



**Alaska Department of Transportation & Public Facilities
Seward Highway MP 75-90**

2006-2007 Freshwater Fish Assessment

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EXECUTIVE SUMMARY

During the summers of 2006 and 2007, HDR Alaska Inc. conducted a study to assess fish species presence, distribution and relative abundance in fresh water habitats within the Seward Highway corridor from mileposts 75 to 90. The study recorded seven fish species and found that 16 of 21 water bodies sampled contained anadromous fish consisting of coho and Chinook salmon. Spawning surveys determined that six of the eight sites surveyed within the highway corridor are used by adult anadromous fish including coho and pink salmon. Dolly Varden were also found in several of the waterbodies sampled.

Survey results are generally consistent with the Alaska Department of Fish & Game (ADF&G) anadromous stream catalog although no adult salmon were documented at Peterson Creek and no chum salmon were recorded at Kern Creek. In addition, juvenile and adult coho salmon and Dolly Varden were documented at milepost 76.0 between the Placer River overflow and Ingram Creek. Anadromous fish had not been previously documented at this site according to ADF&G. In general, wetlands and ponds had greater abundance of fish than streams, with populations dominated by stickleback. Stream site populations were dominated by coho and Dolly Varden.

In general, good juvenile salmon rearing habitat exists above many of the road culverts. However, several of the culverts are perched at low tide which prevents fish passage until high tide occurs. The presence of juvenile salmon in areas of no known spawning activity suggests that juvenile salmon (i.e. pre-smolt) are moving from their natal streams out into Turnagain Arm then migrating to other tributaries in the study area. The presence of a low saline environment in Turnagain Arm (HDR 2006) may preclude osmoregulatory problems associated with early out-migration and could facilitate this juvenile life history pattern.

INTRODUCTION

The Alaska Department of Transportation and Public Facilities (ADOT&PF) is proposing a project to improve sections of the Seward Highway from milepost (MP) 75 near Ingram Creek to MP 90 near Girdwood (Appendix A-Map 1). ADOT&PF has undertaken a program of studies designed to determine the ongoing and potential future effects of the proposed project on environmental resources.

A study of freshwater resources located along the road corridor was undertaken to determine the distribution of fish and habitat in freshwater water bodies that are completely or partially located within 200 feet (ft) to either side of the centerline of the Seward Highway between MP 75 and 90. The primary objective of this study was to characterize the presence or absence of fish and the relative abundance of the various fish species recorded within the Seward Highway MP 75-90 proposed project area. This study was conducted in conjunction with the Seward Highway Aquatic Habitat Analysis (HDR 2007a), results of which are published under a separate report. The results of both studies are being used to characterize aquatic habitats and fish utilization in the project area, and will in turn be used in the development and evaluation of project alternatives.

METHODS

Study Area

The Seward Highway parallels the coastline of Turnagain Arm and crosses several streams between MP 75 and 90. The study area is known for its mud flats and tides as well as for strong winds and heavy precipitation. The highway is located between the ocean and the mountains.

The original construction of the highway and/or adjacent railroad resulted in the creation of numerous wetland areas and ponds on the inland side of the highway. Several streams and ponds also occur naturally within the study area. Sampling for juvenile fish and spawning salmon was conducted in lentic (lake and pond) and lotic (stream) environments fully or partially located 200 ft upstream and/or downstream of the Seward Highway between mileposts 75 and 90 (Appendix A-Map 2). Sampling in the larger bridged Portage Creek, Placer River, and Twentymile River was not conducted because fish resources in these creeks are well-documented and the streams will likely remain bridged in their current location.

Review of Existing Information

The Alaska Department of Fish and Game (ADF&G) Anadromous Fish Catalog lists several known anadromous water bodies in the project area (ADF&G 2007). Listed water bodies include: Ingram Creek (ADF&G stream 247-60-10190 and 247-60-10190-2005), Placer River (ADF&G stream 247-60-10200 and 247-60-10210), Portage Creek (ADF&G stream 247-60-10220 and 247-60-10220-2009), Twentymile River (ADF&G stream 247-60-10230), Peterson Creek (ADF&G stream 247-60-10242), Kern Creek (ADF&G stream 247-60-10244), Virgin Creek (ADF&G stream 247-60-10248 and 247-60-10248-2020), Glacier Creek (ADF&G stream 247-60-10250, 247-60-10250-2004, 247-60-10250-2003 and 247-60-10250-2003-3005), and

three unnamed water bodies (ADF&G streams 247-60-10235, 247-60-10240, and 247-60-10246; Appendix A-Map 1). According to the list, anadromous species present within the Project area include: Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), sockeye salmon (*Oncorhynchus nerka*), eulachon (*Thaleichthys pacificus*), and Dolly Varden (*Salvelinus malma*) (Table 1).

Table 1. Summary of anadromous fish presence in the Seward Highway 75-90 project area according to the Alaska Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes (ADF&G, 2007)

| Seward Hwy MP 75-90 Project Site Name | ADF&G Catalog No. | Anadromous Species | | | | | | | | | | | | | | | | | | | | |
|--|------------------------|--------------------|---|---|------|---|---|------|---|---|---------|---|---|---------|---|---|----------|---|---|--------------|---|---|
| | | Coho | | | Pink | | | Chum | | | Chinook | | | Sockeye | | | Eulachon | | | Dolly Varden | | |
| | | S | R | P | S | R | P | S | R | P | S | R | P | S | R | P | S | R | P | S | R | P |
| Ingram Creek (MP 75.2) | 247-60-10190 | | | X | X | | | | | X | | | | | | | | | | | | X |
| Ingram Slough (MP 75.3) | 247-60-10190-2005 | | | | | X | | | | | | | | | | | | | | | | |
| Placer River Overflow | 247-60-10210 | | | X | | X | | | | | | | | | X | | | | | | | X |
| Placer River | 247-60-10200 | | | X | | | | | | | | | | | X | | | | | | | X |
| Portage Creek (Tributary) | 247-60-10220-2009 | X | X | | | | | | | | | | | | | | | | | | | |
| Portage Creek | 247-60-10220 | X | X | | | X | | | X | | | | | X | X | | | | | | | |
| Twentymile River | 247-60-10230 | X | X | | | | | X | | | | X | X | X | X | | | X | | | | |
| MP 81.9 | 247-60-10235 | | | X | | | | | | | | | | | | | | | | | | |
| Peterson Creek (MP 84.1) | 247-60-10242 | | | | X | | | | | | | | | | | | | | | | | |
| Peterson Creek (Tributary) | 247-60-10240 | | | X | | | | | | | | | | | | | | | | X | X | |
| Kern Creek (MP 86.3) | 247-60-10244 | | | | | X | | | X | | | | | | | | | | | | | X |
| MP 88.1 | 247-60-10246 | | | X | | | | | | | | | | | | | | | | | | |
| Virgin Creek (MP 89.1) | 247-60-10248 | X | X | | | X | | | X | | | | | | | | | | | | | |
| MP 89.6 (Virgin Slough) | 247-60-10248-2020 | | | X | | | | | | | | | | | | | | | | | | |
| Glacier Creek (MP 89.7) | 247-60-10250 | | | X | X | | | | X | | X | X | | | X | | | | | | | |
| Glacier Creek (Tributary) | 247-60-10250-2004 | | | X | | | | | | | | | | | | | | | | | | |
| Glacier Creek (Tributary) | 247-60-10250-2003 | | | X | | | | | | | | | | | | | | | | | | |
| Glacier Creek (Tributary) | 247-60-10250-2003-3005 | | | X | | | | | | | | | | | | | | | | | | |

S = Spawning, R = Rearing, P = Present

Field Methods

Biologists enumerated adult salmon by direct observation (via visual foot surveys) and captured juvenile fish using minnow traps and beach seines to identify the composition of fish species in the study area. ADF&G reviewed study methods and issued fish resource permits (SF2006-152 and SF2007-056) prior to field sampling during both years (Appendix E).

Juvenile fish surveys were completed at 21 sites within the study area (Appendix A-Map 2). In 2006, minnow traps were set from July 19-20, July 31-August 2, August 30-31, and September 26-27. In the summer of 2007, beach seines were used on May 7 and minnow traps were set from May 29-30, June 26-27, July 24-25, August 23-24, and September 27-28. Minnow trapping was conducted in freshwater habitats within the defined highway corridor by setting ¼-inch mesh minnow traps baited with cured salmon eggs. In some lakes and wetland areas, traps were set beyond 200 ft of the highway corridor to allow for a more representative sample of the water body. Minnow traps were fished for approximately 24 hours. All captured fish were identified to species, counted, and measured for fork length before being returned alive at the capture site. Fish capture data including trap placement and removal times are provided in Appendix B.

Foot surveys were completed at eight streams within the study area using a two-person field team (Appendix A-Map 2). Surveys were conducted from June 13-14, July 19-21, July 31-August 2, and August 30-September 1 in the summer of 2006. In 2007, foot surveys were conducted on June 15, June 24-25, July 11, July 26-27, August 15, August 23-24, September 13, and September 27. The survey area for each stream included 200 ft upstream and 200 ft

downstream from the point where the stream intersected the highway. Fish were recorded as being up- or downstream of the road crossing and redds and/or spawning activity or behavior were noted, if observed. Polarized sunglasses were used to maximize the effectiveness of this approach. Complete spawning survey data is provided in Appendix C.

RESULTS AND DISCUSSION

Over the course of the study 21 sites were surveyed for juvenile fish presence and eight sites were surveyed for adult fish and spawning activity. A total of seven fish species were identified during the minnow trap and spawning survey efforts: pink salmon (*Oncorhynchus gorbuscha*), coho salmon (*O. kisutch*), Chinook salmon (*O. tshawytscha*), Dolly Varden (*Salvalineus malma*), sculpin (*Cottus spp.*), ninespine stickleback (*Pungitius pungitrus*), and threespine stickleback (*Gasterosteus aculeatus*). Fish capture and spawning survey results are provided in Appendix B and Appendix C, respectively.

Juvenile Fish Surveys

A total of 201 minnow traps were set within 21 waterbodies during the study, which resulted in a total capture of 3470 fish consisting of 836 juvenile coho salmon, 77 Dolly Varden, 2540 stickleback, 13 juvenile Chinook salmon, and 4 sculpin (Figure 1). Due to the abundance of stickleback, they were not enumerated by species. Stickleback were the most abundant species at most sites; however, at stream sites (Virgin Creek, Kern Creek, Peterson Creek, MP 81.9, and Ingram Creek) coho salmon were typically the most frequently captured species. In general, those stream sites where coho were the most frequently captured fish had lower total catch per trap than pond and wetland areas (Figure 2).

Salmonid species (coho salmon, Chinook salmon, and Dolly Varden) were observed in 16 of the 21 study sites. No anadromous species were documented at sites MP 78.0, MP 83.8, MP 84.6, MP 85.9, and MP 87.7 (Appendix A-Map 3). The relative abundance of species captured from each site is illustrated in Appendix A-Map 3. A comparison of relative abundance by sample year for each study site is provided in the Site Descriptions section of this report.

Minnow traps can result in sampling bias against the catch of certain species and size ranges. Sockeye salmon tend to avoid minnow traps baited with salmon eggs, likely due to feeding preferences. Small fish, such as newly emerged salmon, may be small enough to escape the trap and larger fish, such as Dolly Varden, may be too large to enter the trap. Beach seines were used as an alternative juvenile fish sampling method on May 7, 2007. Beach seining was conducted at five sites (MP 76.0, MP 83.30, MP 83.31, MP 87.1, and MP 88.1) where juvenile coho salmon were identified in 2006. Sticklebacks were captured at all sampled sites except MP 76.0 and one juvenile coho salmon was captured at MP 83.30. No other species of fish were captured during the beach seining surveys.

The March 26, 2007 sampling event was conducted to determine the viability of overwintering juvenile salmon in ponded areas located within the project area. Sampling was conducted at six ponds where juvenile salmon had been documented during 2006 field efforts. All ponds were ice-covered during the sampling event and ice thickness ranged from 2.75 to 3.5 ft. At least two holes were augured in the ice using a gas-powered ice auger at each site and the holes were located where juvenile salmon had been captured in 2006 and in depressions less likely to freeze solid throughout the winter. Unfortunately, depths of less than six inches of water between the

ice and the pond substrate at all six sites precluded the use of minnow traps which are approximately six inches in diameter.

Seward Highway MP 75-90 Minnow Trapping Results Species Abundance, 2006-2007

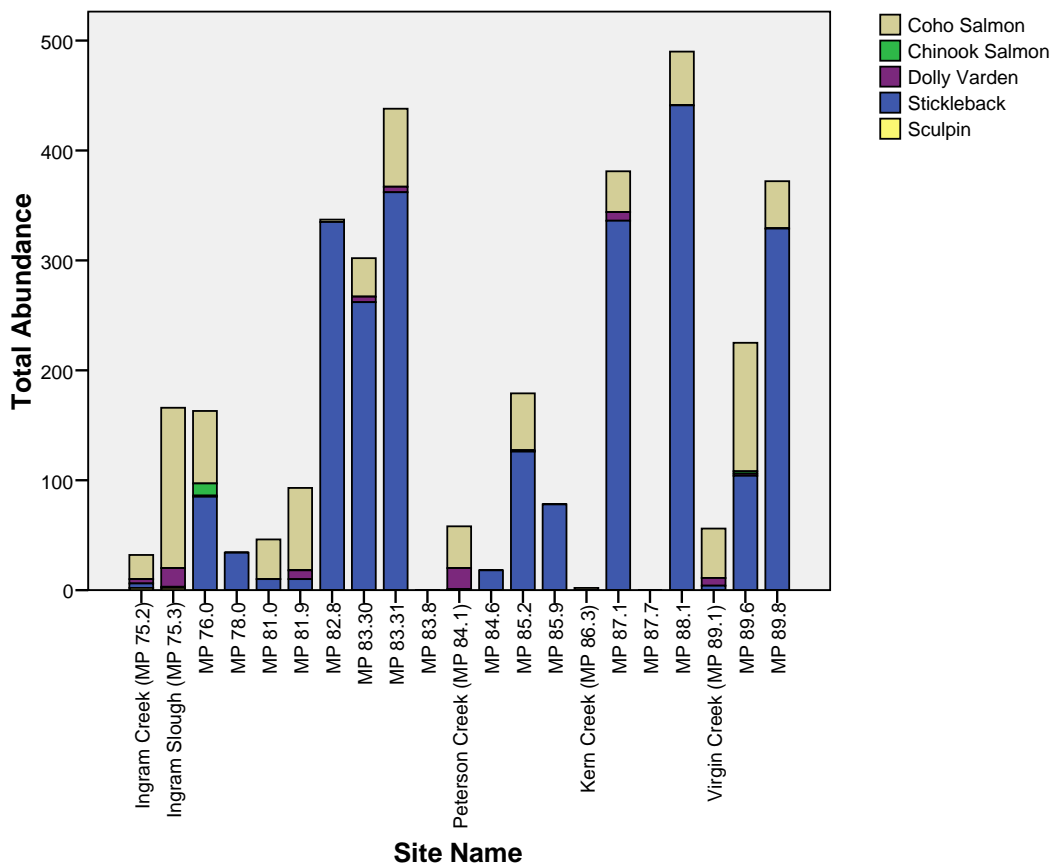


Figure 1. Species total abundance at minnow trapping sample sites

Seward Highway MP 75-90 Minnow Trapping Results Relative Abundance, 2006-2007

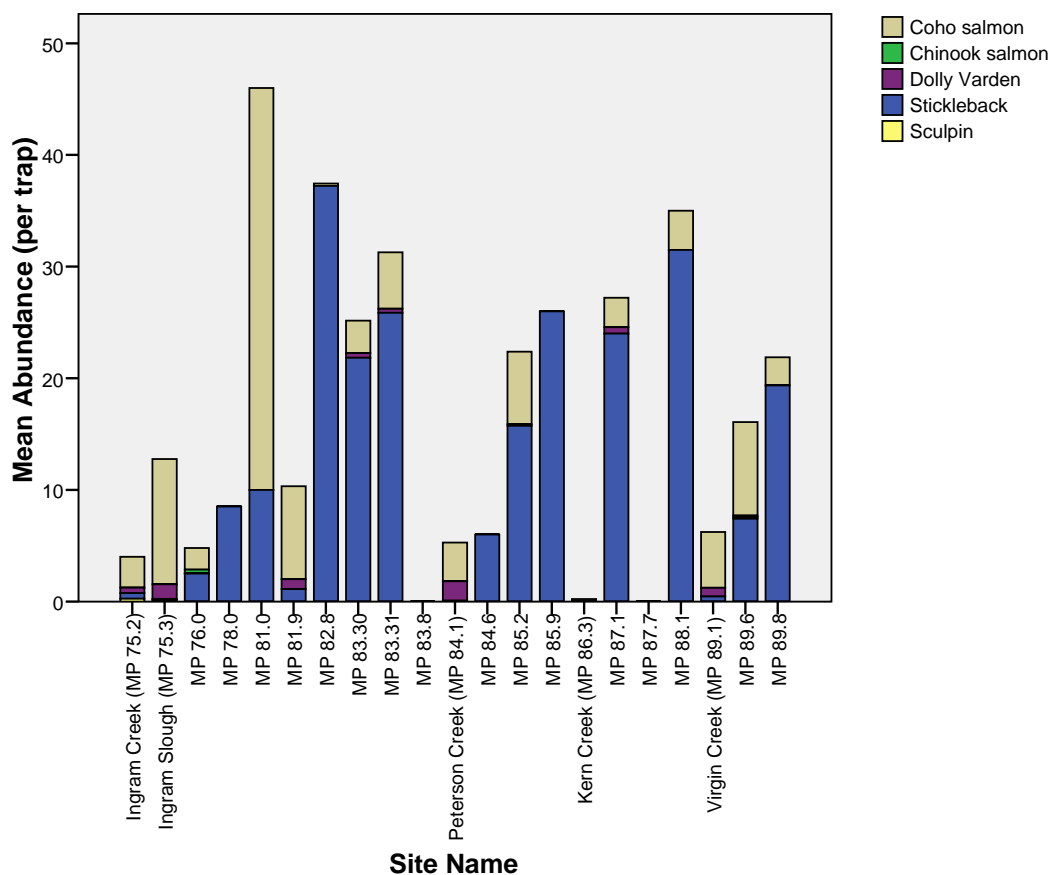


Figure 2. Species mean abundance per trap at minnow trapping sample sites

Standard water quality measurements were taken at each winter sample site (Table 2). Salmonid species generally require dissolved oxygen levels of greater than 5 mg/L (Quinn, 2005). Dissolved oxygen concentrations were <5 mg/L at sites MP 76.0 and MP 83.30 and therefore would not support overwintering of juvenile salmon if the oxygen levels are chronic. It is possible that deeper waters with oxygen conditions more suitable to overwintering salmon were present but not sampled. The remaining sites had dissolved oxygen levels generally considered sufficient for salmonids. Elevated salinity, total dissolved solids (TDS) and/or conductivity at MP 83.30, MP 87.1 and MP 88.1 suggest that these three ponds remain tidally influenced throughout the winter despite thick ice cover.

Table 2. Winter water quality sampling at selected study sites

| Site Name | Auger Hole # | Temperature (°C) | Specific Conductivity (mS/cm) | Relative Conductivity (uS/cm) | Dissolved Oxygen (%) | Dissolved Oxygen (mg/L) | pH | Total Dissolved Solids | Salinity (ppt) |
|-----------|--------------|------------------|-------------------------------|-------------------------------|----------------------|-------------------------|------|------------------------|----------------|
| MP 76.0 | 1 | 0.2 | 0.074 | 39 | 33.5 | 4.85 | 6.13 | No data | No data |
| MP 76.0 | 2 | 0.04 | 0.077 | 40 | 30.1 | 4.38 | 6.84 | No data | No data |
| MP 76.0 | 3 | 0.36 | 0.076 | 40 | 17.7 | 2.54 | 7.21 | No data | No data |
| MP 76.0 | 4 | 0.48 | 0.094 | 50 | 5.6 | 0.79 | 6.41 | No data | No data |
| MP 83.30 | 1 | -0.02 | 1.957 | 1022 | 35.5 | 5.15 | 6.97 | No data | No data |
| MP 83.31 | 1 | 0.07 | 0.251 | 131 | 76.2 | 11.19 | 7.26 | 0.167 | 0.12 |
| MP 85.2 | 1 | 0.04 | 0.158 | 83 | 63.2 | 9.23 | 7.41 | 0.103 | 0.07 |
| MP 87.1 | 1 | -0.01 | 1.681 | 878 | 74.6 | 10.82 | 7.16 | 1.097 | 0.84 |
| MP 87.1 | 2 | 0.4 | 0.76 | 403 | 84.6 | 12.2 | 7.34 | 0.498 | 0.37 |
| MP 88.1 | 1 | 3.49 | 15.63 | 9209 | 87.8 | 11 | 7.14 | 10.18 | 9.01 |

A length-frequency analysis of fish captured during 2006-2007 (Figures 3-24) minnow trapping efforts show a bimodal distribution for coho salmon in 2006 and 2007 indicating the presence of two coho salmon age classes. In 2006, the bimodal distribution suggests that Age 0 fish are <104 mm and Age 1 fish are >110 mm (Figures 3-6). By late August 2006, most Age 1 fish appear to have emigrated from the sample site areas and Age 0 fish ranging from 40 to 119 mm were the most abundant size class captured (Figure 5). In 2007, coho sizes were similar to 2006 and ranged in size from 40-155 mm (Figures 7-12). A bimodal distribution on May 29, 2007 suggests a break between age 0 and age 1 fish at 100 mm (Figure 8). As in 2006 data, later sampling events suggest that Age 1 fish have emigrated from the sample sites (Figures 9-12).

In both 2006 and 2007, Dolly Varden have a wide range of sizes (65 to 220 mm); however, the relatively small number of Dolly Varden captured (n=77) spread over nine sampling dates limits the ability to identify age groups (Figures 13-21). Similarly, only 13 Chinook salmon were captured during 2006 and 2007 minnow trapping efforts. The fish ranged in size from 105-185 mm with the majority of the fish ranging in size from 155-185 mm (Figures 22-24).

Length-Frequency Distribution Coho Salmon July 19, 2006

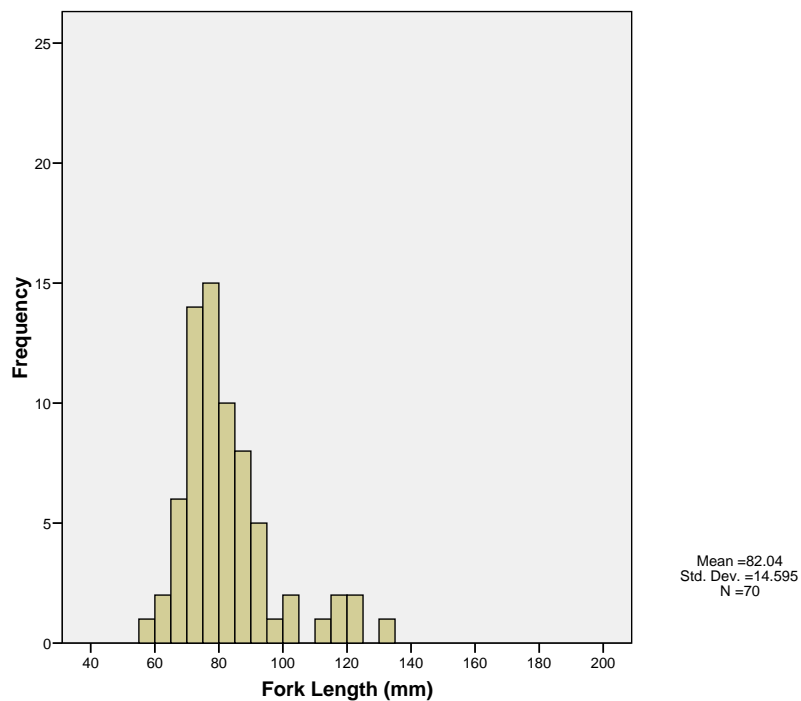


Figure 3. Length-frequency distribution for juvenile coho on 7/19/2006. Five sites were sampled.

Length-Frequency Distribution Coho Salmon August 1, 2006

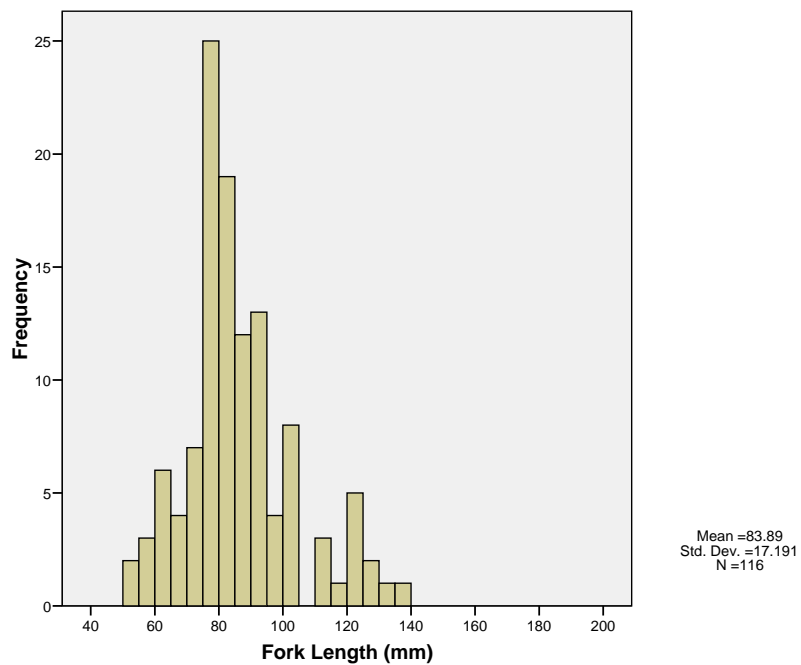


Figure 4. Length-frequency distribution for juvenile coho on 8/1/2006. Nine sites were sampled.

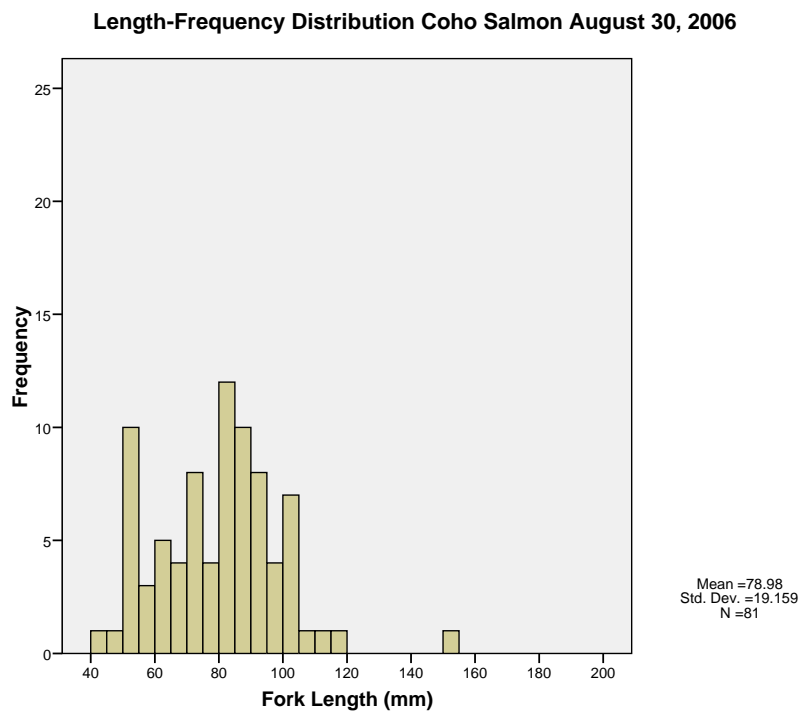


Figure 5. Length-frequency distribution for juvenile coho on 8/30/2006. Three sites were pooled.

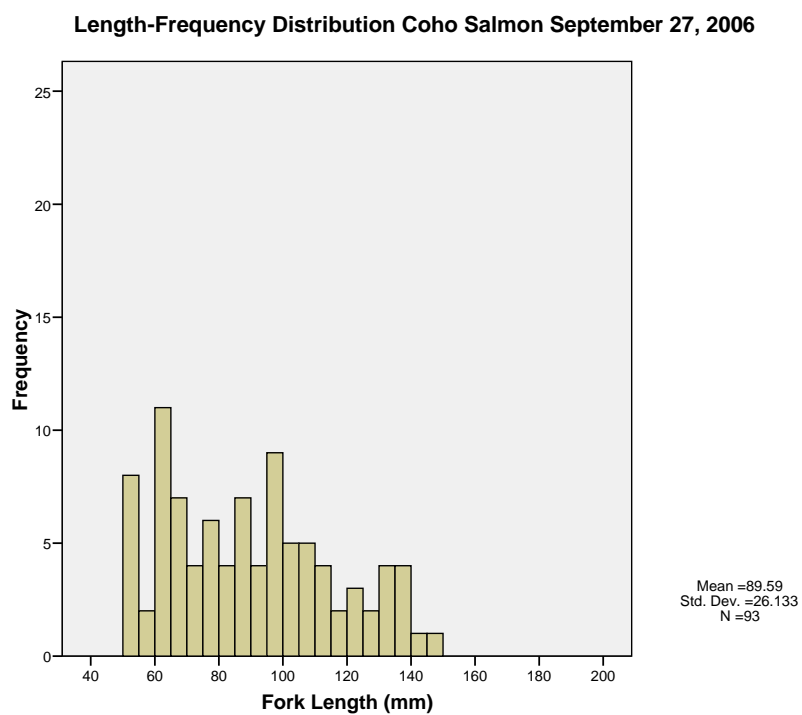


Figure 6. Length-frequency distribution for juvenile coho on 9/27/2006. Four sites were pooled.

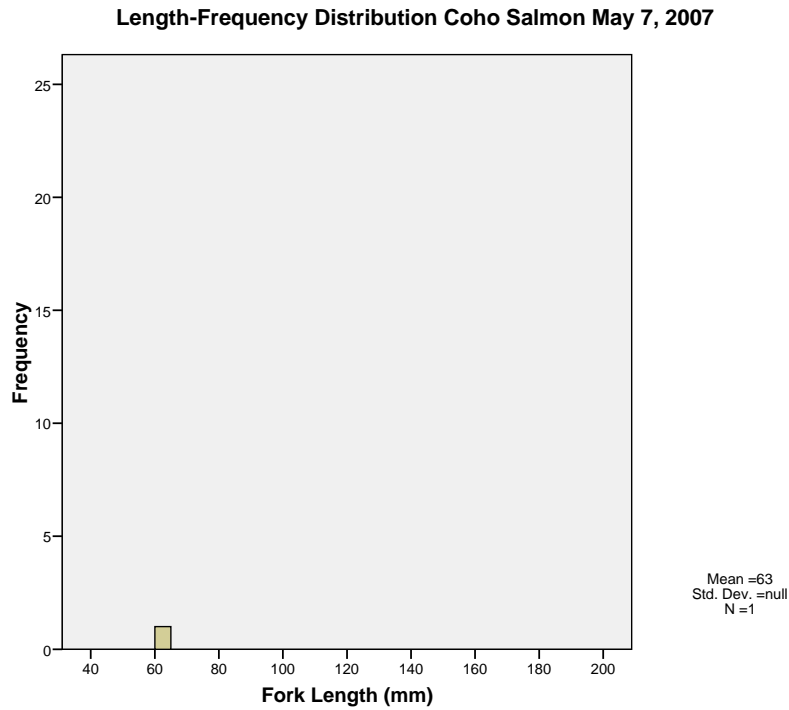


Figure 7. Length-frequency distribution for juvenile coho on 5/1/2007. Datum is from one site.

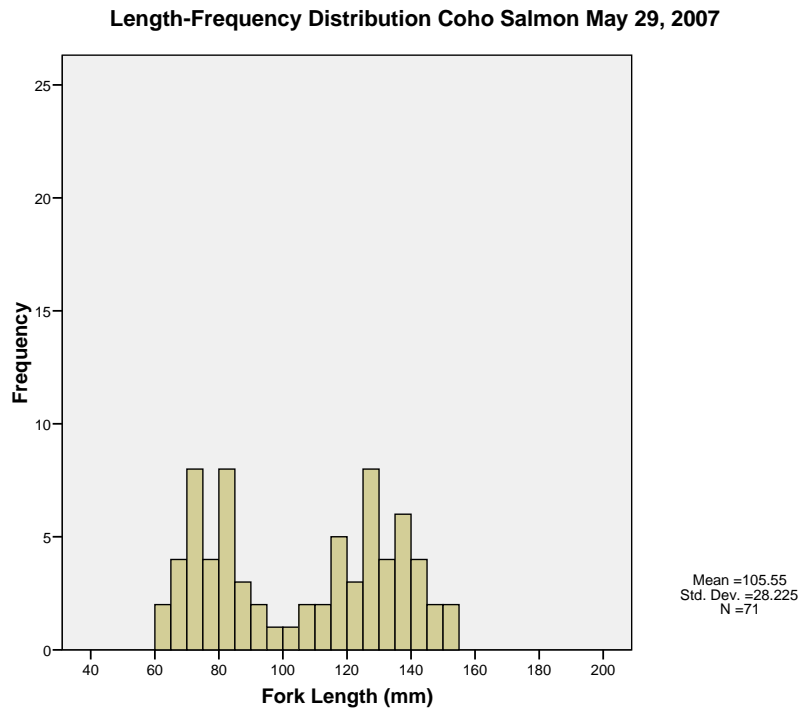
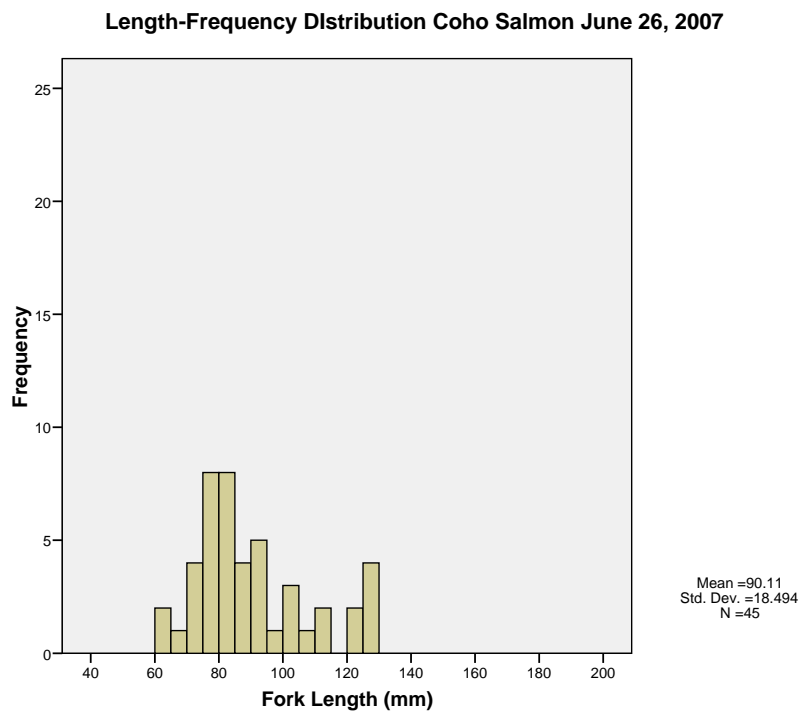
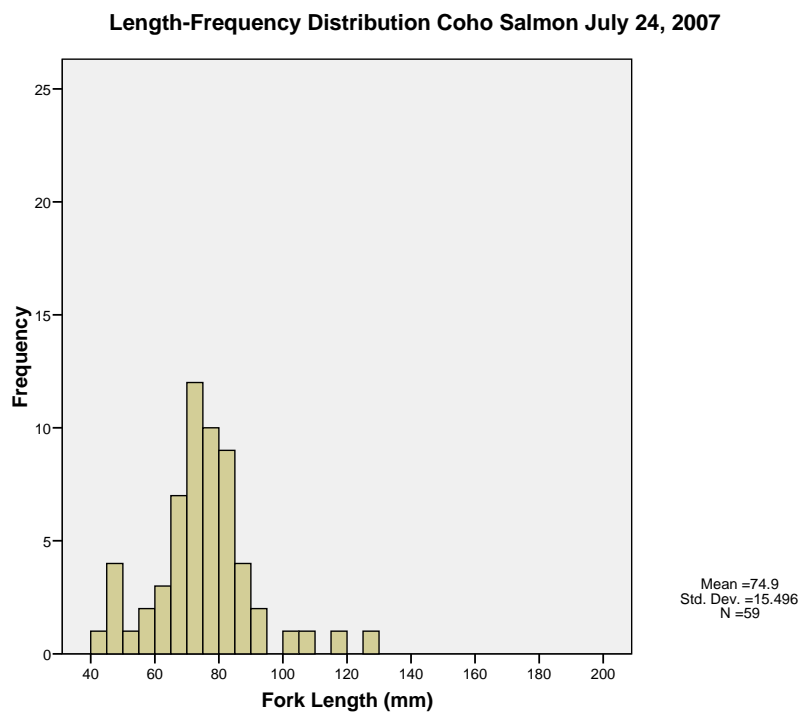


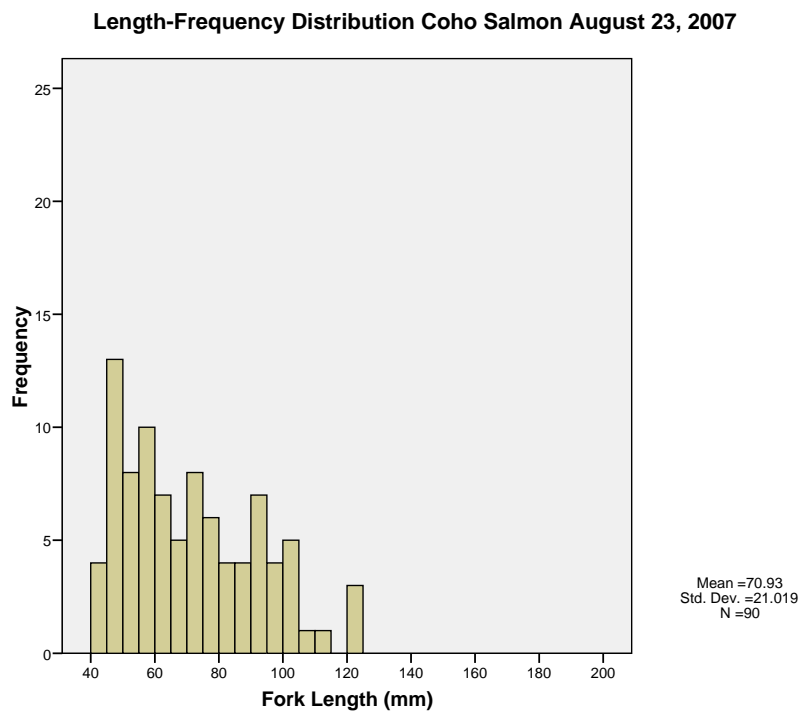
Figure 8. Length-frequency distribution for juvenile coho on 5/29/2007. Data was pooled from seven sites.



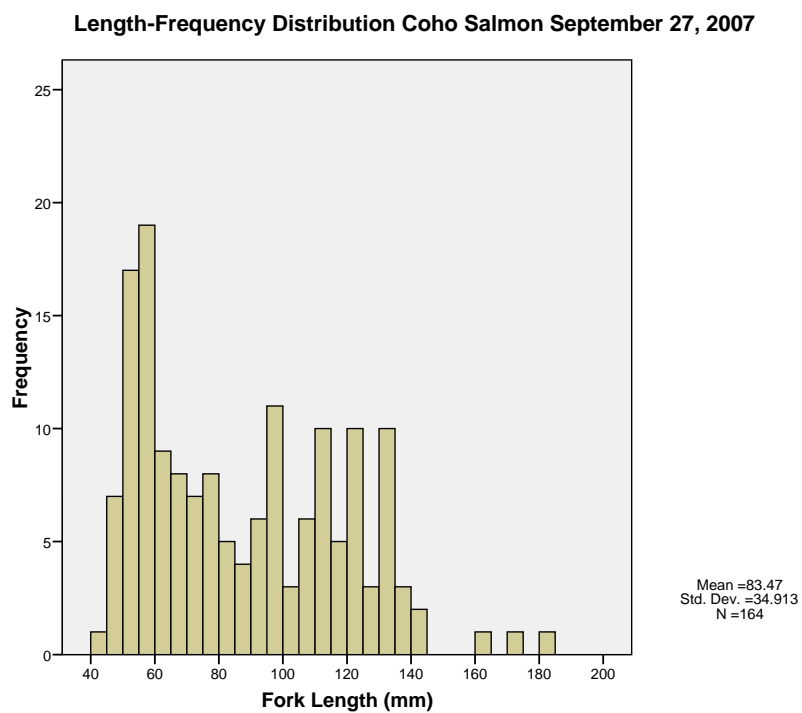
**Figure 9. Length-frequency distribution for juvenile coho on 6/26/2007.
Data was pooled from seven sites.**



**Figure 10. Length-frequency distribution for juvenile coho on 7/24/2007.
Data was pooled from nine sites.**



**Figure 11. Length-frequency distribution for juvenile coho on 8/23/2007.
Data was pooled from 11 sites.**



**Figure 12. Length-frequency distribution for juvenile coho on 9/27/2007.
Data was pooled from 10 sites.**

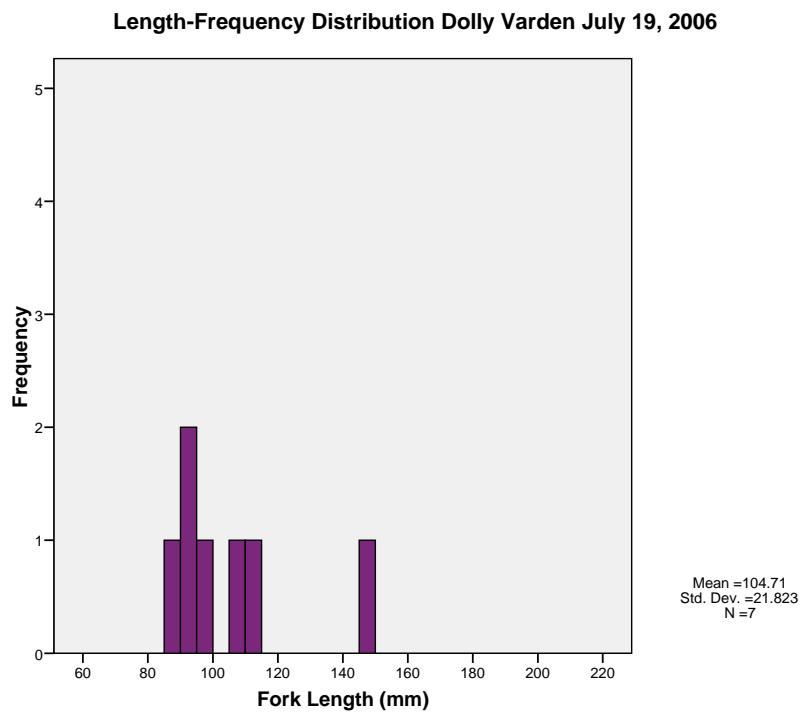


Figure 13. Length-Frequency for Dolly Varden, 7/19/2006

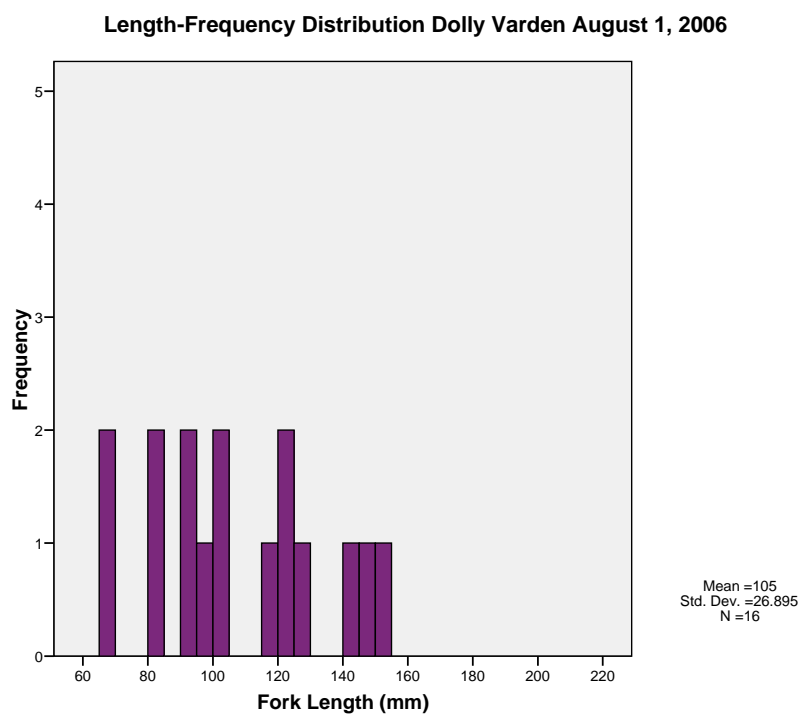


Figure 14. Length-Frequency for Dolly Varden, 8/1/2006

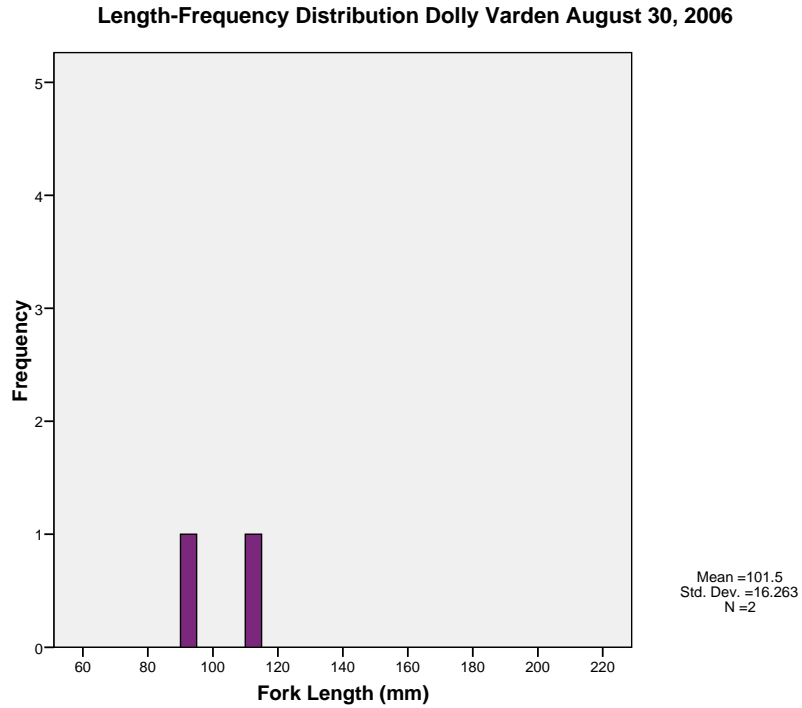


Figure 15. Length-frequency distribution for Dolly Varden on 8/30/2006.

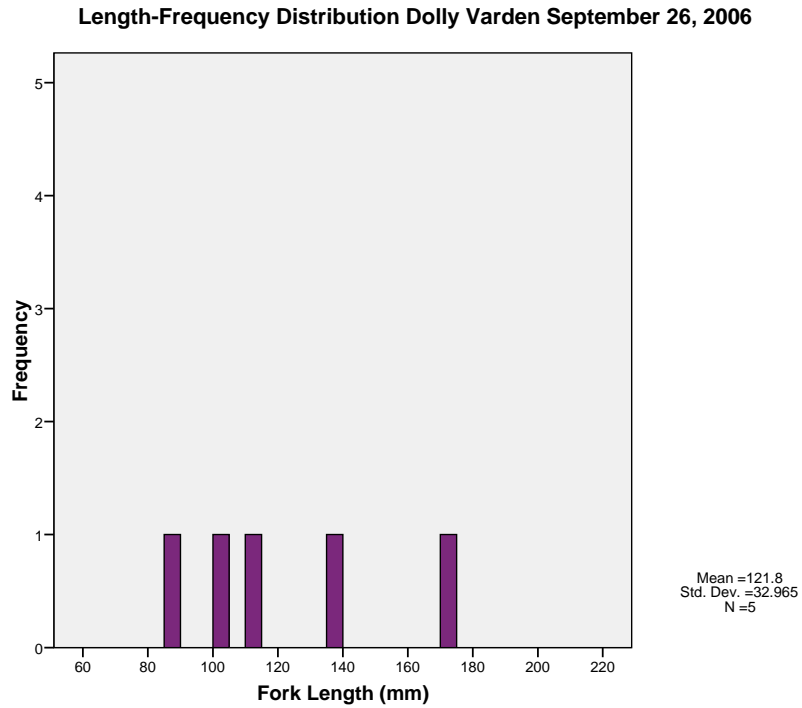


Figure 16. Length-frequency distribution for Dolly Varden on 9/26/2006.

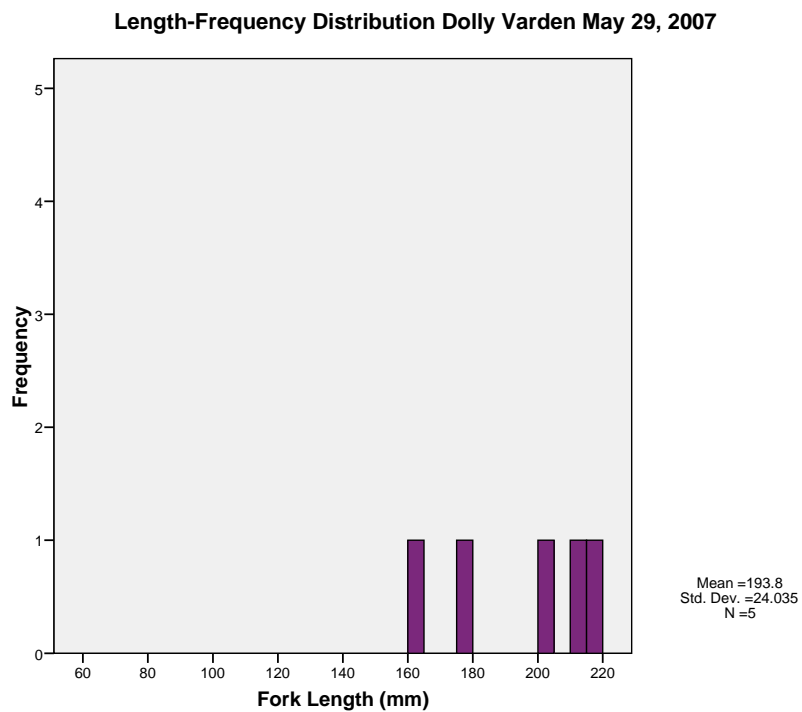


Figure 17. Length-Frequency for Dolly Varden, 5/29/2007

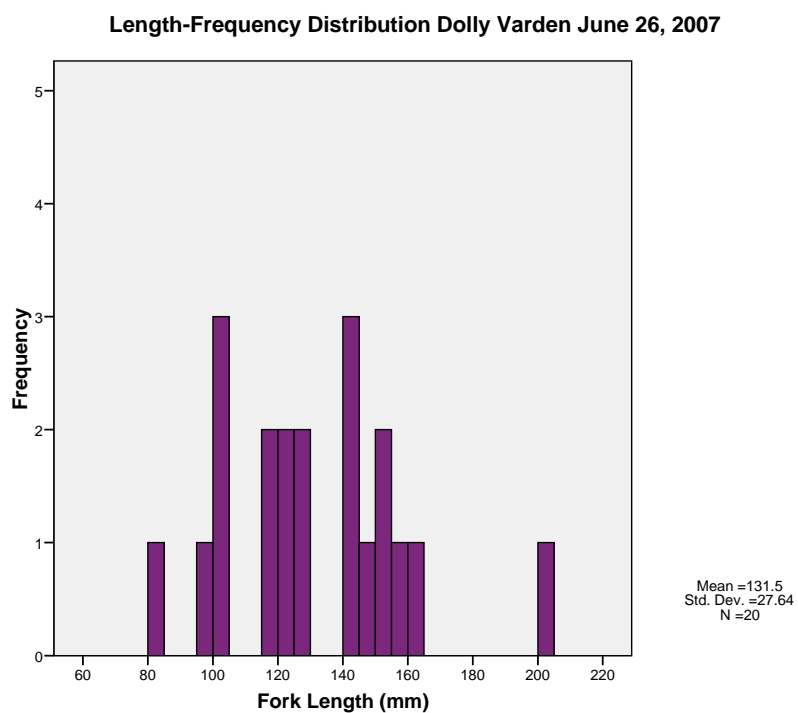


Figure 18. Length-Frequency for Dolly Varden, 6/26/2007

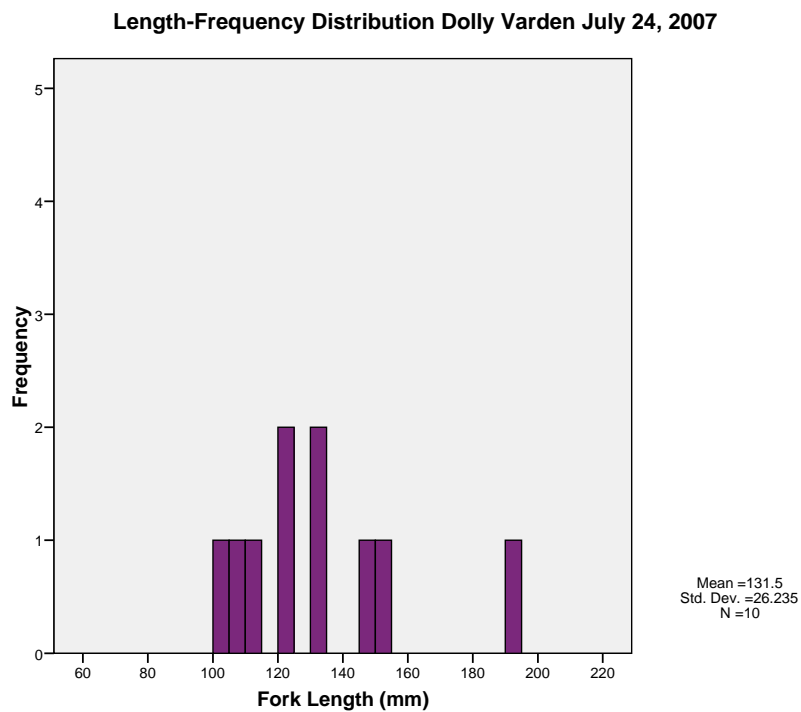


Figure 19. Length-Frequency for Dolly Varden, 7/24/2007

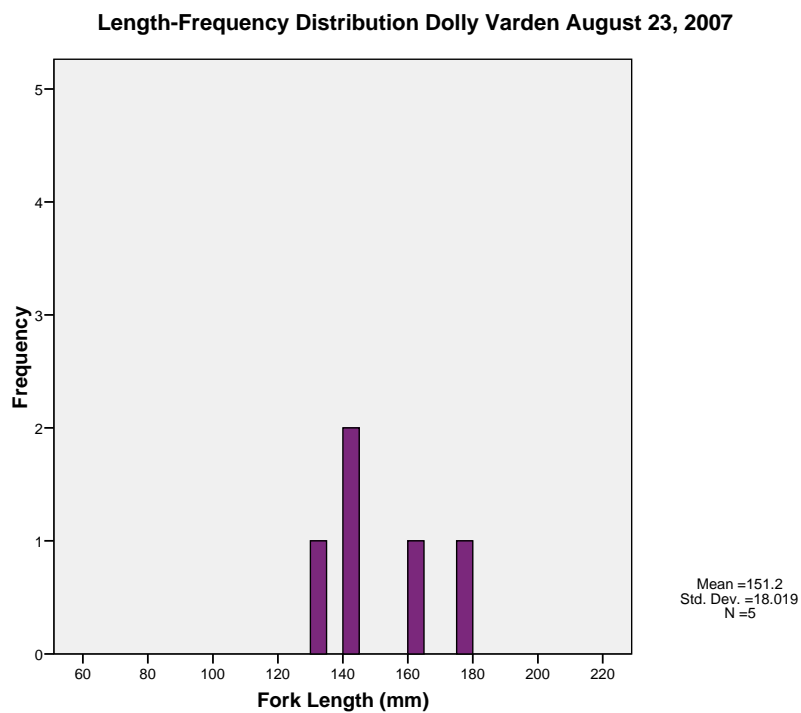


Figure 20. Length-Frequency for Dolly Varden, 8/23/2007

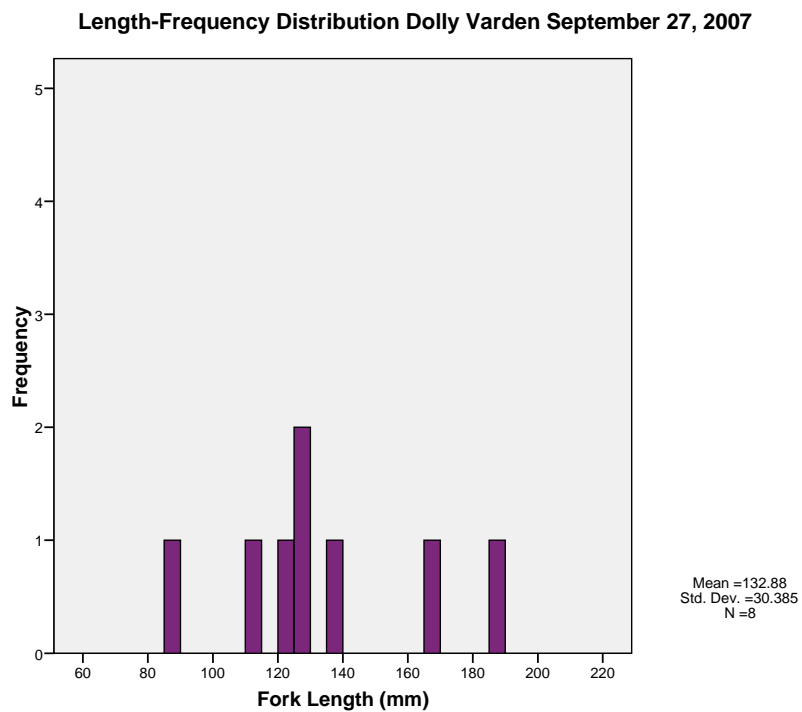


Figure 21. Length-frequency distribution for Dolly Varden on 9/27/2007.

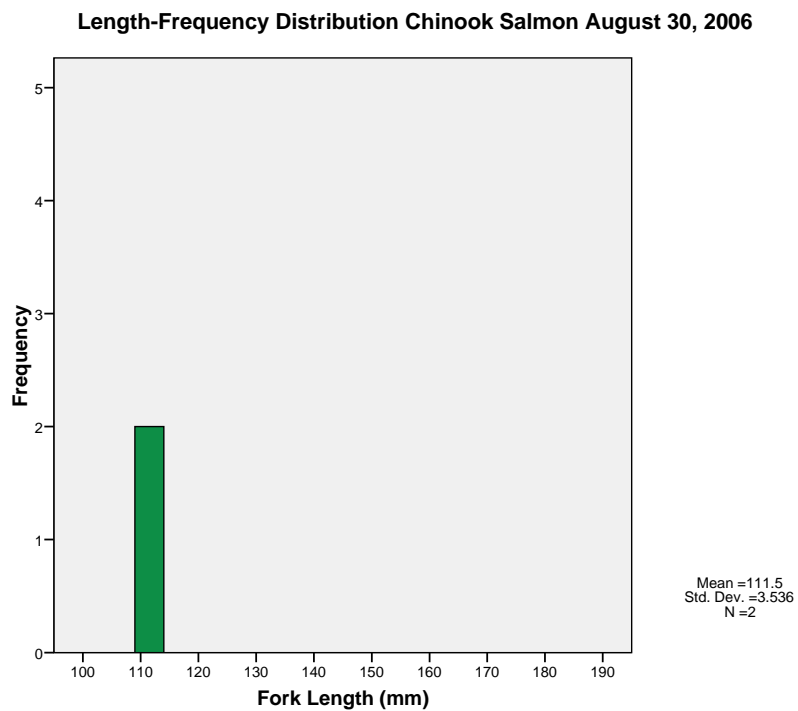


Figure 22. Length-Frequency for Chinook Salmon, 8/30/2006

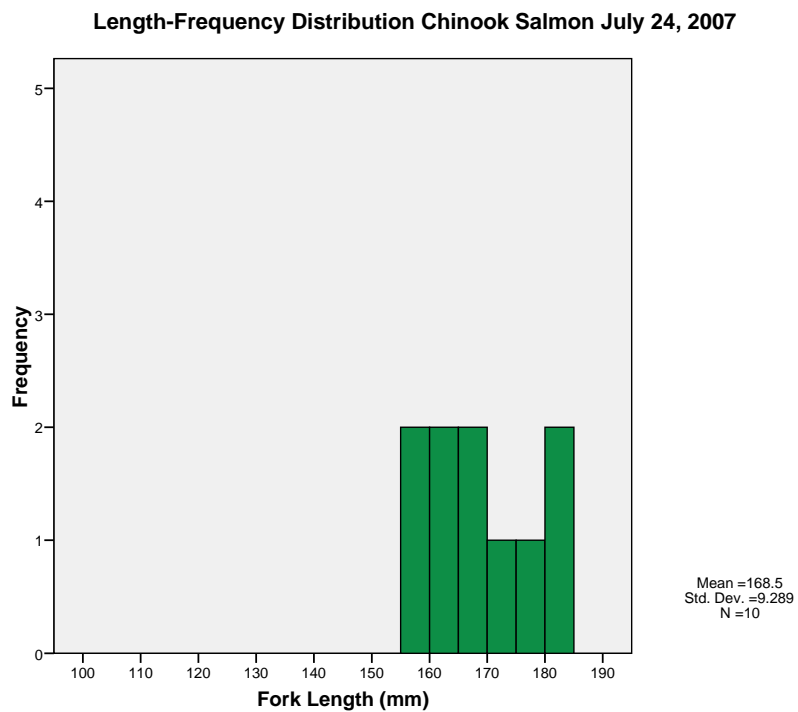


Figure 23. Length-Frequency for Chinook Salmon, 7/24/2007

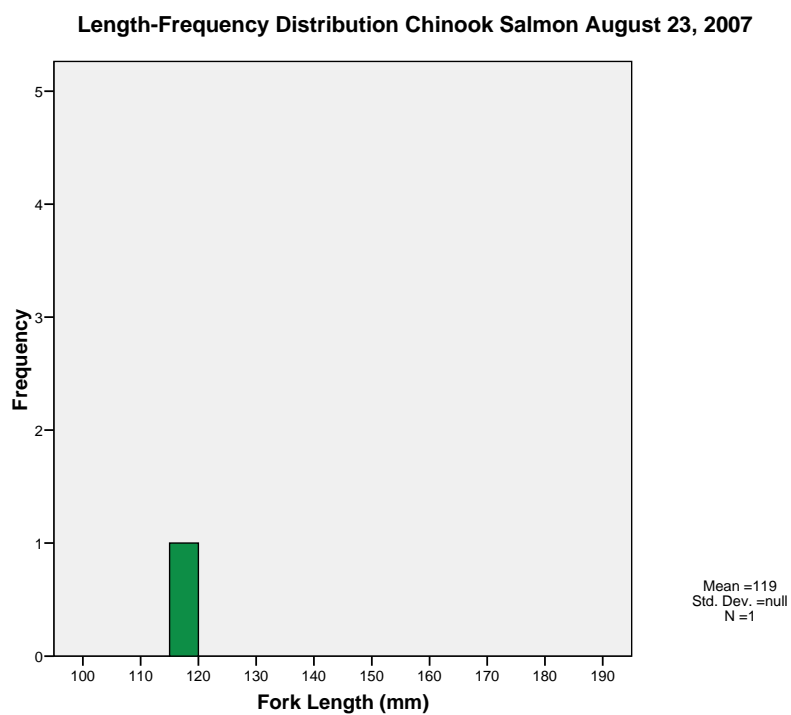


Figure 24. Length-Frequency for Chinook Salmon, 8/23/2007

Spawning Surveys

Three species of salmonids were documented at six of the eight spawning survey sites (Table 3; Appendix A-Map 2). Total adult fish observed, including both alive and mortalities, were 1094 pink salmon, 14 coho salmon and 9 Dolly Varden. A summary of adult fish observed by spawning survey site is provided in Table 3.

Pink salmon were generally more abundant at sites in 2006 (858 pink salmon observed) than in 2007 (236 pink salmon observed). This is common with pink salmon because they take two years to mature and therefore consist of odd- and even-year populations in which the odd- or even-year cycle predominates. In northern latitudes, even-year populations tend to be more abundant than odd-year populations (Quinn 2005).

Table 3. Summary of spawning survey results 2006-2007

| Site location | Species observed | No. of surveys | Spawning observed? | Alive fish | Mortalities | Total no. of fish observed |
|--------------------------|------------------|----------------|--------------------|------------|-------------|----------------------------|
| Ingram Creek (MP 75.2) | Pink salmon | 11 | Yes | 382 | 202 | 584 |
| | Coho salmon | 11 | Yes | 7 | 1 | 8 |
| Ingram Slough (MP 75.3) | Pink salmon | 9 | Yes | 297 | 42 | 339 |
| | Coho salmon | 1 | Yes | 6 | 0 | 6 |
| MP 76.0 | Dolly Varden | 1 | No | 8 | 0 | 8 |
| | None | 11 | No | 0 | 0 | 0 |
| MP 81.9 | None | 11 | No | 0 | 0 | 0 |
| Peterson Creek (MP 84.1) | None | 11 | No | 0 | 0 | 0 |
| Kern Creek (MP 86.3) | Pink salmon | 11 | Yes | 8 | 2 | 10 |
| | Dolly Varden | 11 | No | 1 | 0 | 1 |
| Virgin Creek (MP 89.1) | Pink salmon | 10 | No | 9 | 2 | 11 |
| Glacier Creek (MP 89.7) | Pink salmon | 11 | Yes | 78 | 72 | 149 |

Survey results are generally consistent with the ADF&G anadromous stream catalog although no pink salmon were documented at Peterson Creek and no chum salmon were documented at Kern Creek. In addition, juvenile and adult spawning coho salmon were documented at MP 76.0 between the Placer River overflow and Ingram Creek. A flyover of the study area on April 25, 2007 and a review of aerial photography suggest that adult coho salmon are able to access the large ponds via a small tributary that enters the Placer River overflow channel approximately 2000 ft upstream from the Placer River Bridge.

A summary of spawning survey and minnow trapping results is provided below by individual sample site. Site photos are available in Appendix D.

Site Descriptions

Ingram Creek (MP 75.2)

Ingram Creek flows under the Ingram Creek bridge near milepost 75.0 of the Seward Highway and has been previously documented by ADF&G to contain Dolly Varden, coho, pink, and chum salmon (ADF&G, 2006, Table 1). Eleven spawning surveys were conducted on Ingram Creek (7/19/06, 7/31/06, 8/30/06, 9/20/06, 6/15/07, 6/26/07, 7/11/07, 7/26/07, 8/23/07, 9/13/07, and 9/27/07). Surveys extended downstream beyond the road corridor to account for a potential

alternative which proposes a bridge crossing of the Turnagain Arm originating near Ingram Creek. Spawning surveys covered the area approximately 600 ft downstream to 200 ft upstream of the bridge crossing. A total of 584 pink salmon and 8 coho salmon were recorded over the course of the study (Table 3). Minnow trapping was conducted on 8/1/06, 5/29/07, 7/24/07, 8/23/07, and 9/27/07 and documented juvenile coho, Dolly Varden, threespine stickleback, and sculpin. Coho was the dominant species during both 2006 and 2007 (Figure 25). Site photos for all sample sites are presented in Appendix D.

Ingram Slough (MP 75.3)

Ingram Slough is a small tributary that flows into Ingram Creek approximately 125 ft upstream of the highway. Aerial photography suggests that the creek historically flowed directly into Turnagain Arm but was rerouted into Ingram Creek during the building of the highway following the 1964 earthquake. Nine spawning surveys were conducted at Ingram Slough (7/19/06, 7/31/06, 8/30/06, 9/20/06, 6/26/07, 7/11/07, 8/15/07, 8/23/07, and 9/27/07). A total of 339 pink salmon (Table 3) were observed during 2006 and 2007 surveys confirming the presence of pink salmon as previously documented by ADF&G (ADF&G, 2006, Table 1). Pink salmon spawning activity was observed at the downstream extent of the sample reach near the confluence with Ingram Creek as well as several hundred feet upstream of the confluence. Minnow trapping was conducted on seven separate events (7/20/06, 8/2/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07). Juvenile coho and Dolly Varden were the dominant fish species. Threespine stickleback and sculpin were also captured in 2006 and 2007 respectively (Figure 26).

MP 76.0

MP 76.0 is a large wetland complex located on the southwest side of the highway between mileposts 76.0 and 77.0. A flyover of the study area on April 25, 2007 and a review of aerial photography suggest that the area is connected to the Placer River drainage via a small tributary that enters the Placer River overflow channel approximately 2000 ft upstream from the Placer River Bridge. Minnow trapping conducted on 7/20/06, 8/1/06, 9/27/06, 5/7/07, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07 documented juvenile coho, threespine stickleback and Dolly Varden in both 2006 and 2007. Chinook salmon were only documented in 2007; MP 76.0 is one of only two sites within the project area where Chinook were documented (Figure 27). During the 9/27/06 sampling event, spawning coho salmon and adult Dolly Varden were observed at the northwestern extent of the wetland (Table 3).

MP 78.0

MP 78.0 is a large marsh located in the Placer River system on the south side of the highway between the Placer River and the Placer River Overflow. Minnow trap surveys were conducted on 6/26/07, 7/24/07, and 8/23/07; no surveys were conducted at this site in 2006. Despite its proximity to the Placer River and Placer River Overflow channels, threespine stickleback was the only species documented at this site (Figure 28).

MP 81.0

MP 81.0 is a wetland complex located northeast of the highway and Alaska railroad near milepost 81.0. Minnow trapping was conducted on 7/20/06. The site was not revisited in 2006 or 2007 because it is located behind the railroad corridor and therefore will not be affected by the project. No connection to the Twentymile River was observed and no culvert exists under the highway to provide fish passage however coho salmon and stickleback were recorded at the site (Figure 29).

Relative Abundance Ingram Creek (MP 75.2), 2006-2007



Figure 25. Ingram Creek (MP 75.2) Species Relative Abundance by Sample Year

Relative Abundance Ingram Slough (MP 75.3), 2006-2007

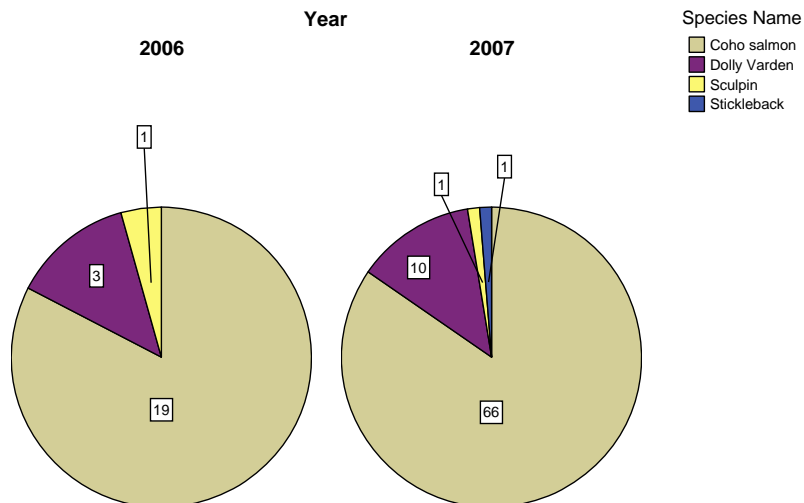


Figure 26. Ingram Slough (MP 75.3) Species Relative Abundance by Sample Year

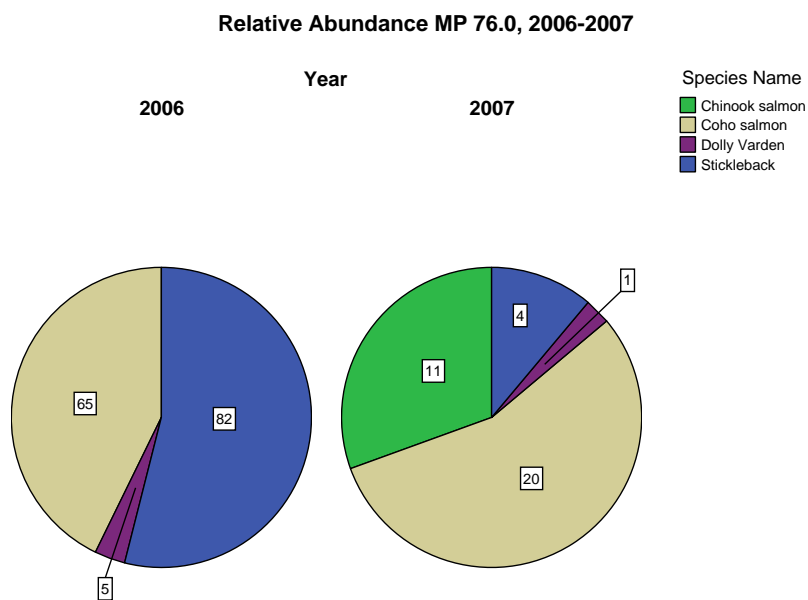


Figure 27. MP 76 Species Relative Abundance by Sample Year

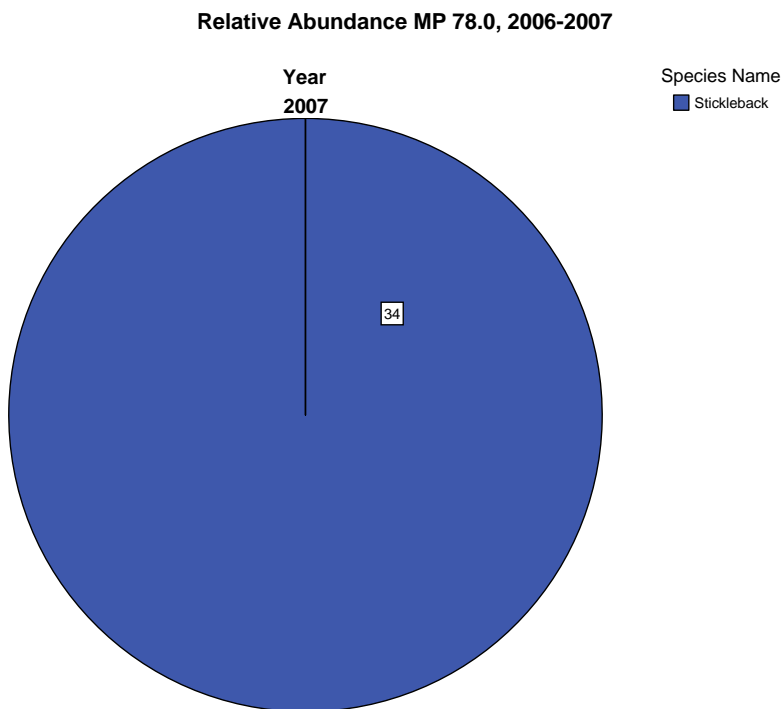


Figure 28. MP 78 Species Relative Abundance by Sample Year

MP 81.9

MP 81.9 is a slough that connects to Turnagain Arm via a 72-inch culvert located approximately 1.5 miles north of the Twentymile River near milepost 82.0. Eleven spawning surveys were conducted at this site (7/19/06, 8/1/06, 9/1/06, 9/20/06, 6/15/07, 6/26/07, 7/11/07, 7/26/07, 8/24/07, 9/13/07, and 9/27/07). No adult fish were observed (Table 3). Seven minnow trapping events were conducted (7/20/06, 8/2/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07). These events documented threespine stickleback, juvenile coho salmon and Dolly Varden (Figure 30). Dolly Varden had not previously been documented at this site according to ADF&G records (ADF&G, 2006; Table 1).

MP 82.8

MP 82.8 is a long narrow pond located between the railroad and the highway southeast of MP 83.0. Minnow trapping was conducted on 8/2/06, 5/29/07, 7/24/07, and 8/23/07. Stickleback were recorded in 2006 and 2007 but juvenile coho salmon were only captured in the 2006 event (Figure 31); however a juvenile coho salmon was visually observed in a small pool immediately upstream of the culvert at MP 82.8. The culvert terminates at a small pool on the upstream end and this small pool appears to be seasonally isolated during low tide from the remainder of the pond at this site (Appendix D-Photo 27).

MP 83.30

MP 83.30 is a pond located east of the highway and railroad and north of milepost 83.0. The site is separated from MP 83.31 by an earthen embankment on its north end. A 36-inch culvert under the railroad and highway near the north end of MP 83.30 connects the pond to Turnagain Arm. Stickleback and a juvenile coho salmon were observed stranded or dead at the downstream end of this culvert during the 7/24/07 event (Appendix D-Photos 30 and 31). Minnow trapping was conducted during eight sampling events (8/2/06, 9/27/06, 5/7/07, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) in a short section of open flowing water located between the railroad and highway culverts. Juvenile coho, Dolly Varden and threespine stickleback were captured in 2006 and 2007 (Figure 32).

MP 83.31

Site 83.31 is a pond located east of the highway and railroad and north of milepost 83.0. The site is separated from MP 83.30 by an earthen embankment on its south end. A 36-inch culvert under the railroad and highway near the south end of MP 83.31 connects the pond to Turnagain Arm. Stickleback and a juvenile coho salmon were observed stranded or dead at the downstream end of this culvert during the 7/24/07 event (Appendix D-Photos 28 and 29). Minnow trapping was conducted during eight sampling events (8/2/06, 9/27/06, 5/7/07, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) in a short section of open flowing water located between the railroad and highway culverts. Juvenile coho, Dolly Varden and threespine stickleback were captured in 2006 and 2007 (Figure 33).

MP 83.8

MP 83.8 is a small wetland area located south of Peterson Creek near milepost 84. The site was sampled once using minnow traps (8/2/06) and no fish were captured. No connectivity between MP 83.8 and Peterson Creek was found and therefore no additional sampling was conducted.

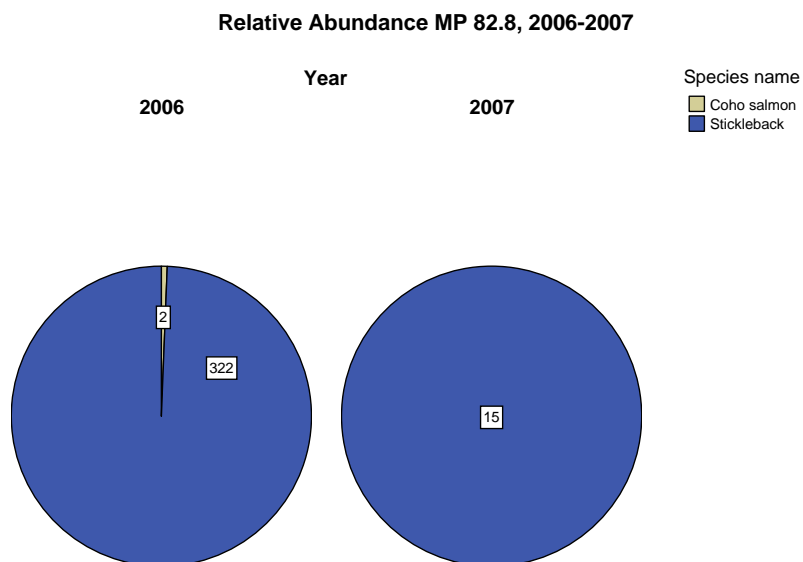


Figure 31. MP 82.8 Species Relative Abundance by Sample Year

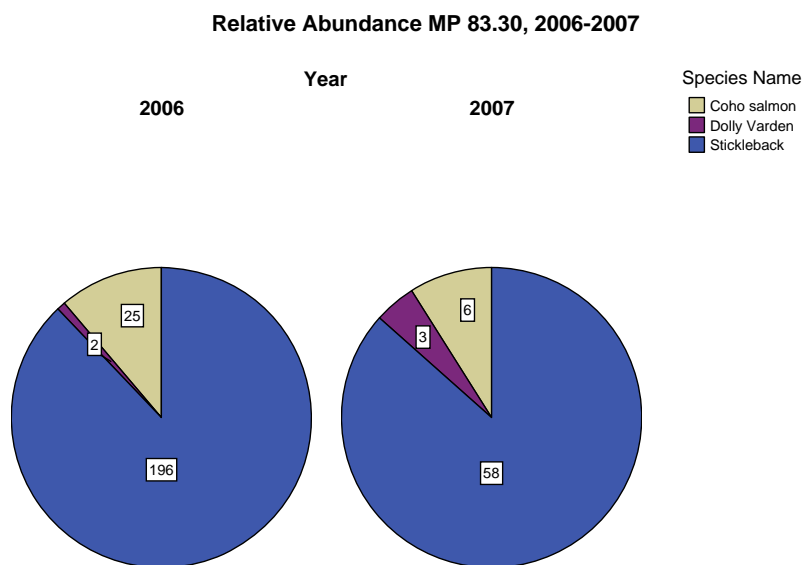


Figure 32. MP 83.30 Species Relative Abundance by Sample Year

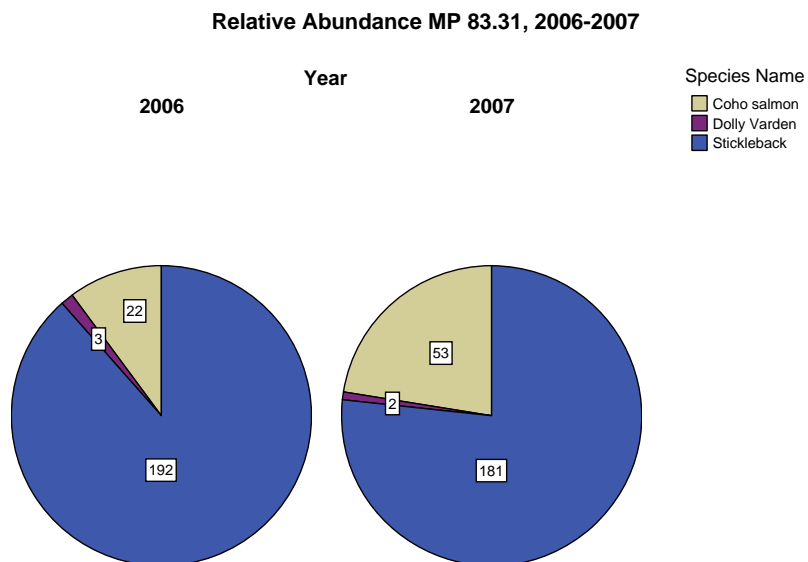


Figure 33. MP 83.31 Species Relative Abundance by Sample Year

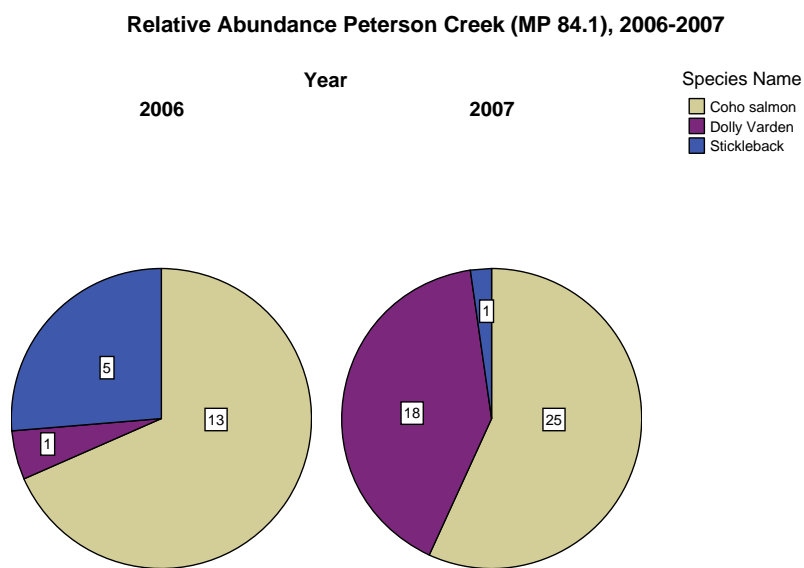


Figure 34. Peterson Creek (MP 84.1) Species Relative Abundance by Sample Year

Peterson Creek (MP 84.1)

Peterson Creek is a glacially-silted stream bridged by the Seward Highway just north of milepost 84.0. Spawning pink salmon have been documented in the creek by earlier studies (ADF&G 2006; Table 1). Eleven spawning surveys were conducted at the creek (7/19/06, 8/1/06, 9/1/06, 9/20/06, 6/15/07, 6/26/07, 7/11/07, 7/26/07, 8/24/07, 9/13/07, and 9/27/07) and no adult fish were observed (Table 3). The glacially-silted waters present at the site reduce the effectiveness of foot surveys and therefore some fish may not have been visible; however, the fact that no salmon carcasses were observed during both years of the study suggest that the presence of salmon within and immediately upstream of the study reach is minimal. Minnow trapping was conducted during seven sampling events (7/19/06, 8/1/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) and captured stickleback, juvenile coho salmon and Dolly Varden (Figure 34). All of the fish were captured from a small tributary of Peterson Creek that flows parallel to the Seward Highway and flows into Peterson Creek immediately upstream and northeast of the Peterson Creek bridge. The tributary is fully-described in the Aquatic Habitat Analysis Report for the Project (HDR Alaska, 2007a).

MP 84.6

MP 84.6 is a small slough located approximately midway between mileposts 84 and 85 and is connected to Turnagain Arm via a 36-inch culvert. Minnow trapping was conducted on 8/2/06 and insufficient water depth for sampling was available on 7/24/07. It was trapped again on 8/23/2007 and no fish were captured. Threespine stickleback was the only species captured in 2006 (Figure 35).

MP 85.2

MP 85.2 is a pond and wetland area that is approximately 0.65 miles in length and located between milepost 85.0 and 86.0. The site is connected to Turnagain Arm via a 36-inch culvert. Minnow trapping was conducted on 8/2/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07. Threespine stickleback were observed during both 2006 and 2007 while Dolly Varden were only observed in 2006 and coho were only observed in 2007 (Figure 36).

MP 85.9

MP 85.9 is a long narrow pond located approximately 20ft NE of the highway and is connected to Turnagain Arm via a 36-inch culvert. Minnow trapping was conducted on 8/2/06 and 5/29/07 and only threespine stickleback were captured (Figure 37).

Kern Creek (MP 86.3)

Kern Creek flows under the railroad and highway through two 120-inch culverts located between mileposts 86 and 87; pink, chum and coho salmon have been documented during past surveys (ADF&G 2006; Table 1). Eleven spawning surveys (7/19/06, 8/1/06, 9/1/06, 9/20/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, 9/13/07, and 9/27/07) were conducted on Kern Creek. Ten adult pink salmon and one Dolly Varden were observed (Table 3). Six minnow trapping efforts (7/19/06, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) were conducted at Kern Creek. Juvenile coho salmon were captured only during 2007 efforts (Figure 38).

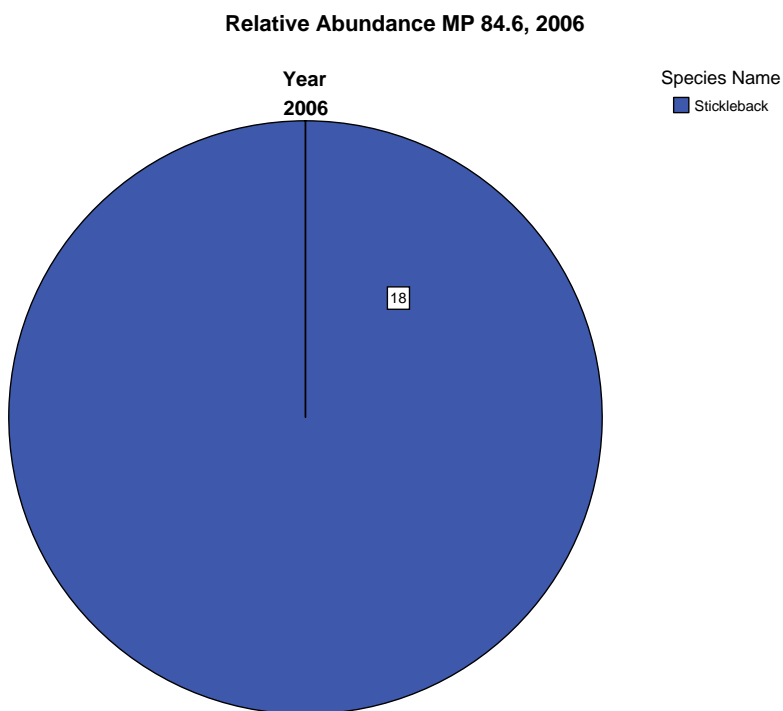


Figure 35. MP 84.6 Species Relative Abundance by Sample Year

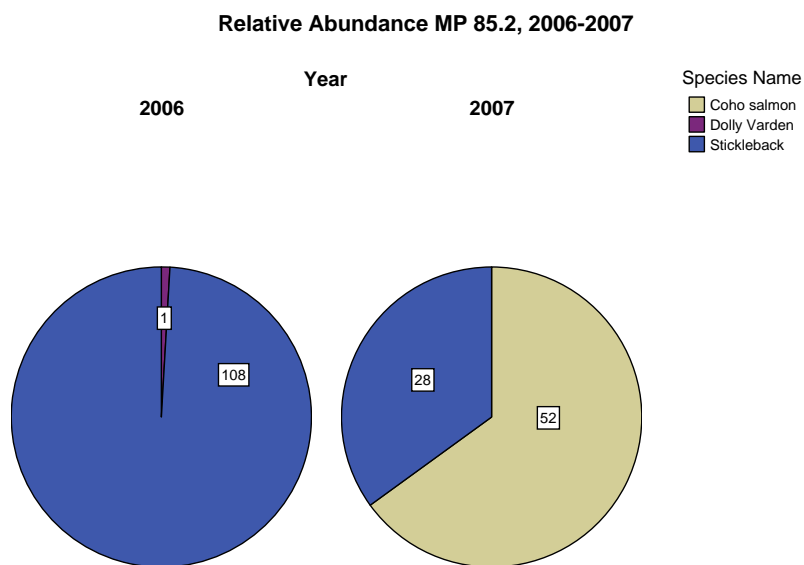


Figure 36. MP 85.2 Species Relative Abundance by Sample Year

MP 87.1

MP 87.1 is a large pond located adjacent to milepost 87.0 that drains to Turnagain Arm via a 42-inch culvert. Numerous stickleback were observed stranded or dead at the downstream end of this culvert during the 7/24/07 sampling event (Appendix D-Photos 32 and 33). Minnow trapping was conducted on 7/20/06, 8/1/06, 5/7/07, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07 and threespine stickleback, juvenile coho salmon and Dolly Varden were captured during both years (Figure 39).

MP 87.7

MP 87.7 is a small pond located between milepost 87.0 and 88.0 that is connected to Turnagain Arm via a 24-inch culvert. The site was examined in 2006 and 2007 but minnow traps were not set due to insufficient water depths and the available habitat was determined to be unsuitable for fish.

MP 88.1

MP 88.1 is a pond located at milepost 88.0 connected to Turnagain Arm via a 60-inch culvert. Minnow trapping was conducted during eight sampling events (7/20/06, 9/27/06, 5/7/07, 5/29/07, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) and juvenile coho salmon and threespine stickleback were captured in both 2006 and 2007 (Figure 40).

Virgin Creek (MP 89.1)

Virgin Creek is bridged at the highway with a box culvert. Coho, pink and chum salmon have been previously documented in Virgin Creek (ADF&G, 2006; Table 1). Ten spawning surveys were conducted at this site (7/21/06, 8/1/06, 8/30/06, 9/20/06, 6/15/07, 7/11/07, 7/26/07, 8/24/07, 9/13/07, and 9/27/07) and adult pink salmon and Dolly Varden were documented both up- and downstream of the highway. A total of six pink salmon were observed (Table 3). Minnow trapping was conducted on six sampling events (8/2/06, 8/31/06, 6/26/07, 7/24/07, 8/23/07, and 9/27/07) and juvenile coho and Dolly Varden were captured during both years of the study, whereas threespine stickleback and sculpin were only trapped in 2007 (Figure 41).

MP 89.6

MP 89.6 is a wetland area that is located on the north side of the highway between Virgin and Glacier Creeks. The site is connected to Turnagain Arm via a 60-inch culvert. Minnow trapping was conducted on six sampling events (8/1/06, 8/31/06, 6/26/07, 7/24/07, 8/23/07, and 9/27/07). Threespine stickleback and juvenile coho were observed during 2006 and 2007 while juvenile Chinook salmon and Dolly Varden were only observed in 2006 (Figure 42).

Glacier Creek (MP 89.7)

Glacier Creek is a glacially-silted stream bridged by the Seward Highway east of milepost 90 and the turnoff to Girdwood. Five species of salmon (sockeye, Chinook, coho, pink and chum salmon) have been previously documented in Glacier Creek (ADF&G 2006; Table 1). Eleven spawning surveys were conducted on Glacier Creek (7/21/06, 8/1/06, 8/30/06, 9/26/06, 6/15/07, 6/26/07, 7/11/07, 7/24/07, 8/23/07, 9/13/07, and 9/27/07). A total of 80 pink salmon were observed up- and downstream of the highway (Table 3). The glacially-silted waters present at the site reduce the effectiveness of foot surveys and therefore more fish were likely present than observed during survey events.

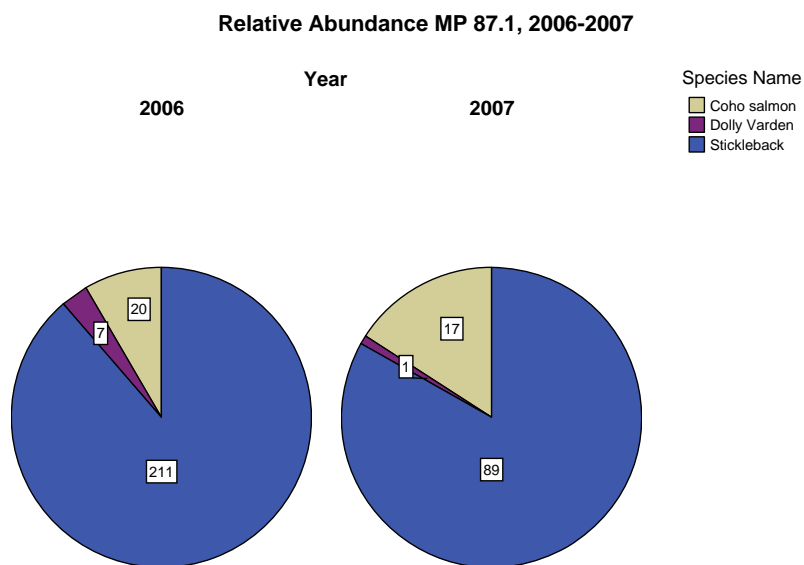


Figure 39. MP 87.1 Species Relative Abundance by Sample Year

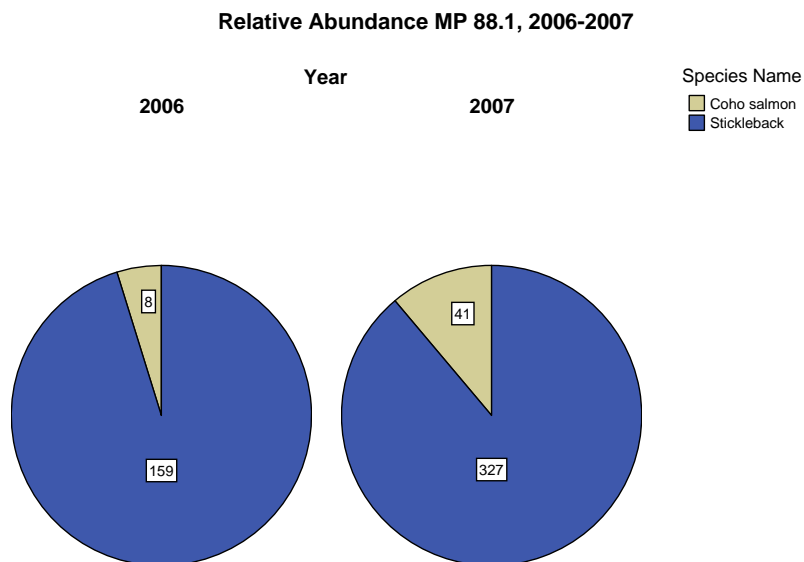


Figure 40. MP 88.1 Species Relative Abundance by Sample Year

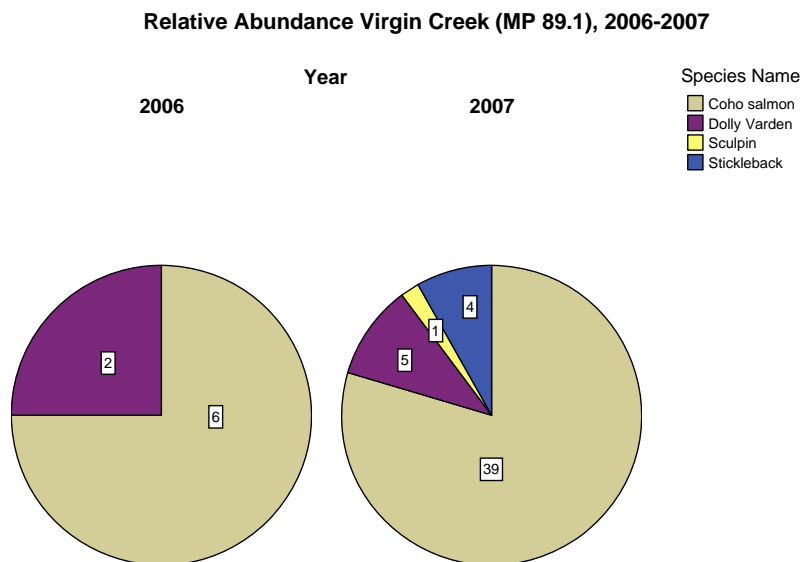


Figure 41. Virgin Creek (MP 89.1) Species Relative Abundance by Sample Year

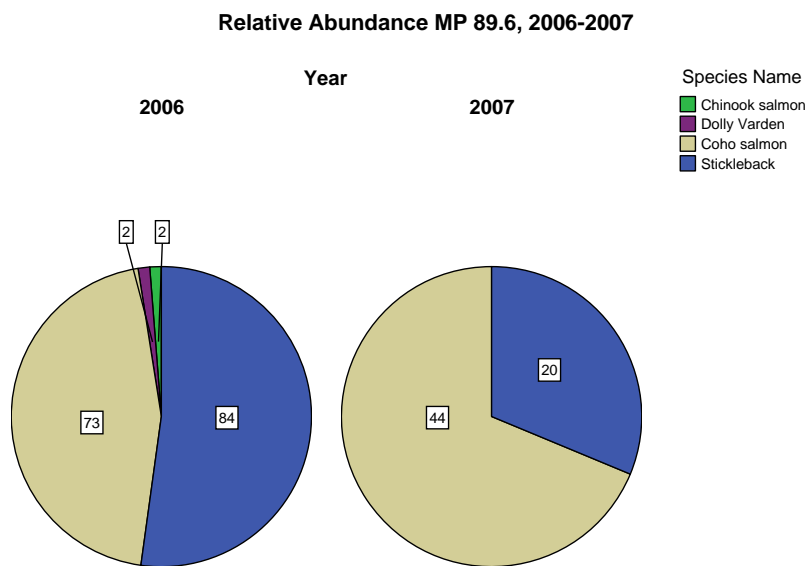


Figure 42. MP 89.6 Species Relative Abundance by Sample Year

MP 89.8

MP 89.8 is a large wetland complex extending from milepost 89 to 90 and located south of the highway and is connected to Turnagain Arm via a 24-inch culvert. Minnow trapping was conducted on 8/2/06, 8/31/06, 6/26/07, 7/24/07, 8/23/07, and 9/27/07 and juvenile coho and threespine stickleback were captured in both 2006 and 2007 (Figure 43).

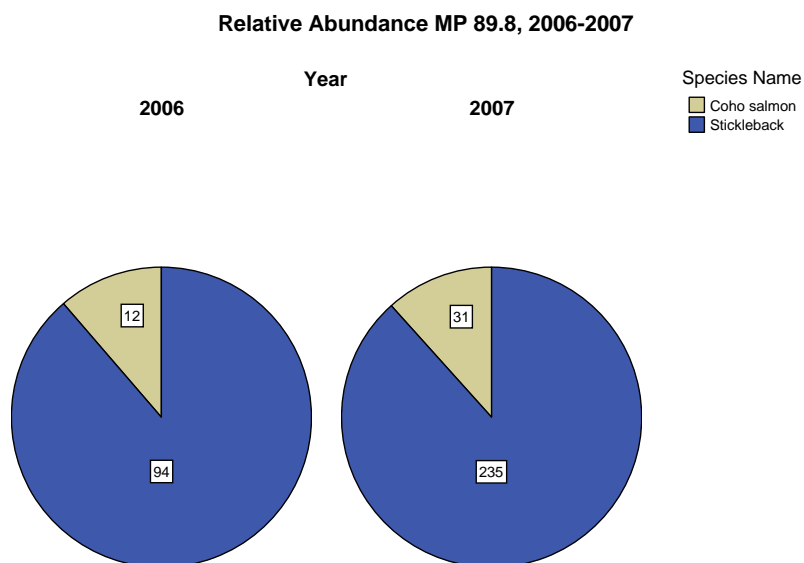


Figure 43. MP 89.8 Species Relative Abundance by Sample Year

REFERENCES

Alaska Department of Fish and Game (ADF&G). 2007. Anadromous Stream Catalog. Accessed on line at http://gis.sf.adfg.state.ak.us/AWC_IMS/viewer.htm. Viewed in March 2007.

Brna, Phil, United States Fish and Wildlife Service. 12/13/06. Personal communication with Paul McLarnon regarding present and historical fish species distribution in Turnagain Arm.

HDR Alaska, Inc. 2007a. Seward Highway MP 75-90 Aquatic Habitat Analysis, 2007.

HDR Alaska, Inc. 2007b. Seward Highway Freshwater Fisheries Resources Study Plan.

HDR Alaska, Inc. 2006. Seward Highway MP 75-90 Eulachon Larvae Distribution and Density in Turnagain Arm, 2006.

Quinn, T.P. 2005. The behaviour and ecology of Pacific salmon and trout. University of Washington Press. 378 p.

Appendix A
Maps

Appendix B
Fish Capture Data

Appendix C
Spawning Survey Data

Appendix D
Photos

Appendix E
Fish Resource Permits