.09 mm/d. The coho salmon that was 85 mm on August 12, would have been 98 mm on September 23, and was 123 mm on May 15, for a winter growth rate of 0.01 mm/day. Winter growth by length was 0.25 to 0.30 times growth during the fall. Winter growth rate by weight for these two fish was 0.24 and 0.19 g/g/d, which was 0.18 to 0.14 times fall growth by weight.

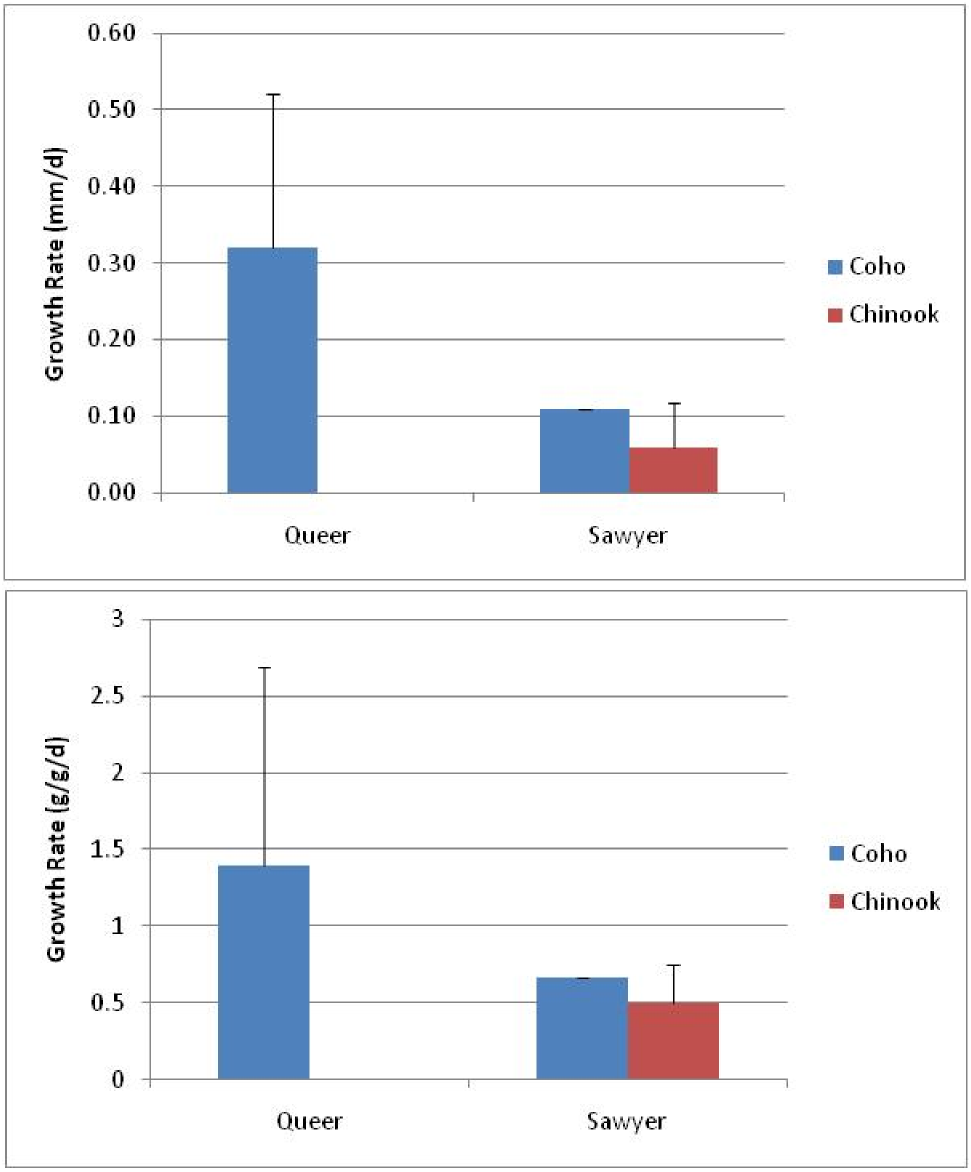

Figure 4. Average fall growth rates (error bars are on standard deviation) by length and weight for Queer Creek coho (n = 3), Sawyer Creek coho (n = 1), and Sawyer Creek Chinook (n = 5).

Stream Temperatures

Daily water temperatures for the two streams are shown in Figure 5. The water logger at Queer Creek was out of the water for part of the year resulting in only seasonal partial data. Stream water temperatures are slightly warmer in the Queer Creek, the wetland stream, compared with Sawyer Creek. Average August water temperatures in Queer Creek were near 14°C with 425 cumulative degree-days. In September, average water temperatures in Queer Creek dropped to near 11°C with 267 degree- days. In Sawyer Creek average August water temperature was 12°C with 373 degree- days, and in September, average water temperature was 9°C with 231 degree- days.

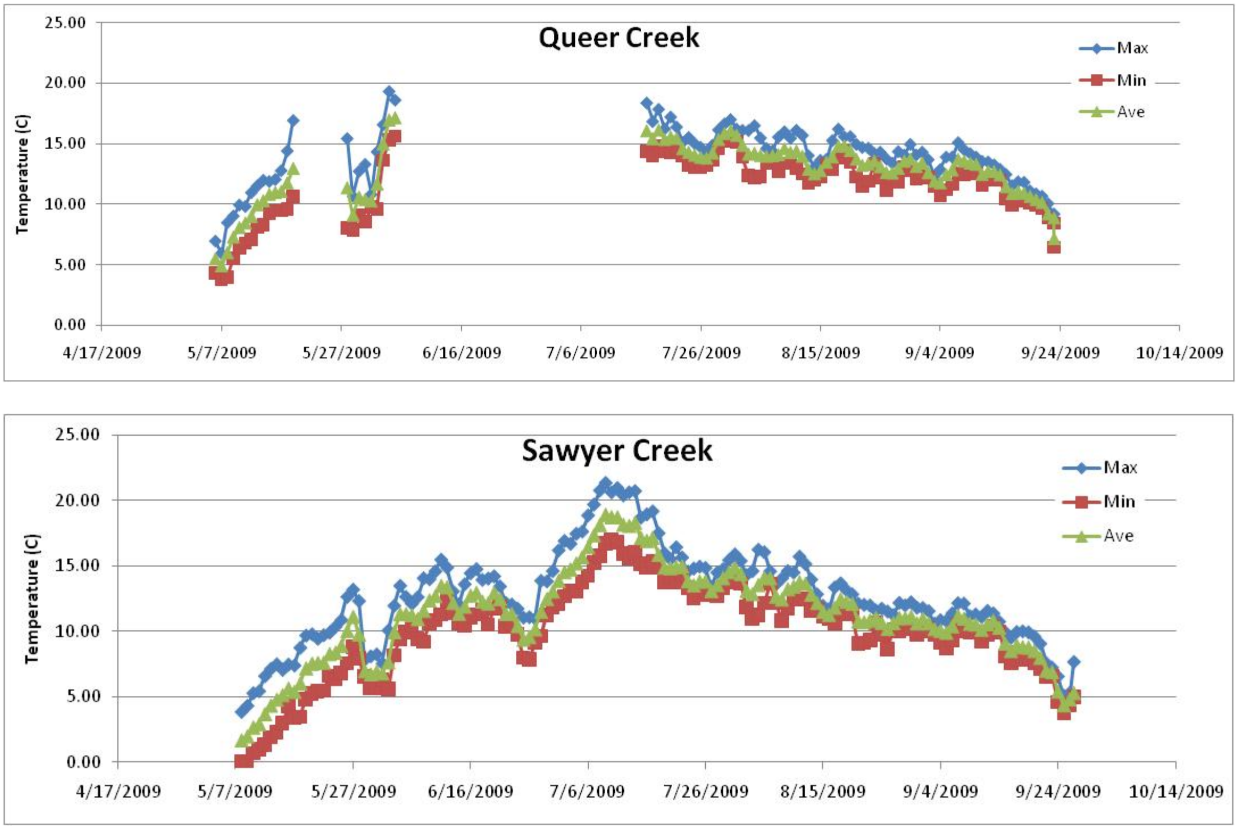

Figure 5. Daily stream water temperature statistics for Sawyer Creek and Queer Creek in 2009.

Discussion

The study methods appear to be an effective way to track movement and growth of rearing salmon; however, a larger number of fish should be tagged to increase statistical confidence, methods to detect sampling efficiency need to be improved. Approximately 3 % of the tagged fish were recaptured 40 days after tagging. Therefore, approximately 600 fish would need to be tagged to expect a recovery of 20 fish. The sampling effort to recover tagged fish could be increased which should raise the percent recovery. In this pilot study, 20 traps were placed approximately every 10 to 20 meters and fished for approximately 20 hours. Bryant et al. (2009) set baited minnow traps every 2 meters and fished them for 2 hours, which could increase recapture. Trapping also could be augmented with electrofishing.

The location of PIT-tagged fish has been accomplished by surveys using submersible antennas (Roussel et al. 2000, Roussel et al. 2004) and through the use of stationary antenna arrays (Bryant et al. 2009, Connolly et al. 2008). Surveys conducted using submersible antennas are less expensive, but stationary arrays provide continuous monitoring. Detection using either method will depend on tag size, battery power and tuning. Roussel et al. (2000) estimated detection range up to 100 cm conducting surveys with a submersible antenna. Detection with the Portable FS2001 (Biomark) submersible antenna using 12 mm tags in this study was approximately 25 to 50 cm. Detection in this study is comparable to similar studies using stationary arrays. We detected 46% to 55% of the tagged fish least once following tagging. Bryant et al. (2009) reporting detecting 60% of the tagged cutthroat trout and 54% of the tagged Dolly Varden using a suite of stationary arrays and recapture of tagged fish.

The detection of randomly placed PIT tags attached to rocks did not appear to be an effective method to evaluate sampling efficiency. Surrogates did not measure differences in detection due to the ability of fish to move vertically through the water column and surrogates tended to be placed at similar depths regardless to difference in channel characteristics. Water depths in Queer Creek were often over 1 m and generally less than 0.5 m in Sawyer Creek. Given the ability of the submersible antenna to detect tags up to a distance of 0.25 m, passing the antenna through the water at 0.5 depth would detect tagged fish throughout the water column in Sawyer Creek, but only a portion of the water column in Queer Creek. Surveyors, however, knew that surrogates would be located on the stream bed. Therefore, surrogates would have an equal chance of being detected, while tagged fish would be less likely to be detected in deeper water. Field technicians tended to place surrogates at within similar depths and within simple habitats even though more complex habitat types were available. For example, surrogates were rarely placed at depths that could not be reached by hand without overtopping chest waders. For similar reasons, surrogates generally were not placed deeply beneath undercut banks, or within debris dams. In addition, more surrogates should be used so that corrections are not exaggerated. We recommend initial testing of differences in detection efficiency among sites on one occasion prior to initiating studies and releasing tagged fish. The number of surrogates used should be similar to the number of proposed tagged fish. Tags should be placed on stones, woody debris, undercut banks, and within the substrate and other complex habitat types. In addition, field technicians should understand that tags do not need to be retrieved.

Comparisons of growth rates between species and streams in this study and with other studies are limited due to the extremely low numbers of recovered fish. However, growth rates of coho and Chinook salmon in Sawyer Creek, the upland stream, were similar to growth rates measured in other forested streams. For example, Dolloff (1987) reported growth rates ranging from 0.49 to 0.78 g/g/d among different stream types in Southeast Alaska through August and September. Spring growth rates in for Coastal Oregon streams have ranged from 0.39 to 0.84 g/g/day (Ebersole et al. 2006). These rates are comparable to the fall growth rate in Sawyer Creek, which ranged from 0.4 to 0.7 g/g/d and averaged 0.5 g/g/day. Juvenile salmon in Southeast Alaska increased in length at a rate of 0.10 to 0.17 mm/d compared to 0.06 mm/d in Sawyer Creek. However, growth by length was much higher than these values in Queer Creek at 0.32 mm/d.

The growth rates in Queer Creek, averaged 1.39 g/g/day and were considerably higher than values for Southeast Alaska or Coastal Oregon streams. High growth rates have been obtained in floodplains of coastal Oregon where growth of 1.37 to 1.43 g/g/day were recorded (Henning et al. 2006). Therefore, coho salmon growth in a wetland stream of the Susitna River drainage is comparable to productive coastal floodplains.

Winter growth rates in Queer Creek were similar, but slightly lower than rates measured in coastal Oregon streams. Winter growth in Queer Creek was 0.19 to 0.24 g/g/day. Higher growth rates have been recorded for Coastal Oregon streams, where winter growth rates ranged from 0.15 to 0.58 g/g/d

(Ebersole et al. 2006). Growth rates of 0.33 g/g/d were recorded by Bennett (2006) for coho salmon overwintering in coastal streams of the Olympic Peninsula in Washington. While winter growth rates in Queer Creek are lower, these values are high considering that coastal Oregon and Washington streams often remain ice-free for a large part of the winter while Queer Creek is under the cover of ice from late October through April.

Growth rates vary with temperature and food availability, which may explain the differences observed between wetland and upland streams. Optimal rearing temperatures for coho salmon juvenile rearing and growth are from 12 to 15°C (Richter and Kolmes 2005). Water temperatures in Sawyer Creek were at the lower end of this optimal range and at the upper end in Queer Creek. Optimal temperatures for juvenile salmon growth are higher when fish are satiated with food (Richter and Kolmes 2005). Water temperatures during growth rate measurements in Oregon streams ranged from 17 to 22°C (Ebersole et al. 2006). Extremely high coho salmon growth rates for fish rearing in emergent floodplains of coastal Oregon at water temperatures of 16 to 19°C (Henning et al. 2006). Growth rates in all studies cited here decreased during winter months and may be associated with reduced water temperatures. However, concomitant with changes in seasonal water temperatures are changes in solar radiation and primary production.

Site fidelity is another method of evaluating habitat quality. Based on site fidelity, habitat quality for coho salmon was better in Queer Creek, the wetland stream, compared to Sawyer Creek, the upland stream. This is consistent with differences in growth rates between these two streams. By the end of September, 7.5% of the tagged coho were still present in Queer Creek, compared to 5% of the tagged coho in Sawyer Creek. For comparison, coho site fidelity was measured at 16% for Prairie Creek, a northern California Coastal stream (Bell 2001).

The inability to detect differences in upstream or downstream movement is likely due to the low number of tagged fish. Percent movement was based on the detection of up to 4 fish that had moved from one reach to the other. Increasing the number of tagged fish would increase the confidence in detecting fish movements. Kahler et al. (2001) documented the movement of 28 % to 60% of marked fish between small habitat units. This study documented movement of 0 to 13% of tagged fish up to 100 meters. We had anticipated upstream movement of coho salmon in the wetland stream as rearing fish moved into lower water velocity habitats for overwinter. However, this hypothesis was not supported by this limited data set.

This pilot study demonstrates that the survey and recapture of PIT tagged fish is an effective way to evaluate site fidelity and growth rates. This study documented differences in site fidelity between salmon species and between stream types. However, replication is necessary to determine if the differences are specific to these streams or if they can be extrapolated to other sites. Initial data however, support the use of growth rates and site fidelity to evaluate the quality of habitat for rearing juvenile salmon. The limited data suggests that wetland streams of the western Susitna River drainage provide quality coho salmon rearing habitat and that growth rates within these streams equals or exceeds the growth rates measured in other locations.

Growth rates of coho salmon in wetland streams of Southcentral Alaska should be further tested. If confirmed, factors influencing this high productivity should be investigated. High growth rates in lowland streams of the Susitna drainage would increase the importance of these systems to overall coho salmon production. This could influence the evaluation of development projects land management decisions that could influence the productivity of these streams. The restoration of migration barriers to these streams systems would become a priority.

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