MEAN SMOLT AGE ESTIMATION AND UNDER-AGING BIAS OF NASS RIVER STEELHEAD POPULATIONS

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Abstract

In the Nass River watershed, juvenile and adult steelhead (*Oncorhynchus mykiss*) scales were collected to summarize the mean smolt ages for major summer and winter steelhead populations, and to investigate the lack of the first-year annulus formation which results in under-aging bias. The mean smolt age and potential aging biases were investigated because it was an influential parameter to the Nass River steelhead production model. The oldest mean smolt ages for summer steelhead populations were found for the upper Nass River tributaries of Damdochax Creek (3.74 years) and Bell-Irving River (3.73 years), whereas the youngest was for the Meziadin River (3.27 years). The oldest mean smolt ages for winter steelhead populations were from Ishkheenickh (3.36 years) and Kincolith rivers (3.51 years), whereas the youngest was from Chambers Creek (3.00 years). Mean smolt ages were estimated for four populations which had no previous estimates: Bell-Irving River, Chambers Creek, Kincolith River and pooled winter steelhead from the lower Nass River (3.38 years). The mean smolt ages could not be estimated from the length of the growing season because the growing season data were incomplete, however inferences were made regarding the relative lengths of the growing season. The limited growing season data indicated interior rivers had shorter growing seasons than coastal rivers, and that the influence of large lakes on the growing season may depend on the degree of glacial influence. The mean smolt ages estimated from yearling fork length were similar to the estimates from adult scales in the Bell-Irving, Cranberry and Meziadin rivers, but the estimates from yearling fork length in the Kwinageese (2.29 years) and Tseax rivers (2.29 years) and Damdochax Creek (2.72 years) were lower than the estimates from adult scales. However these estimates were based on a small number of samples.

Comparisons of otolith and scale ages indicated there was no under-aging of juvenile steelhead, since the ages had 100 percent correspondence. However, the results indicated some adult steelhead scales may be missing the first-year annulus because on juvenile steelhead some scales from a fish were missing the first-year annulus whereas other scales from the same fish exhibited the first-year annulus. Thus, the large number of scales collected from juveniles permitted the exclusion of scales obviously missing the first-year annulus. The presence of large (>70 mm) age 0 steelhead in the Bell-Irving and Kwinageese rivers and Damdochax Creek indicated some steelhead may be missing the first-year annulus in these populations. The number of circuli from the scale focus to the scale margin was positively related to fork length for age 0 steelhead from the Bell-Irving, Cranberry, and Kwinageese rivers and for the pooled sample. Although the relationship was not significant for steelhead in the Tseax River or Seaskinnish Creek and may have been limited by few samples. The predicted maximum number of circuli formed during the first growing season ranged from 8.0 (Bell-Irving River) to 10.7 (Kwinageese River) and was 9.1 for the pooled sample, based on a maximum length of 70 mm for an age 0 fish. In 1997, adult steelhead from the Meziadin River had the highest percentage of fish suspected missing the first-year annulus (33%), followed by the Kwinageese (29%), Bell-Irving (20%) and Cranberry rivers (12%). In comparison, the maximum circuli counts on age 0 steelhead near the end of the growing season indicated 17 to 96 percent of adult steelhead were missing the first-year annulus. In sum, the missing first-year annulus may be a common negative bias in the mean smolt ages of Nass River summer steelhead populations because of the observed small size and low circuli counts on age 0 fish.

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1.0.0.0 Introduction

Currently, the B.C. Fisheries Branch is developing a habitat capability model to predict smolt production and adult abundances for Nass River summer and winter steelhead (*Oncorhynchus mykiss*) populations (Bocking *et al.* 1998). Parts of the model rely on steelhead life history characteristics which influence smolt yield, the number of required spawners and life history model estimates, such as the number of recruits per spawner, allowable harvest rates and Beverton-Holt's A value (Parken 1997b). However, some life history characteristics were more influential than others on smolt yield (Bocking and English 1992) and the life history model estimates (Parken 1997b).

Sensitivity analysis of the different model parameters indicated the effects of measurement errors on steelhead production (Bocking and English 1992; Parken 1997a). The most sensitive life history model parameter was mean smolt age, followed by egg-to-fry survival, smolt-to-adult survival and female length, when older biostandards were used (from Tautz *et al.* 1992; Parken 1997a). However, when the variability of the updated biostandards was incorporated, the most sensitive parameter was smolt-to-adult survival, followed by egg-to-fry survival, mean smolt age and female length (Parken 1997a).

The mean smolt age parameter was of particular interest because the freshwater portion of adult steelhead scales was suspected to be under-aged (negatively biased; Hooton *et al.* 1987; Tautz *et al.* 1992). In the Nass River steelhead production model (Bocking *et al.* 1998), fry-to-smolt survival was predicted from the mean smolt age using a relationship developed in the Skeena steelhead carrying capacity model, where each year of freshwater rearing was associated with a mortality rate of approximately 50 percent (Tautz *et al.* 1992). Therefore, a negatively biased mean smolt age would result in an overestimated fry-to-smolt survival. Bocking and English (1992) reported that these errors had a large effect on steelhead smolt yield in the Skeena steelhead carrying capacity model (Tautz *et al.* 1992). Similarly, Parken (1997a) reported that if the true mean smolt age was older than current estimates, then the recruits per spawner, allowable harvest rates and stock productivity estimates would be overestimated. Furthermore, these errors would result in underestimating the number of successfully spawning steelhead required to fully seed the rearing habitat. These investigations indicated accurate mean smolt age estimates were required for the Nass River steelhead production model.

For the Skeena steelhead carrying capacity model, Tautz *et al.* (1992) estimated mean smolt age from the length of the growing season, as measured by mean daily water temperatures. Mean smolt age was estimated from the length of the growing season instead of adult scales because the first-year annulus was suspected to be missing on scales of steelhead from colder Skeena River tributaries (Tautz *et al.* 1992). The relationship between mean smolt age and growing season was based on a relationship developed for Atlantic salmon (*Salmo salar*) that was adjusted to Skeena River summer steelhead (Tautz *et al.* 1992; Parken 1997b). Bocking and English (1992) compared steelhead mean smolt ages estimated from smolt scales, adult scales, yearling fork length and the growing season length. Mean smolt age estimates from the fork length of yearlings were consistently less than estimates from adult and smolt scales, however estimates from the length of the growing season were intermediate (Figure 5 in Bocking and English 1992).

Steelhead scale ages may be biased low (under-aged) because the first-year annulus may be indistinguishable (Jensen and Johnsen 1982; Hooton *et al.* 1987; Lentsch and Griffith 1987). The first-year annulus may be indistinguishable on salmonids that form few circuli before the end of the first growing season because annulus recognition relies on the change in circuli spacing during the winter (Clutter and Whitesel 1956). Thus, if few circuli spacings are present before the winter it may be difficult to recognize the dissimilarity in circuli spacing for the first-year annulus (Hooton *et al.* 1987; Lentsch and Griffith 1987). Populations with small age 0 fish at the end of the growing season will have low mean circuli counts, since circuli counts increase with fork length for salmonids (Clutter and Whitesel 1956; Horncastle and Hay 1981; Jensen and Johnsen 1982; Lentsch and Griffith 1987). Small age 0 fish are common in populations that spawn late in the season or that rear in cold or unproductive streams, and accordingly these populations may have individual fish missing the first-year annulus because few circuli may form before the end of the first growing season (Jensen and Johnsen 1982; Hooton *et al.* 1987; Lentsch and Griffith 1987).

Furthermore, steelhead scale ages may be biased low because scales were not formed in the first-year and thus the first annulus represents the second winter (Jensen and Johnsen 1982; Hooton *et al.* 1987). Similar to circuli counts, scale formation was dependent on fish size (Clutter and Whitesel 1956; Jensen and Johnsen 1982; Lentsch and Griffith 1987) and for fish that do not grow large enough to form scales during the first-year, the first observed annulus would represent age 2 and not age 1 (Jensen and Johnsen 1982; Hooton *et al.* 1987).

The missing first-year annulus was reported for a number of trout and char populations living in cold lakes or streams. For Nass River steelhead populations, some yearling steelhead (> 70 mm fork length) in Damdochax Creek (Triton 1994a) and Kwinageese River (Triton 1994b) had not formed an annulus and were interpreted as missing the first-year annulus. From a large sample of Vancouver Island steelhead, the wide range of circuli counts from the scale focus to the first observed annulus indicated some steelhead were missing the first-year annulus and had incomplete scale formation at age 1 (Hooton *et al.* 1987). The first-year annulus was missing from some cutthroat (*O. clarki*) and rainbow-cutthroat hybrids among 25 populations with short growing seasons in Colorado, Idaho, Montana and Wyoming (Lentsch and Griffith 1987). In Cottonwood Lake, California, up to 50 percent of the golden trout (*O. mykiss aquabonita*) lacked a first-year annulus (Curtis 1934 cited by Lentsch and Griffith 1987). For brown trout (*S. trutta*) in a Norwegian lake, Jensen (1977 cited by Jensen and Johnsen 1982) reported the first-year annulus was missing from some fish and for others it could be seen only on one or two scales while it was missing in the other scales from the same fish. Power (1969 cited by Jensen and Johnsen 1982) reported that Atlantic salmon near Ungava Bay were also missing the first-year annulus. Also, the first-year annulus was missing from brook trout (*Salvelinus fontinalis*) in Montana (Domrose 1963 cited by Lentsch and Griffith 1987).

Other salmonid populations were missing the first-year annulus because they did not form scales during their first year. On Vancouver Island, freshwater age 0 steelhead as large as 46 mm were found devoid of scales and indicated some individuals may be under-aged by one year (Hooton *et al.* 1987). Jensen and Johnsen (1982) reported that Atlantic salmon less than 35 mm and brown trout less than 40 mm from cold Norwegian rivers (water temperatures exceed 6.5° C for less than 70-80 days) did not form scales during their first year and lacked the first-year annulus.

The objectives of summarizing the mean smolt ages of Nass River summer and winter steelhead populations were:

1) to estimate the mean smolt age of populations from adult steelhead scales;
2) to estimate the mean smolt age of populations from the length of the growing season;
3) and to estimate the mean smolt age of populations from the length of yearlings.

The objectives of investigating the missing first-year annulus were:

1) to examine if under-aging biases occur in Nass River steelhead populations by comparing otolith and scale ages;
2) to examine if under-aging biases occur by comparing the lengths of steelhead aged as 0 years to the maximum lengths of age 0 steelhead determined from length-frequency analysis;
3) to use the predicted maximum number of circuli to the first annulus to estimate the percentage of juvenile and adult steelhead missing the first-year annulus in each population;
4) and to use the maximum number of circuli observed on age 0 steelhead at the end of the first growing season to estimate the percentage of juvenile and adult steelhead missing the first-year annulus in each population.

2.0.0.0 Study Area

The Nass River originates in the Skeena Mountains of north western British Columbia and flows southwest for approximately 400 km into Portland Inlet (Figure 1). The Nass River watershed is the third largest watershed entirely contained within British Columbia and drains approximately 20 500 km^2 (Alexander and Koski 1995). The Nass River has nine main tributaries: Ishkheenickh, Tseax, Tchitin, Cranberry, White, Meziadin, Bell-Irving and Kwinageese rivers and Damdochax Creek. Common fish species in the Nass River watershed include sockeye salmon (*O. nerka*), chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), steelhead trout, cutthroat trout (*O. clarki*), Rocky Mountain whitefish (*Prosopium williamsoni*), bull char (*Salvelinus confluentus*), Dolly Varden char (*S. malma*), largescale sucker (*Catostomus macrocheilus*), redside shiner (*Richardsonius balteatus*), peamouth chub (*Mylocheilus caurinus*) and northern squawfish (*Ptychocheilus oregonesis*; McPhail and Carveth 1994). In contrast to the nearby Skeena River watershed, lake trout, (*S. namaycush*), lake whitefish (*Coregonus clupeaformis*), pygmy whitefish (*Prosopium coulteri*), lake chub (*Couesius plumbeus*), white sucker (*Catostomus commersoni*) and burbot (*Lota lota*) have not been reported in the Nass River watershed (McPhail and Carveth 1994). The Nass River watershed lies within two ecoprovinces (Coastal Mountains and Sub-Boreal Interior) and contains six biogeoclimatic zones: Alpine Tundra, Sub-Boreal Spruce, Engelmann Spruce-Subalpine Fir, Interior Cedar-Hemlock, Mountain Hemlock, Coastal Western Hemlock (Pojar and Nuzsdorfer 1988).

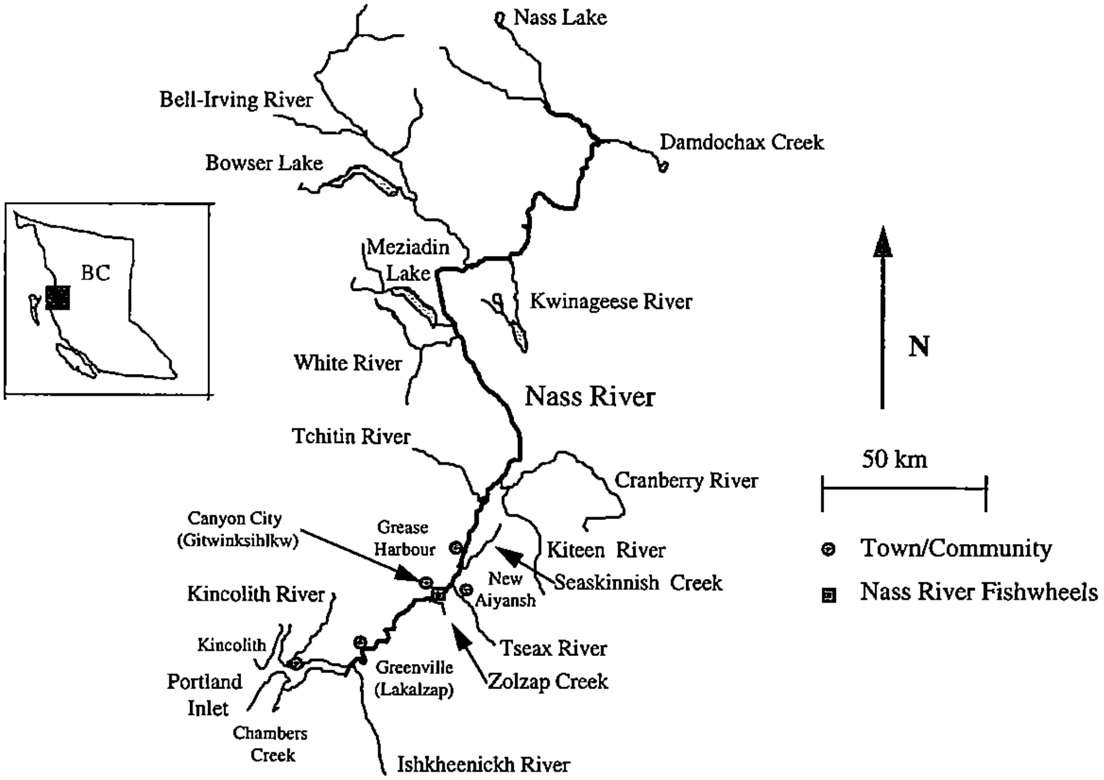

Figure 1. The Nass River watershed and major tributaries.

3.0.0.0 Methods

3.1.0.0 Mean Smolt Age Estimates

3.1.1.0 Adult Scales

In 1997, the Nisga'a Tribal Council collected scales from adult winter steelhead in the Kincolith, Tseax and Nass rivers and from adult summer steelhead at the Nass River fishwheels. Also, the Ministry of Environment, Lands and Parks (MELP) collected adult summer steelhead scales from the Bell-Irving, Cranberry, Kiteen, Kwinageese and Meziadin rivers and winter steelhead scales from the Kincolith and Ishkheenickh rivers and Chambers Creek. Approximately 5 to 10 scales per fish were collected between the lateral line and dorsal fin for aging from each steelhead. Scales collected by the Nisga'a Tribal Council were stored in scale books and scales collected by MELP were stored in scale envelopes.

Scale impressions, projections and aging were completed by C. Lidstone (Birkenhead Scale Analyses, D'Arcy, B.C.) and R. Tetreau (Fisheries Technician; MELP). Scale impressions, projections and aging were completed by C. Lidstone for winter steelhead from the Kincolith, Tseax and Nass rivers, summer steelhead from the Nass River fishwheels, and summer steelhead from the Bell-Irving, Cranberry, Kiteen, Kwinageese and Meziadin rivers (Lidstone 1997). Scale impressions and aging were completed by R. Tetreau for the winter steelhead from Chambers Creek, Kincolith and Ishkheenickh rivers collected by MELP. Adult summer steelhead scale samples from the Bell-Irving, Cranberry, Kwinageese and Meziadin rivers in 1997 were re-examined by R. Tetreau (Tetreau 1998).

Mean smolt ages were summarized by Nass River tributary populations by combining the data collected in 1997 with the historic scale age data (Parken 1997b). The mean smolt ages of summer steelhead were compared between populations with an ANOVA test and Tukey's HSD test was used for *post hoc* pairwise comparisons (Zar 1984). Similarly, the mean smolt ages were compared between winter steelhead populations with an ANOVA test and Tukey's HSD test was used for *post hoc* pairwise comparisons.

3.1.2.0 Length of the Growing Season

The growth rate of salmonids was correlated with a number of environmental and physical variables (Symons 1979; Slaney *et al.* 1986; Lentsch and Griffith 1987; Ptolemy 1993), but food availability (Grant and Kramer 1990) and water temperature (Symons 1979; Jensen and Johnsen 1982; Lentsch and Griffith 1987) were the main ecological factors. Water temperature influences digestive rates and when temperatures were outside of the optimal range the digestive rates decreased for rainbow trout (Dwyer *et al.* 1981 cited by Lentsch and Griffith 1987) and Atlantic salmon (Dwyer and Piper 1984 cited by Lentsch and Griffith 1987). For example, Elliot (1973 cited by Symons 1979) reported rainbow and brown trout could not digest more than one meal per day for water temperatures below 7.3° C.

Steelhead growth rates can be inferred from smolt age because steelhead smolts typically emigrate from streams (smoltification) at a consistent size, with some inter-annual variation in age class composition (Ward and Slaney 1988). Thus, steelhead populations with fast growth rates have lower mean smolt ages than populations with slow growth rates. The mean smolt age of Atlantic salmon was inversely related to the length of the growing season (Symons 1979). Symons (1979) measured the growing season as the number of days per year with mean daily water temperatures exceeding 7° C. Thus, Atlantic salmon from streams with short growing seasons were associated with long freshwater rearing periods to smoltification and high mean smolt ages.

The relationship between the mean smolt age of Skeena River steelhead and the length of the growing season differed from the relationship described for Atlantic salmon, due to life history differences (Tautz *et al.* 1992). Atlantic salmon required more than one year of rearing to reach smolt size(at least a 500 day long growing season; Symons 1979), whereas some adult wild Vancouver Island steelhead smolted after one year of rearing (Hooton *et al.* 1987; Ward 1996). Therefore, the growing season and mean smolt age relationship described by Symons (1979) was adjusted to suit steelhead life history by adjusting the slope in order for the regression line to pass through the mean smolt age datum for Babine River steelhead and to allow one year old smolts (Tautz *et al.* 1992; Parken 1997b). The relationship was adjusted to the Babine steelhead population because it had the longest growing season of any Skeena River summer steelhead population, and thus the scales probably were not missing the first-year annulus (Tautz *et al.* 1992; Parken 1997b).

The mean smolt age of Skeena River summer steelhead was related to the length of the growing season with equation 1 (Tautz *et al.* 1992):

Equation 1

$$MSA = 8.16 \times 0.9938^{G7}$$

where MSA was the mean smolt age and $G7$ was the number of days per year with mean daily water temperatures exceeding 7° C. Mean smolt age estimates predicted from the length of the growing season were preferred over estimates from adult scales because the estimates from the growing season were not influenced by under-aging biases due to the missing first-year annulus (Tautz *et al.* 1992). In addition to predicting smolt age, the length of the growing season was inversely related to the percentage of Atlantic salmon not forming scales during the first year (Jensen and Johnsen 1982) and inversely related to the percentage of cutthroat missing the first-year annulus (Lentsch and Griffith 1987).

Water temperature was monitored in the Bell-Irving, Bowser, Cranberry, Meziadin, Kwinageese and Tseax rivers and Oweegee, Seaskinnish, Snowbank and Teigen creeks with temperature data loggers (Onset Stowaway Temp; Figure 2). Temperature data loggers were deployed in the second week of August (Parken 1997c) and downloaded during the third week of October (Parken 1997d). The growing season length could not be measured because the temperature data loggers were deployed midway through the growing season. However, inferences were made regarding the relative length of the growing season from the dates when mean daily water temperatures dropped below 7° C.

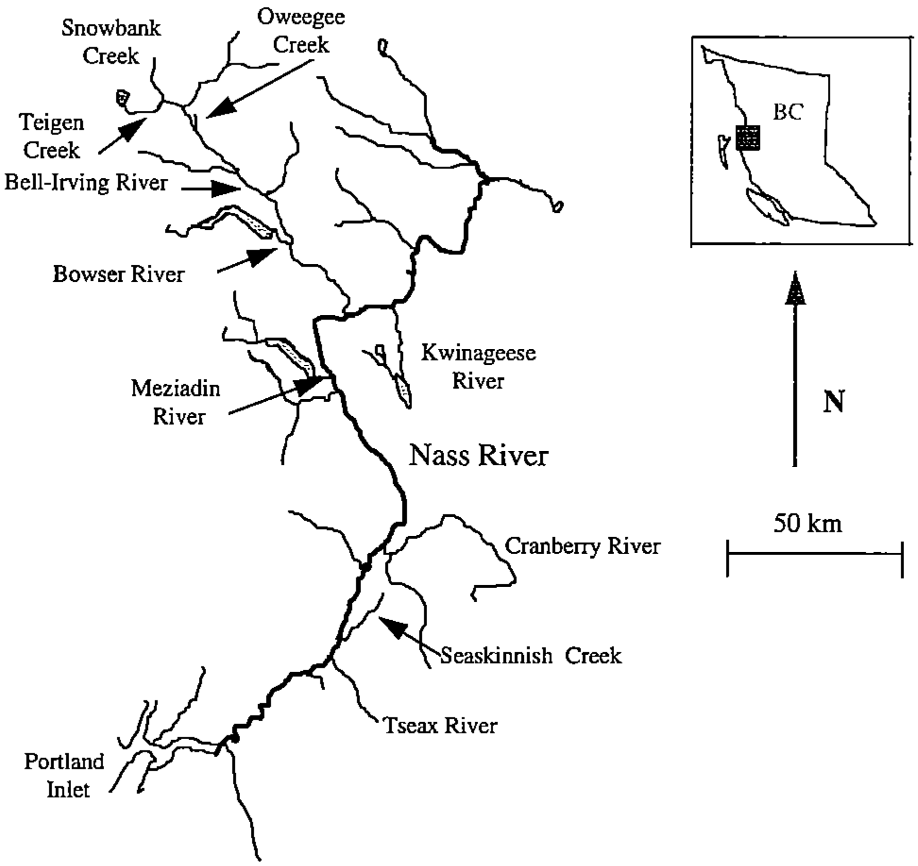

Figure 2. The Nass River watershed and tributaries where the mean daily water temperatures were monitored.

3.1.3.0 Yearling Fork Length

Juvenile steelhead and rainbow trout were captured by electrofishing in the Cranberry, Meziadin, Kwinageese and Tseax rivers and Seaskinnish Creek from September 13 to 16, 1997 (Parken 1997e). Steelhead rearing habitat was sampled until 10 steelhead fry and 10 steelhead parr were captured or until time limitations were met. All fish were anesthetized with Bromoseltzer and measured (fork length) to the nearest millimeter. All fish were identified to species and juvenile salmon were identified using characteristics described by Pollard *et al.* (1997). Paired otolith and scale samples were collected from 10 fry and 10 parr from each stream when samples were sufficient. Fifteen to 20 scales were collected in a smear sample from each steelhead. Liver tissue samples were also collected for future genetic analyses from parr that were sampled for otoliths.

Addition steelhead length information was gathered from fisheries inventories on the Bell-Irving River (Saimoto and Saimoto 1998), Damdochax Creek (Triton 1994a), Kwinageese River (Triton 1994b) and Cranberry River (Sebastian 1986). Sympatric populations of rainbow trout and steelhead existed in the Meziadin River, Kwinageese River, and Damdochax Creek, and were reported from Dragon Lake in the Seaskinnish Creek watershed (SISS 1991). Juvenile steelhead were not visually distinguishable from rainbow trout in these systems and therefore rainbow trout were included with steelhead for analyses. The effect on the analyses of combining rainbow trout and steelhead samples was unknown.

In other streams, the mean smolt age of steelhead was inversely related to yearling fork length near the end of the growing season for British Columbia steelhead populations (Bocking and English 1992; Parken 1997b). Thus, fast growing juvenile steelhead populations achieved smolt size more quickly and had lower mean smolt ages than slow growing populations that take longer to reach smolt size. Mean smolt age (*MSA*) was estimated from yearling fork length (FL_{1+}) with equation 2 (Bocking and English 1992):

Equation 2

$$MSA = 10^{(3.58-(1.59\times\log_{10} FL_{1+}))}$$

The mean lengths of age 0 steelhead were compared between populations with an ANOVA test and Tukey's HSD test was used for *post hoc* pairwise comparisons (Zar 1984). The mean lengths of age 1, 2, 3 or 4 steelhead were not compared between populations because few were collected from each population. Length frequency histograms were compared between populations to investigate size differences between populations.

3.2.0.0 Lack of First-year Annulus Investigations

3.2.1.0 Otolith and Scale Age Comparisons

Paired otolith and scale samples were collected from adult winter steelhead in the Kincolith, Tseax and mainstem Nass River by the Nisga'a Tribal Council during the Nisga'a fishery catch monitoring program. Paired otolith and scale samples were collected from juvenile steelhead in the Bell-Irving River watershed by Saimoto and Saimoto (1998) and from the Cranberry, Meziadin, Kwinageese and Tseax rivers and Seaskinnish Creek by Parken (1997e).

The paired otolith and scale samples were aged by C. Lidstone of Birkenhead Scale Analyses, D'Arcy, B.C. (Lidstone 1997). Otoliths and scales were aged independently, however several of the scales were examined in order to choose the best one for reading (Lidstone 1997). Otolith and scale ages were compared for each paired sample to estimate the percentage of steelhead scales that were missing the first-year annulus.

3.2.2.0 Length of Age 0 Criteria

In the Nass and Skeena river watersheds, age 0 steelhead have a typically short growing season which limits the maximum size they achieve by the end of the first growing season. Based on extensive juvenile steelhead sampling surveys in the Skeena and Nass, the mean lengths of age 0 populations ranged from 28 to 51 mm and of age 1 from 66 to 98 mm near the end of the growing season (Bocking and English 1992). This information suggested the maximum size of age 0 steelhead was 70 mm near the end of the growing season in the Skeena and Nass watersheds and that steelhead larger than 70 mm and aged as 0 years old were under-aged (R.S. Hooton, personal communication). Thus, the 70 mm cut-off distinguished age 0 steelhead from parr in Damdochax Creek (Triton 1994a) and Kwinageese River (Triton 1994b).

Steelhead that exceeded 70 mm and aged as 0 years were assumed missing the first-year annulus. The presence of these steelhead indicated that some of the juvenile steelhead had scales that did not form the first-year annulus, and therefore some of the adult steelhead in that population may be missing the first-year annulus and be under-aged.

3.2.3.0 Number of Circuli to Length of Age 0 Criteria

Steelhead lacking the first annulus may be distinguished by the number of circuli to the first-year annulus. A strong relationship between circuli counts and length was reported for juvenile steelhead (Horncastle and Hay 1981), cutthroat trout (Lentsch and Griffith 1987), sockeye salmon (Clutter and Whitesel 1956), Atlantic salmon and brown trout (Jensen and Johnsen 1982). Lentsch and Griffith (1987) used the relationship to estimate the predicted number of circuli on the largest age 0 cutthroat trout and cutthroat-rainbow hybrids. Thus, the predicted maximum number of circuli formed during the first growing season (C1) was the number of circuli that was predicted for the largest age 0 fish. A fish was considered missing the first-year annulus if the circuli counts to the first observed annulus exceeded C1.

The number of circuli to the scale margin was determined from scales of age 0 steelhead from the Bell-Irving, Cranberry, Meziadin, Kwinageese and Tseax rivers and Seaskinnish Creek collected in 1997 (Lidstone 1997). The relationship between the number of circuli and fork length was examined by simple linear regression and the Pearson correlation coefficient for each population and for all samples pooled (Zar 1984). C1 was determined for a 70 mm steelhead because that was the maximum size for age 0 steelhead near the end of the growing season in the Skeena and Nass watersheds. C1 was estimated for each population with a significant relationship between fork length and circuli count. The relationship for the pooled sample estimated C1 for the pooled summer steelhead sampled at the Nass River fishwheels.

Adult and juvenile steelhead scales were aged and the number of circuli to the first observed annulus was recorded (Lidstone 1997). The Nisga'a Tribal Council collected scales from adult winter steelhead in the Kincolith, Tseax and Nass rivers and from adult summer steelhead at the Nass River fishwheels. Also, MELP collected adult summer steelhead scales from the Bell-Irving, Cranberry, Kwinageese and Meziadin rivers. Juvenile steelhead scales were collected from the Bell-Irving River watershed by Saimoto and Saimoto (1998) and from the Cranberry, Meziadin, Kwinageese and Tseax rivers and Seaskinnish Creek by Parken (1997e).

The mean and range in circuli counts to the first annulus was summarized for adult and juvenile steelhead by population. The mean number of circuli to the first annulus was compared between juvenile and adult steelhead within populations with a student's t-test. The mean number of circuli to the first annulus from adult steelhead populations was compared between populations with an ANOVA test and Tukey's HSD test was used for *post hoc* pairwise comparisons (Zar 1984). The mean number of circuli to the first annulus from juvenile steelhead populations was compared between populations with an ANOVA test and Tukey's HSD test was used for *post hoc* pairwise comparisons. In addition, the mean number of circuli to the first annulus on adult and juvenile steelhead scales was used as an indicator of growing season length and stream productivity, and was compared to the growing season length inferred from mean daily water temperatures.

3.2.4.0 Number of Circuli for Age 0 at the End of the Growing Season

The maximum number circuli to the scale margin observed on age 0 fish near the end of the growing season was the criteria (C2) for distinguishing fish missing the first-year annulus (Lentsch and Griffith 1987). Thus, C2 was the observed number of circuli on steelhead fry near the end of the growing season whereas C1 was the predicted number of circuli for a 70 mm steelhead. Juvenile and adult steelhead with circuli counts to the first annulus exceeding C2 were considered missing the first-year annulus. The circuli counts from age 0 steelhead near the end of the growing season may also identify populations with individuals that may not form enough circuli during the first growing season to detect the change in circuli spacing for the first-year annulus. This presence of fish missing the first annulus was identified by the wide range of circuli counts to the first annulus in juvenile and adult steelhead populations (Hooton *et al.* 1987).

4.0.0.0 Results

4.1.0.0 Mean Smolt Age Estimates

4.1.1.0 Adult Scales

In the Nass River watershed, the mean smolt age of steelhead populations generally increased with distance from the mouth of the Nass River (Table 1; Figure 1). Summer steelhead populations in the Nass River headwaters area (Bell-Irving River and Damdochax Creek) had older mean smolt ages than downstream populations. Furthermore, the mean smolt ages for winter steelhead and sympatric summer and winter steelhead populations (lower watershed) were generally less than the mean smolt ages for summer steelhead populations (upper watershed).

Table 1. A summary of the mean, standard error (SE), standard deviation (SD) and range in smolt age for steelhead in the Bell-Irving, Cranberry, Ishkheenickh, Kincolith, Kwinageese, Meziadin and Tseax rivers, Damdochax and Seaskinnish creeks, the Nass River fishwheels and Nisga'a fishery catch monitoring program.

	Smolt Age					***ANOVA***
Population	**Mean (yr.)**	**SE (yr.)**	**SD (yr.)**	**Range (yr.)**	**Sample Size**	***P* Value**
Summer steelhead						
Bell-Irving	3.73	0.14	0.74	3-5	30	0.0005
Cranberry	3.53	0.03	0.53	3-5	275	
Damdochax	3.74	0.11	0.59	2-5	27	
Kwinageese	3.53	0.09	0.49	3-4	64	
Meziadin	3.27	0.15	0.70	2-4	22	
Pooled summer steelhead						
Fishwheels (1996-97)	3.35	0.02	0.57	2-5	631	
Winter steelhead						
Chambers	3.00	0.00	0.00	NA	23	0.005
Ishkheenickh	3.36	0.09	0.49	3-4	28	
Kincolith[1]	3.51	0.10	0.63	3-5	43	
Tseax[1,2]	3.35	0.12	0.49	3-4	17	
Pooled winter steelhead						
Catch monitoring[1]	3.38	0.10	0.50	3-4	26	

1. Includes data collected by the Nisga'a Tribal Council and LGL Ltd.
2. Includes summer and winter steelhead.

For summer steelhead, the mean smolt age differed between populations (ANOVA, $F = 8.66$, $P < 0.0005$) and ranged from 3.27 years in the Meziadin River to 3.74 years in Damdochax Creek (Table 1). The oldest mean smolt ages were for the upper Nass tributaries of Damdochax Creek and Bell-Irving River, whereas the youngest mean smolt age was for Meziadin River. The mean smolt age of steelhead from the Nass River fishwheels differed from steelhead in the Bell-Irving (Tukey HSD = -0.38, $P = 0.004$), Cranberry (Tukey HSD = -0.19, $P < 0.0005$), and Damdochax (Tukey HSD = -0.39, $P = 0.005$), but was similar to those from Kwinageese (Tukey HSD = -0.18, $P = 0.133$) and Meziadin (Tukey HSD = 0.07, $P = 0.990$). The mean smolt age of Meziadin steelhead differed from Damdochax (Tukey HSD = -0.47, $P = 0.044$) and Bell-Irving steelhead (Tukey HSD = -0.46, $P = 0.042$). All other pairwise comparisons between populations indicated they had similar mean smolt ages (Tukey HSD, $P > 0.05$).

For winter steelhead, the mean smolt age differed between populations (ANOVA, F = 3.95, $P = 0.005$) and ranged from 3.00 years in Chambers Creek to 3.51 years in Kincolith River (Table 1). The oldest mean smolt ages were from Ishkheenickh and Kincolith rivers, whereas the youngest were from Chambers Creek. The mean smolt age of steelhead sampled in Chambers Creek differed from steelhead in the Kincolith River (Tukey HSD = -0.51, $P < 0.001$), but was similar to steelhead in Ishkheenickh River (Tukey HSD = -0.36, $P = 0.066$), Tseax River (Tukey HSD = -0.36, $P = 0.084$), and the pooled winter steelhead from the Nisga'a fishery catch monitoring program (Tukey HSD = -0.38, $P = 0.057$). All other pairwise comparisons between populations indicated they had similar mean smolt ages (Tukey HSD, $P > 0.05$).

4.1.2.0 Length of the Growing Season

The mean smolt ages could not be estimated from the length of the growing season because the beginning date of the growing season was not determined (Figures 3 and 4). However, the end date of the growing season in 1997 was estimated for all rivers and creeks monitored, except for Meziadin and Tseax rivers which remained above 7° C in mid October. Thus, the relative lengths of the growing seasons were compared between rivers based on the dates when mean daily water temperatures dropped below the 7° C growing season criteria.

The Tseax and Meziadin rivers may have the longest growing seasons as mean daily water temperatures remained above 7° C on October 21, 1997 whereas the other rivers had dropped and remained below the 7° C criteria (Figure 3; Table 2). The relatively flat temperature profile in the Tseax River suggested the porous lava flow had a large moderating effect on water temperatures. The Tseax lava flow is porous and permeable which enables extensive exchanges between river and ground water (Gottesfeld 1985). For example, Vetter Creek consists mainly of water moving through the lava flow and disappears into the lava flow through a series of collapse features, and eventually leaves the lava flow via a series of springs and rivulets along the Nass River (Gottesfeld 1985). These large exchanges between surface and subsurface water appeared to moderate temperature fluctuations in the summer and maintain warmer water temperatures into the fall. The Meziadin River may have the next longest growing season and was probably influenced by Meziadin Lake (surface area = 31 km^2, volume = 1.4×10^9 m^3; Klein 1972) which may moderate water temperatures and extend the growing season. The Bell-Irving River had the shortest growing season which may reflect the large glacial influence in the watershed. The Cranberry River had the second shortest growing season and was not lake-headed.

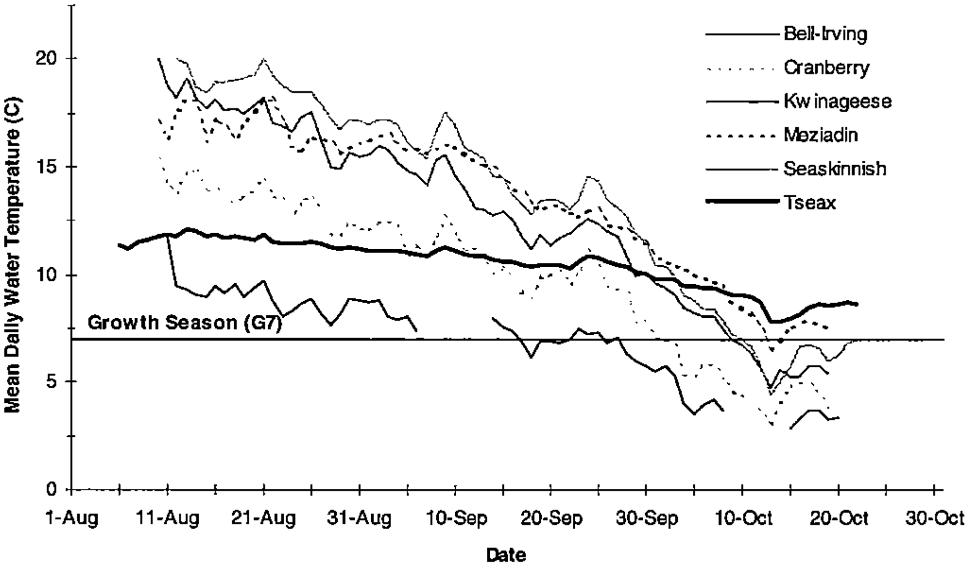

Figure 3. Mean daily water temperatures for Bell-Irving, Cranberry, Kwinageese, Meziadin, and Tseax rivers and Seaskinnish Creek.

Intra-watershed variability in the length of the growing season was examined by monitoring five systems within the Bell-Irving watershed (Figure 4; Table 2). The Bowser River had the shortest growing season and mean daily water temperatures rarely exceeded 8° C despite having a large lake in the system (Bowser Lake, surface area = 36 km^2; Coombes 1988). The short growing season in the Bowser River indicated the large glacial influence in the watershed. The Bell-Irving River had a slightly longer growing season and also was influenced strongly by glaciers. Oweegee Creek had the longest growing season and was influenced by five small, shallow lakes. In August and September, water temperatures in Oweegee Creek were on average three to five degrees higher than the other systems monitored in the Bell-Irving watershed.

The mean daily water temperatures of Teigen and Snowbank creeks provided a good comparison of the moderating influence of lakes on stream temperature (Figure 4). Teigen Creek was influenced by Teigen Lake (surface area = 2.1 km^2, volume = $43x10^6$ m^3; Weber and Phillip 1982) and an unnamed lake whereas Snowbank Creek was not lake-headed, but was influenced by a number of small beaver dams (Saimoto and Saimoto 1998). The mean daily water temperature was usually two degrees warmer in Teigen than Snowbank creek, and accordingly the growing season was approximately two weeks longer in Teigen than Snowbank creek (Table 2).

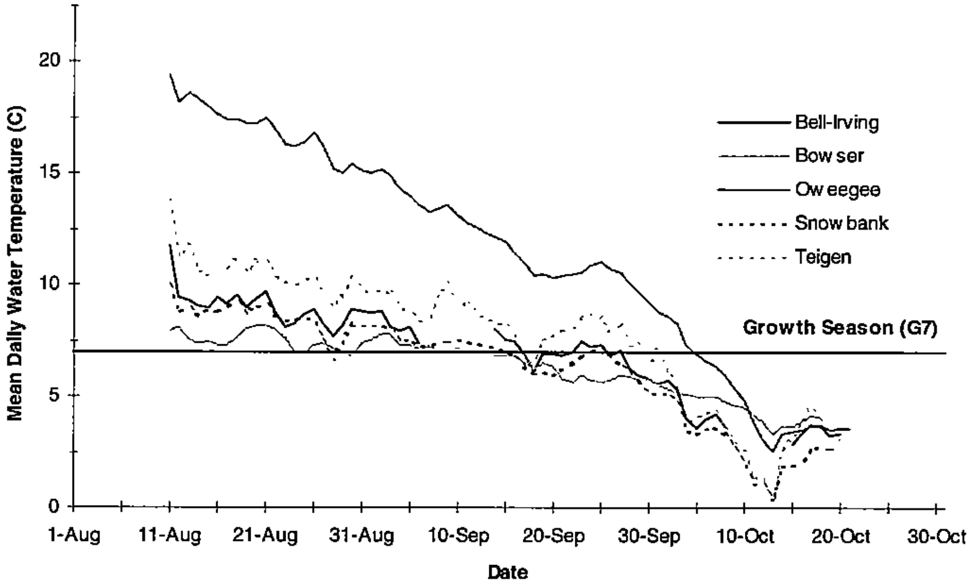

Figure 4. Mean daily water temperatures for Bell-Irving and Bowser rivers and Oweegee, Snowbank and Teigen creeks.

Table 2. The estimated end dates for the growing season in 1997.

Waterbody	End Date of Growing Season
Bell-Irving River	September 28
Bowser River	September 12
Cranberry River	October 2
Kwinageese River	October 9
Meziadin River	after October 19
Oweegee Creek	October 5
Seaskinnish Creek	October 11
Snowbank Creek	September 17
Teigen Creek	October 2
Tseax River	after October 22

4.1.3.0 Yearling Fork Length

The mean smolt ages estimated from yearling fork length were similar to the estimates from adult scales in the Bell-Irving, Cranberry and Meziadin rivers, but they were lower than the estimates from adult scales in the Kwinageese and Tseax rivers and Damdochax Creek (Table 3). Mean smolt age estimates ranged from 2.29 years in the Kwinageese and Tseax rivers (1997) to 4.10 years in the Cranberry River. However, estimates from 1997 should be interpreted cautiously due to few samples. The mean smolt age estimates from yearling fork lengths in the Damdochax, Kwinageese and Tseax were approximately one year less than the estimates from adult scales. For the Cranberry River, the estimate from the 1986 yearlings (Sebastian 1987) was very similar to the estimate from adult scales, however for 1997 yearlings the mean smolt age estimate was about 0.6 years higher than the estimate from adult scales. In comparison, the estimate from the Bell-Irving River yearlings was approximately 0.25 years less than the estimate from adult scales, whereas the estimate for the Meziadin River was about 0.25 years more than the estimate from adult scales.

The mean lengths at age were summarized for juvenile steelhead collected from the Bell-Irving, Cranberry, Kwinageese, Meziadin, Seaskinnish and Tseax in 1997 and from the Cranberry, Damdochax and Kwinageese in 1986, 1993 and 1993, respectively (Table 3). In 1997, the mean lengths of age 0 steelhead differed between rivers (ANOVA, $F = 3.12$, $P = 0.022$). Age 0 Cranberry River steelhead were smaller than those in Seaskinnish Creek (Tukey HSD = -1.01, $P = 0.038$), but were similar to those from the Bell-Irving, Kwinageese, and Tseax rivers (Tukey HSD, $P > 0.05$). All other pairwise comparisons between fry populations indicated they were similar in size (Tukey HSD, $P > 0.05$). Few samples for other age classes were collected and prevented comparisons between rivers.

Table 3. A summary of the mean, standard error, standard deviation and range in steelhead fork length and mean smolt age (MSA) estimated from yearling fork length and adult scales for the Bell-Irving (Bell.), Cranberry (Cran.), Kwinageese (Kwin.), Meziadin (Mez.), and Tseax rivers, and Damdochax (Damd.) and Seaskinnish (Seas.) creeks.

		Steelhead Population								
		Bell.[1]	**Cran.**		**Damd.[1]**	**Kwin.[1]**		**Mez.**	**Seas.**	**Tseax**
Age	**Year**	**1997**	**1986[1]**	**1997**	**1993**	**1993[1]**	**1997**	**1997**	**1997**	**1997**
0	Mean (mm)	52.0	36.4	44.4	52.5	53.4	50.1	48	54.5	45.7
	SE (mm)	0.27	0.23	0.09	NA	NA	0.22	NA	0.18	0.17
	SD (mm)	1.13	1.15	0.28	NA	NA	0.70	NA	0.55	0.54
	Range (mm)	41-79	26-52	40-48	35-72	32-69	41-63	NA	45-64	40-55
	Sample Size	17	325	10	223	75	10	1	10	10
1	Mean (mm)	81.2	80.4	73.5	95.1	99.6	106.0	80.8	99.3	106.0
	SE (mm)	0.15	2.58	0.14	NA	NA	0.35	0.38	0.24	0.30
	SD (mm)	1.04	17.7	0.34	NA	NA	0.78	1.37	0.48	0.73
	Range (mm)	60-105	57-120	69-78	76-117	73-114	99-116	64-109	95-106	96-114
	Sample Size	51	47	6	15	7	5	13	4	6
2	Mean (mm)	114.5	139.0	86.3	NA	148.8	119	188	111.3	99
	SE (mm)	0.27	5.10	0.54	NA	NA	1.03	NA	0.41	1.50
	SD (mm)	1.67	11.4	0.93	NA	NA	2.30	NA	1.01	2.12
	Range (mm)	82-170	128-153	80-97	NA	142-158	94-154	NA	96-126	84-114
	Sample Size	37	5	3	NA	4	5	1	5	2
3	Mean (mm)	153.8	NA	78	NA	NA	NA	170.0	NA	179
	SE (mm)	0.69	NA	NA	NA	NA	NA	0.64	NA	NA
	SD (mm)	3.03	NA	NA	NA	NA	NA	1.11	NA	NA
	Range (mm)	111-225	NA	NA	NA	NA	NA	158-180	NA	NA
	Sample Size	19	NA	1	NA	NA	NA	3	NA	1
MSA Estimate (yr.)										
Yearling Length		3.50	3.55	4.10	2.72	2.53	2.29	3.53	2.54	2.29
Adult Scales		3.73	3.53	3.53	3.74	3.53	3.53	3.27	NA	3.35

1. Data for Bell. from Saimoto and Saimoto (1988), Cran. in 1986 from Sebastian (1987), Damd. from (Triton 1994a), and Kwin. in 1993 from (Triton 1994b).

For steelhead that were not aged, the length-frequency distributions indicated similar results as the comparisons of age 0 fork length (Figure 5). Seaskinnish Creek steelhead fry were the largest, followed by Kwinageese, Tseax, Cranberry and Bell-Irving (data in Saimoto and Saimoto 1998). Inferences were not made for Meziadin as few age 0 were sampled.

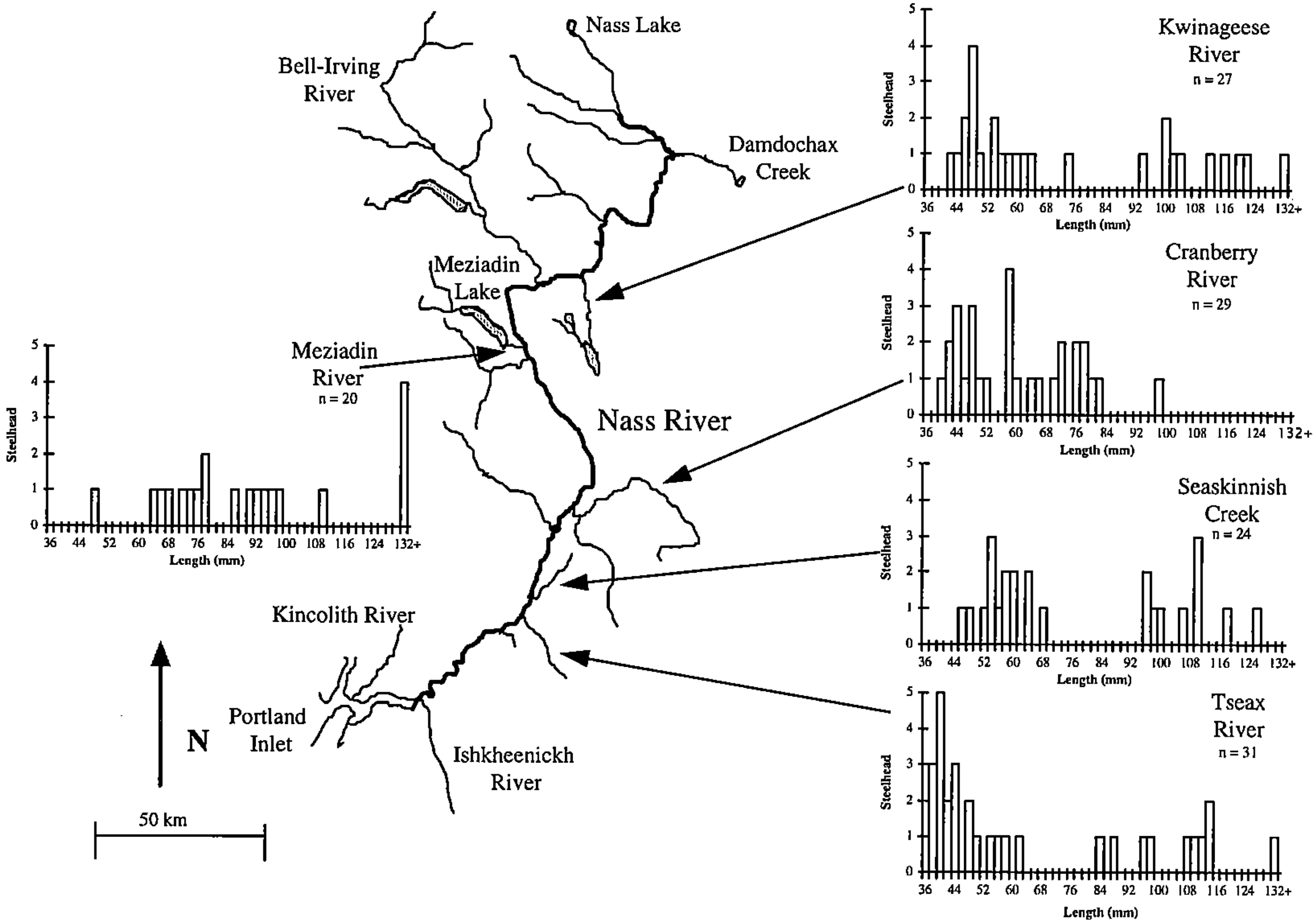

Figure 5. The size distribution (fork length) of juvenile steelhead in the Cranberry, Kwinageese, Meziadin and Tseax rivers and Seaskinnish Creek.

These results generally corresponded to the growing season information (Figure 3; Table 2) where Seaskinnish Creek and Kwinageese River had relatively long growing seasons, whereas the Bell-Irving and Cranberry rivers had relatively short growing seasons. The Tseax River had the longest growing season and had some large steelhead fry, however some of the steelhead fry were small and were among the smallest ones sampled in the Nass during the fall of 1997 (range, 36 to 61 mm; Figure 5). The wide size distribution of age 0 steelhead in the Tseax River indicated that growth rates were variable or that steelhead fry emergence was variable. For example, fresh-run steelhead have been observed entering the Tseax River in June and the progeny of these steelhead would probably emerge later than the progeny of steelhead spawning earlier in late April and early May (R. Tetreau, personal communication, 1998). Also, these results indicated that other resources, such as food or rearing space (Tautz *et al.* 1992), may be more influential on steelhead fry size in the early fall.

4.2.0.0 Lack of First-year Annulus Investigations

4.2.1.0 Otolith and Scale Age Comparisons

Scale and otolith ages corresponded for 220 of the 221 paired samples (99.5%) from the Bell-Irving, Cranberry, Kincolith, Kwinageese, Meziadin and Tseax rivers, Seaskinnish Creek and pooled winter steelhead (Table 4). Furthermore, the scale was regenerated for the sample that differed in scale and otolith ages. For adult steelhead otoliths, the freshwater ages corresponded to the scale ages, however on the otoliths spawning checks were indistinguishable from saltwater annuli and some spawning checks were unrecognizable (Lidstone 1997). Among the paired juvenile steelhead samples, Lidstone (1997) reported that some of the scales had not formed the first-year annulus, however a scale that had formed the first-year annulus was chosen after examining several scales from the same fish. Thus, under-aging of steelhead was minimized by examining several scales to find one with the first-year annulus, provided that sufficient numbers of scales were collected.

Table 4. A summary of the sample sizes for paired otolith and scale age comparisons for each river by age category.

	Number Aged as 0	**Number Aged as 1+ or older**	**Number of Adult Steelhead**	**Total**
Bell-Irving River	1	83	NA	84
Cranberry River	10	10	NA	20
Kwinageese River	10	10	NA	20
Meziadin River	1	17	NA	18
Seaskinnish Creek	10	10	NA	20
Tseax River	10	10	1	21
Kincolith River	NA	NA	13	13
Pooled winter steelhead	NA	NA	25	25
Total	42	140	39	221

4.2.2.0 Length of Age 0 Criteria

The presence of 70 mm or larger juvenile steelhead aged as 0 in three of the seven populations indicated some juvenile steelhead may be missing the first-year annulus. Juvenile steelhead larger than 70 mm were aged as 0 in the Bell-Irving (Saimoto and Saimoto 1998), Damdochax (Triton 1994a) and Kwinageese rivers (Triton 1994b). In the Bell-Irving River, 2 of 107 juvenile steelhead larger than 70 mm were aged as 0 years old (Saimoto and Saimoto 1998). In Damdochax Creek, aged scales from 3 of 18 juvenile steelhead larger than 70 mm were aged as 0 and were suspected missing the first-year annulus (Triton 1994a). In the Kwinageese River, Triton (1994b) aged scales from 11 juvenile steelhead larger than 70 mm and some were aged as 0, but they were determined to be yearlings due to their size.

In 1997, no juvenile steelhead larger than 70 mm were aged as 0 in the Cranberry, Kwinageese, Meziadin or Tseax rivers or Seaskinnish Creek, however few samples were collected from each system and samples were collected from a variety of size categories and may not have been representative of the abundance of different age classes. In 1997, none of the juveniles larger than 70 mm were aged as 0 in the Cranberry River (n = 9), Kwinageese River (n = 10), Meziadin River (n = 17), Tseax River (n = 10) or Seaskinnish Creek (n = 10).

4.2.3.0 Number of Circuli to Length of Age 0 Criteria

The number of circuli from the scale focus to the scale margin was positively related to fork length for age 0 steelhead from the Bell-Irving, Cranberry, and Kwinageese rivers and for the pooled sample (Figure 6). However, the relationship was not significant for steelhead from the Tseax River or Seaskinnish Creek. Although significant relationships were observed for some populations, the fit was generally poor as indicated by the low correlation coefficients, and may reflect the low sample sizes. For the pooled sample there was no apparent pattern among the residuals when they were plotted against the predicted values (Appendix C), and when the residuals were plotted against the observed fish lengths the analysis illustrated homogenous error variances (Appendix D), except for the three largest fish. The analyses indicated the linear regression model was appropriate for the range of values investigated.

The predicted maximum number of circuli formed during the first growing season (C1) was estimated for populations with significant relationships between the number of circuli and the length of age 0 steelhead (Figure 6). The assumed maximum length of an age 0 steelhead in the Nass River watershed was 70 mm and thus, steelhead with more circuli than C1 were considered missing the first-year annulus. The C1 criteria ranged from 8.0 in the Bell-Irving River to 10.7 in the Kwinageese River and was 9.1 for the pooled sample (Figure 6). In the Bell-Irving River, steelhead with more than 8 circuli to the first annulus were considered missing the first-year annulus and under-aged by one year. Similarly, Kwinageese River steelhead with more than 11 circuli were considered missing the first-year annulus. For steelhead from the Nass River fishwheels, the relationship for the pooled sample indicated adult steelhead with more than 9 circuli were missing the first-year annulus.

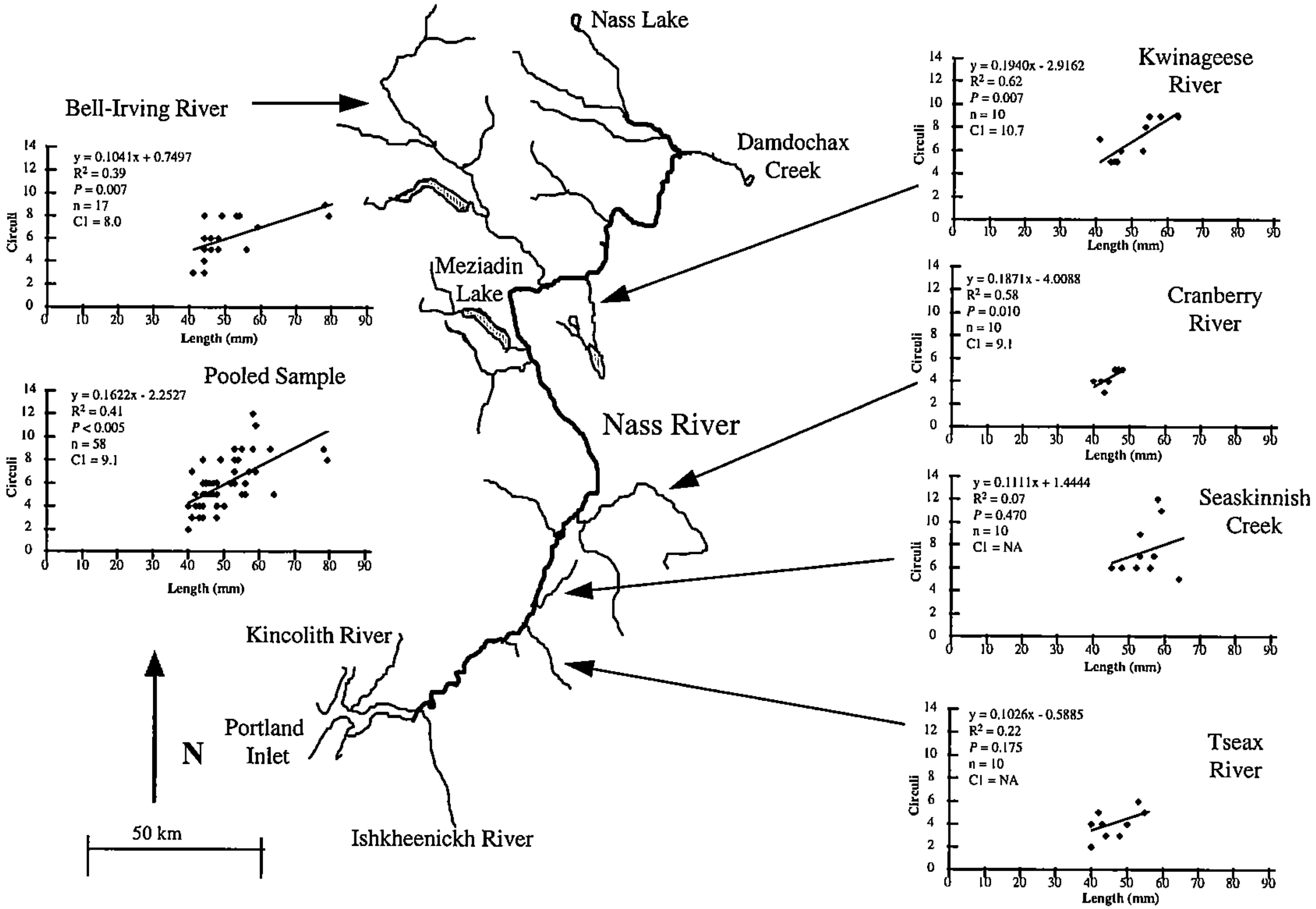

Figure 6. The relationship between circuli count from the focus to scale margin and fork length of age 0 steelhead from the Bell-Irving, Kwinageese, Cranberry and Tseax rivers and Seaskinnish Creek. The number of circuli was predicted for a 70 mm steelhead (C1) for significant relationships.

The predicted maximum number of circuli for Kwinageese and Cranberry steelhead should be interpreted cautiously because circuli counts were predicted for lengths beyond the range of the data the relationship was developed from.

Some steelhead were suspected missing the first-year annulus in the six juvenile (age 1, 2, 3 and 4) populations examined and in five of the six adult populations examined (Table 5). From 10 to 40 percent of the juvenile steelhead within each population were missing the first-year annulus. The highest percentages of juvenile steelhead missing the first-year annulus were in Seaskinnish Creek (40%) and Tseax River (33%). However, for these populations no significant relationship existed between fork length and circuli count and C1 was estimated from the pooled sample. The C1 criteria from the pooled sample may have been too low and not reflected the conditions or the relationships of Seaskinnish Creek or Tseax River. Therefore, the percentages should be interpreted cautiously until more information becomes available or until a relationship can be determined. A higher percentage of juvenile Cranberry steelhead (20%) were missing the first-year annulus than Bell-Irving (10%) or Kwinageese (10%) steelhead.

Table 5. The mean, range and sample size (n) of circuli counted from the scale focus to the first annulus for juvenile and adult steelhead from Bell-Irving, Cranberry, Kiteen, Kwinageese, Meziadin and Tseax rivers, Seaskinnish Creek, the Nass River fishwheels and the Nisga'a catch monitoring program.

	Juvenile Steelhead				Adult Steelhead			
	Number of Circuli			Percentage	Number of Circuli			Percentage
Population	Mean	Range	n	Exceeding C1	Mean	Range	n	Exceeding C1
Summer steelhead								
Bell-Irving	6.2	3-11	116	10%	6.7	3-11	30	20%
Cranberry	7.7	5-11	10	20%	8.3	4-12	137	12%
Kiteen	NA	NA	NA	NA	8.5	8-9	2	0%
Kwinageese	9.3	6-10	10	10%	9.7	6-13	7	29%
Meziadin	9.2	7-16	17	24%[1]	8.0	6-10	6	33%[1]
Pooled summer steelhead								
Fishwheels (1997)	NA	NA	NA	NA	7.5	3-13	306	13%
Winter steelhead								
Seaskinnish[2]	9.7	6-12	10	40%[1]	NA	NA	NA	NA
Tseax[2]	7.6	4-10	9	33%[1]	NA	NA	NA	NA
Kincolith	NA	NA	NA	NA	7.0	4-11	26	NA
Pooled winter steelhead								
Catch Monitoring	NA	NA	NA	NA	7.6	5-11	16	NA

1. For populations without a significant relationship between the number of circuli and juvenile steelhead fork length the C1 value predicted from the pooled sample was the estimated criteria.
2. Includes summer and winter steelhead.

The percentages of adult steelhead missing the first-year annulus contrasted to the pattern for juvenile steelhead (Table 5). A higher percentage of adult Kwinageese (29%) steelhead were missing the first-year annulus than Bell-Irving (20%) or Cranberry steelhead (12%). Thirteen percent of the adult steelhead sampled at the fishwheels were missing the first-year annulus. Among Meziadin steelhead, 33 percent were missing the first-year annulus although C1 was estimated from the pooled sample and may not represent the relationship between circuli count and fork length in the Meziadin River. The estimated percentage of under-aged Kwinageese and Meziadin steelhead should be interpreted cautiously due to the small number of adult scale samples.

The circuli counts to the first annulus were similar for juvenile and adult steelhead collected from the same river (Table 5). Juvenile and adult steelhead had similar circuli counts to the first annulus in the Bell-Irving (t-test, $t = -1.35$, $P = 0.181$), Cranberry (t-test, $t = -1.02$, $P = 0.312$), Kwinageese (t-test, $t = -0.38$, $P = 0.713$), and Meziadin rivers (t-test, $t = 1.29$, $P = 0.210$; Table 5). The similar circuli counts to the first annulus indicated the first annuli recognized on juvenile scales was similar to the first annuli recognized on adult scales.

The mean number of circuli to the first annulus differed between adult steelhead populations (ANOVA, $F = 7.50$, $P < 0.0005$; Table 5). The mean circuli counts to the first annulus ranged from 6.7 in the Bell-Irving River to 9.7 in the Kwinageese River. The mean number of circuli to the first annulus of Meziadin steelhead was similar to the means for Cranberry, Kwinageese and Bell-Irving steelhead and steelhead from the Nass River fishwheels (Tukey HSD > -1.71, $P > 0.646$). Adult Bell-Irving steelhead had fewer circuli counts than Cranberry (Tukey HSD = -1.61, $P = 0.001$) and Kwinageese steelhead (Tukey HSD = -3.05, $P = 0.004$), but similar counts to steelhead from the Nass River fishwheels (Tukey HSD = -0.81, $P = 0.291$). The mean number of circuli to the first annulus of steelhead captured at the Nass River fishwheels differed from those in Cranberry (Tukey HSD = -0.80, $P = 0.001$) and Kwinageese rivers (Tukey HSD = -2.24, $P = 0.043$). All other comparisons between populations indicated similar mean circuli counts to the first annulus (Tukey HSD, $P > 0.05$).

The mean number of circuli to the first annulus from adult steelhead indicated the relative size of steelhead during the first year. The mean counts to the first annulus corresponded to the growing season length (Figure 3), however comparisons were limited since few samples were collected from the Meziadin or Kwinageese rivers, and none were collected from Seaskinnish Creek or Tseax River (Table 5). The fewest circuli counts to the first annulus were observed in the Bell-Irving which also had the shortest growing season (Figure 3; Table 2). Similarly, the highest circuli counts were in the Kwinageese River which had one of the longer growing seasons. Circuli counts from the Meziadin River were intermediate of the other populations, in spite of having one of the longer growing seasons; however few samples limited interpretations. The mean number of circuli for steelhead from the Nass River fishwheels was higher than those from the Bell-Irving, but lower than those from other populations. However, inferences were limited since some populations were represented by few samples.

The mean number of circuli to the first annulus differed between juvenile steelhead populations (ANOVA, $F = 17.65$, $P < 0.0005$; Table 5). The mean circuli counts to the first annulus ranged from 6.2 in the Bell-Irving River to 9.7 in Seaskinnish Creek. Juvenile Bell-Irving steelhead had fewer circuli than Kwinageese (Tukey HSD = -3.13, $P < 0.0005$) and Meziadin steelhead (Tukey HSD = -3.06, $P < 0.0005$), but they were similar to Cranberry (Tukey HSD = -1.53, $P = 0.117$) and Tseax steelhead (Tukey HSD = -1.38, $P = 0.249$). All other pairwise comparisons between populations indicated similar mean circuli counts to the first annulus (Tukey HSD, $P > 0.05$).

Among juvenile steelhead populations, three groups were apparent which corresponded to low, medium and high circuli counts to the first annulus (Table 5). Bell-Irving juvenile steelhead had few circuli to the first annulus (mean = 6.2 circuli) compared to the medium circuli counts for Tseax (mean = 7.6 circuli) and Cranberry steelhead (mean = 7.7 circuli). In comparison, Meziadin (mean = 9.2 circuli), Kwinageese (mean = 9.3 circuli) and Seaskinnish (mean = 9.7) juvenile steelhead had considerably higher circuli counts to the first annulus. These results generally corresponded to the relative growing season length (Figure 3, Table 2) where the Meziadin River, Kwinageese River and Seaskinnish Creek had long growing seasons, the Cranberry River had a medium growing season and the Bell-Irving River had a short growing season. Juvenile steelhead in the Tseax River had medium circuli counts, but a long growing season and was considered an outlier.

The pattern of the circuli counts to the first annulus for juvenile steelhead (Table 5) followed a similar pattern as the fry length distributions (Figure 5) as expected, since circuli counts were related to fork length for three of the five populations examined (Figure 5). The juvenile steelhead populations with high circuli counts to the first annulus (Seaskinnish and Kwinageese) had larger age 0 steelhead than other populations, as indicated by the length frequency distributions (Figure 5). Meziadin steelhead were not compared since few age 0 steelhead were sampled (n = 1). The juvenile steelhead populations with medium circuli counts (Tseax and Cranberry) also had medium-sized age 0 steelhead (Figure 5) and the population with the lowest circuli counts had the smallest age 0 steelhead (range, 31 to 59 mm; Saimoto and Saimoto 1998).

4.2.4.0 Number of Circuli for Age 0 at the End of the Growing Season

The maximum number of circuli observed on age 0 steelhead near the end of the growing season (mid September; C2) indicated from 0 to 67 percent of juvenile steelhead and 17 to 96 percent of adult steelhead were missing the first-year annulus (Table 6). The percentage of adult steelhead exceeding C2 was consistently higher than the percentage of juvenile steelhead exceeding C2. This was similar to the results of the percentage of adults and juveniles exceeding C1, however for one population (Cranberry) the percentage of juvenile steelhead exceeding C1 was higher than the percentage observed for adult steelhead. The maximum number of circuli observed on age 0 steelhead near the end of the growing season ranged from 5 in the Cranberry River to 12 in Seaskinnish Creek.

Among steelhead fry sampled in 1997, all fish had formed scales and the mean number of circuli differed between populations (ANOVA, F = 8.145, $P < 0.0005$; Table 6). Cranberry steelhead fry had fewer circuli than fry from Seaskinnish Creek (Tukey HSD = -3.20, $P = 0.001$) and Kwinageese River (Tukey HSD = -2.60, $P = 0.008$), but had similar circuli counts as fry from the Bell-Irving (Tukey HSD = -1.50, $P = 0.189$) and Tseax rivers (Tukey HSD = 0.20, $P = 0.999$). Tseax steelhead fry had fewer circuli than fry from Seaskinnish Creek (Tukey HSD = -3.40, $P < 0.0005$) and Kwinageese River (Tukey HSD = -2.80, $P = 0.004$), but had similar circuli counts as fry from the Bell-Irving (Tukey HSD = -1.70, $P = 0.103$) and Cranberry rivers. All other pairwise comparisons between fry populations indicated similar mean circuli counts (Tukey HSD, $P > 0.05$).

Table 6. The mean, range and maximum (C2) number of circuli counted from the scale focus to the scale margin for age 0 steelhead from Bell-Irving, Cranberry, Kwinageese, Meziadin, and Tseax rivers, Seaskinnish Creek and the Nass River fishwheels.

	Age 0 Steelhead Number of Circuli				**Percentage Exceeding C2**	
Population	**Mean**	**Range**	**Sample Size**	**C2**	**Juveniles**	**Adults**
Summer steelhead						
Bell-Irving[3]	6.1	3-9	17	8	10%	20%
Cranberry	4.3	3-5	10	5	20%	96%
Kwinageese	6.9	5-9	10	9	50%	72%
Meziadin[2]	4	NA	1	9[2]	23%	33%
Pooled summer steelhead Fishwheels (1997)[2]	NA	NA	NA	9[2]	NA	17%
Winter steelhead						
Seaskinnish[1]	7.5	5-12	10	12	0%	NA
Tseax[1]	4.1	2-6	10	6	67%	NA

1. Includes summer and winter steelhead.
2. For populations without a significant relationship between circuli count and fork length, C2 was predicted from the pooled sample.
3. C2 was set at 8 circuli for the Bell-Irving since the age 0 steelhead with 9 circuli was suspected to be under-aged.

5.0.0.0 Discussion

5.1.0.0 Mean Smolt Age Estimates

The mean smolt age estimates from adult steelhead scales were generally similar to previous estimates for Nass River populations (Parken 1997b). For the Cranberry and Kwinageese populations, the mean smolt age estimates were the same as the previous estimates. Also, only small differences were noted in mean smolt age for the Ishkheenickh and Tseax populations as well as for the pooled summer steelhead from the Nass River fishwheels. The mean smolt age of Meziadin steelhead (3.27 years) increased by about a quarter of a year over the previous estimate (3.00 years; Parken 1997b). Previously, the mean smolt age of Chambers Creek steelhead was estimated as the midpoint of Ishkheenickh and Tseax steelhead (3.41 years; Parken 1997b), however the scale samples from 1997 indicated the mean smolt age was lower (3.00 years). Mean smolt age was estimated for three other populations that had no previous estimates (Bell-Irving = 3.73 years, Kincolith = 3.51 years and pooled winter steelhead = 3.38 years).

The mean smolt ages from adult scales of Nass River summer steelhead populations were lower than the range reported for Skeena River summer steelhead populations (Bocking and English 1992). The mean smolt age of Nass River summer steelhead ranged from 3.27 years in the Meziadin River to 3.74 years in Damdochax Creek. In contrast, Skeena River summer steelhead ranged in mean smolt age from 3.45 years (Buck Creek) to 5.68 years (Goathorn Creek; Bocking and English 1992). The mean smolt age of Cranberry River steelhead from adult scales (3.53 years) was slightly higher than Sebastian's (1987) mean smolt age estimate (3.30 years) based on the length of the growing season. Tautz *et al.* (1992) estimated the mean smolt age of Skeena River summer steelhead ranged from 3.3 years (Babine River) to 4.5 years (upper Sustut River) based on the length of the growing season.

The limited growing season data indicated interior rivers had shorter growing seasons than coastal rivers. Also, the effect of large lakes on the growing season may depend on the degree of glacial influence. Glacially influenced streams in the Nass River headwaters area, such as the Bell-Irving and Bowser rivers, may have very short growing seasons, which was similar to the results reported for rivers in the Skeena River headwaters area, such as the Sustut and Kluatantan rivers (Tautz *et al.* 1992). Meziadin Lake, a large interior lake, moderated water temperatures in the Meziadin River and extended the growing season considerably with respect to other Nass River tributaries. Similarly, Tautz *et al.* (1992) reported that Babine Lake (surface area = 490.7 km^2, volume = $27x10^9$ m^3; Johnson 1962) moderated water temperatures in the Babine River, which had the longest growing season of all Skeena River tributaries with summer steelhead populations. However, in spite of having a large lake some glacially influenced rivers may not experience the long growing seasons observed in the Meziadin or Babine rivers. For example, Bowser River had a very short growing season and mean daily water temperatures dropped below 7° C during August

(Figure 4) and in the Skeena watershed, the Morice River had a short growing season (Tautz *et al.* 1992): both rivers flow from large, glacially influenced lakes.

The mean smolt age estimates from adult scales and the fork lengths of yearling steelhead produced varying results for the different populations. These mean smolt age estimates were similar to those from adult scales in the Bell-Irving, Cranberry and Meziadin rivers. In contrast, the estimates from the fork lengths of yearlings were lower than estimates from adult scales in the Kwinageese and Tseax rivers and Damdochax Creek. The estimates from adult scales were not consistently higher or lower than the estimates from the fork lengths of yearlings. The results indicated the estimates from yearlings may have been limited by few samples, or the relationship between mean smolt age and the fork length of yearlings may not be appropriate for Nass River steelhead.

Nass River winter steelhead populations usually had lower mean smolt ages than summer steelhead populations which was similar to results reported for Vancouver Island summer and winter steelhead (Hooton *et al.* 1987). In the Nass River watershed, the differences in mean smolt age between summer and winter populations may be indicative of the length of the growing season, with coastal populations (winter steelhead) having longer growing seasons than interior populations (summer steelhead).

5.2.0.0 Lack of First-year Annulus Investigations

Comparisons of otolith and scale ages indicated there was no under-aging of juvenile steelhead, since the ages had 100 percent correspondence. However, the results indicated some steelhead scales were missing the first-year annulus. The high agreement between otolith and scale ages was influenced by the large number of scales collected from juveniles (smear sample) which permitted the exclusion of scales missing the first-year annulus. Scales were examined before reading to choose the best one, and thus a scale with the first-year annulus was chosen over those without the first-year annulus (Lidstone 1997). Jensen (1977 cited by Jensen and Johnsen 1982) reported similar results from brown trout in Norway where the first-year annulus could be seen on one or two scales while it was missing in the other scales from the same fish. Therefore, these results demonstrated that some adult steelhead may be under-aged by one year because on juvenile steelhead the first-year annulus was not evident on all scales collected from the same fish. The small number of scales collected from adult steelhead (typically 5 to 10) reduced the probability of reading one with the first-year annulus, whereas many scales were collected from juvenile steelhead which increased the probability of reading one with the first-year annulus.

The presence of large (>70 mm) age 0 steelhead in three of seven Nass River summer steelhead populations indicated some steelhead scales may be missing the first-year annulus, since it was unlikely that steelhead fry emerging in late July and early August at about 25 mm would grow larger than 70 mm by mid September (Bocking and English 1992; R.S. Hooton, personal communication, 1998). Large juvenile steelhead in the Bell-Irving (Saimoto and Saimoto 1998), Damdochax (Triton 1994a) and Kwinageese (1994b) watersheds were under-aged as age 0, and indicated the first-year annulus was indistinguishable or may not form in upper Nass River steelhead populations.

Adult steelhead were suspected missing the first-year annulus in five of the six Nass River summer steelhead populations based on the predicted maximum number of circuli formed during the first growing season. None of the adult Kiteen River steelhead were suspected missing the first-year annulus, although the ability to detect a missing first-year annulus was limited by the small sample (n = 2). For the other populations, the percentage of adult steelhead suspected missing the first-year annulus ranged from 12 percent in the Cranberry River to 33 percent in the Meziadin River. For Skeena River summer steelhead, the percentage of adults missing the first-year annulus ranged from 2 percent (Babine River) to 61 percent (Sustut River) based on the comparison of mean smolt age from adult scales (Cox-Rogers 1986) to the mean smolt age from the length of the growing season (Tautz *et al.* 1992).

The predicted maximum number of circuli formed during the first growing season for Nass River summer steelhead populations was intermediate of the maximum number of circuli predicted for other salmonid species. For Nass River steelhead populations, the expected maximum number of circuli formed during the first growing season ranged from 8 in the Bell-Irving River to 11 in the Kwinageese River. In comparison, cutthroat trout in Idaho and Yellowstone National Park were expected to form a maximum of 10 circuli if they grew to 80 mm during the first growing season (Lentsch and Griffith 1987). For Atlantic salmon in the Beiarelva and Saltdalselva rivers, Norway, a maximum of five circuli were formed during the first growing season (Jensen and Johnsen 1982). For Atlantic salmon in Ungava Bay, a maximum of four circuli were expected during the first growing season and all fish with five or more circuli to the first annulus were assumed under-aged by one year (Power 1969 cited by Jensen and Johnsen 1982). Also, Jensen (1977 cited by Jensen and Johnsen 1982) reported that brown trout in a Norwegian mountain lake were expected to form four circuli during the first growing season and one year was added to the ages of all fish with five or more wide circuli to the first annulus.

The maximum number of circuli observed for age 0 steelhead near the end of the growing season (C2) was less than the predicted maximum number formed during the first growing season (C1). The maximum circuli counts observed on age 0 steelhead near the end of the growing season ranged from 5 to 12 circuli for summer steelhead populations whereas the predicted maximum ranged from 8 to 11 circuli. The circuli counts observed on age 0 steelhead indicated that 10 to 96 percent of adult Nass River summer steelhead were missing the first-year annulus. However, these results must be interpreted cautiously since steelhead were sampled before the end of the growing season and because the mean circuli counts on wild age 0 Vancouver Island steelhead increased on average by one or two circuli during the winter (Horncastle and Hay 1981). Furthermore, the maximum circuli counts observed on age 0 steelhead were based on few samples ($\leq$10 steelhead) from each Nass River population.

The wide size range of age 0 Nass River steelhead populations and the presence of some small steelhead near the end of the growing season indicated that size-biased survival may influence year class composition, and accordingly affect mean circuli counts to the first annulus. Density dependent survival from fry to age 1 parr was reported from steelhead (Hume and Parkinson 1987; Hume and Parkinson 1988; Close and Anderson 1992; Ward and Slaney 1993) and Atlantic salmon (Symons 1979; McMenemy 1995), and the overwinter survival of steelhead was suspected to be dependent on body size (Hume and Parkinson 1988; Close and Anderson 1992). Thus, the mean circuli counts to the first annulus on adults and juveniles may be higher than the mean counts for age 0 because the smaller age 0 steelhead with lower circuli counts may experience lower survival rates than the larger age 0 steelhead with higher circuli counts (size-biased survival). The mean circuli count to the first annulus of juvenile and adult steelhead was expected to be positively biased as a result of size-biased survival (Hume and Parkinson 1988; Close and Anderson 1992) and because mean circuli counts increased between the late fall and spring for wild age 0 Vancouver Island steelhead (Horncastle and Hay 1988).

The missing first-year annulus may be a common negative bias in the mean smolt ages of Nass River summer steelhead populations because of the small size and low circuli counts observed on age 0 steelhead. Some of the age 0 steelhead from the Bell-Irving, Cranberry, Meziadin and Tseax rivers were small (<45 mm) and had formed few circuli (<4) near the end of the growing season. The small number of circuli formed during the first growing season may make the first-year annulus difficult to recognize because the narrowing in circuli spacing during the first winter may not be evident when compared against the spacing of the few circuli formed during the first growing season (Lentsch and Griffith 1987). Hooton *et al.* (1987) suggested that the formation of four or five circuli during the first year may be insufficient to detect the first-year annulus on steelhead. The absence of the first-year annulus would then be reflected by a wide range in circuli counts to the first observed annulus (Hooton *et al.* 1987).

The absence of scale formation did not appear to be a source of under-aging bias among Nass River steelhead populations. In 1997, all age 0 steelhead sampled had formed scales which indicated Nass River juvenile steelhead as small as 40 mm had developed scales whereas on Vancouver Island steelhead as small as 46 mm were found devoid of scales (Hooton *et al.* 1987). Thus, the absence of scale formation was not common among Nass River steelhead populations based on these limited analyses, however more samples should be examined before eliminating scale formation as a source of under-aging bias. Also, some small age 0 steelhead (36 to 40 mm) in the Tseax River were not sampled for scales.

6.0.0.0 Recommendations

1. Mean daily water temperature should continue to be monitored in the major steelhead tributaries and temperature data loggers should be deployed into the main lower Nass watershed tributaries (i.e. Chambers Creek, Kincolith River and Ishkheenickh River) and upper tributaries (i.e. White River, Damdochax Creek) for improved spatial representation.

2. Until better estimates are available, the mean smolt ages from adult scales should be adjusted to account for under-aging using the maximum number of circuli to the first annulus criteria (C1). The adjustments should be made for the Bell-Irving, Cranberry and Nass River fishwheel populations, however the adjustments should not be made for the Kwinageese and Meziadin populations until there are more adult steelhead scale samples with circuli counts to the first annulus. The adjustment would increase the mean smolt age in the Cranberry population from 3.53 years to 3.65 years. The difference of 0.12 years indicates 12 percent of the adult steelhead were under-aged by one year. The adjusted mean smolt age estimates should be interpreted cautiously until the relationship between circuli count and fork length can be better defined for 70 mm steelhead.

3. Scale samples should be collected from juvenile steelhead in the Bell-Irving, Cranberry, Kwinageese, Meziadin, and Tseax rivers and Seaskinnish Creek and other Nass River steelhead streams that will be inventoried by MELP in 1998. Scales should be collected from all captured juvenile steelhead to be directly representative of the relative abundance of different age classes and size distributions. The number of circuli to the first annulus and to the margin of the scale should be recorded for all juvenile steelhead scale samples.

4. Future analyses of the maximum number of circuli formed during the first growing season should estimate the maximum length of an age 0 steelhead separately for each population. The results of this study indicated age 0 steelhead size may vary between populations and therefore, the C1 values may be more characteristic of a population if the maximum length of an age 0 fish was based on empirical information from that population. Also, the maximum size of an age 0 steelhead at the end of the growing season appeared to be less than 70 mm for some steelhead populations based on recent fisheries inventory information conducted near the end of the growing season. The maximum length of an age 0 steelhead at the end of the growing season may be estimated for each population from the length frequency histogram of steelhead sampled near the end of the growing season.

5. Scale samples should be collected from at least 20 additional fry in the Cranberry, Kwinageese, Meziadin, and Tseax rivers and Oweegee, Teigen and Seaskinnish creeks and measured for circuli counts from the scale focus to margin. The information would help define the relationships between circuli counts and juvenile steelhead length. The information could also be analyzed in context with the growing season data.

6. Scale samples should be collected from adult steelhead in the Tseax River and Seaskinnish Creek to estimate the percentage of sympatric summer and winter steelhead that

are missing the first-year annulus. Mean circuli counts could be compared to the pattern observed for juvenile steelhead.

7. Future analyses should perform separate investigations for growing season length and degree days (or temperature units) since some systems, such as Tseax appear to have very long growing seasons, but potentially fewer degree days (or temperature units).

8. If adult steelhead scale samples are insufficient for some tributaries, then the historic scale samples could be analyzed for the number of circuli to the first annulus. This would provide an improved estimate of the percentage of adult steelhead missing the first annulus for some populations.

9. All historic juvenile steelhead scales collected at the fishwheels or in smolt traps in the mainstem Nass should be re-analyzed for circuli counts and distance to the first annulus. The data would be representative of a mixed juvenile steelhead population of summer and winter steelhead that rear in the Nass River watershed upstream of Canyon City.

10. Yearling steelhead should be sampled for scales during the spring period (May-June) to determine the percentage of age 1 fish that did not form the first-year annulus. All fish aged as 0 can be considered missing the first-year annulus, since no age 0 steelhead should have emerged at this time. However, many Nass and Skeena tributaries are in spring freshet and very turbid at this time which makes sampling juveniles impractical.

11. Juvenile steelhead that have some scales missing the first-year annulus and other scales with the first annulus in the sample should be distinguished. The mean circuli counts from these steelhead may be useful for determining the number of circuli formed to the first annulus.

12. In the Meziadin River, juvenile steelhead sampling should occur in a different area to try to capture more age 0 steelhead.

13. Maximum length criteria for age 0 steelhead should be developed independently for each major steelhead population, since the different populations have different growth rates.

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8.0 Appendix

Appendix A. A summary of the scale age, otolith age and circuli counts to the first annulus for adult steelhead collected in 1997.

Steelhead ages were reported with the number of winters spent in freshwater before the decimal point followed by the number of winters spent in the ocean. A + identifies a summer steelhead with some scale growth after its last winter in the ocean. In contrast, winter steelhead do not have a + because they entered freshwater near the end of the winter. An S identifies a previous spawning event and represents 1 ocean year and an R or a U represents regenerated scales that could not be used to determine age. A steelhead age 3.2S1+ was a summer steelhead that spent 3 winters in freshwater before smolting and then spent 2 winters in the ocean before its first spawning run and then spent another winter in the ocean before making its second spawning migration. The steelhead was freshwater age 3 and ocean age 4. Steelhead ages that were not linked to length or sex data were summarized in a box beside the sampling date and related information.

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Bell-Irving	21-Oct-97	77.0	m	3.2+	NA	10
Bell-Irving	21-Oct-97	64.0	f	4.2+	NA	9
Bell-Irving	21-Oct-97	74.0	m	4.2S1+	NA	8
Bell-Irving	26-Nov-97	52.0	m	3.1+	NA	5
Bell-Irving	26-Nov-97	50.0	m	3.1+	NA	3
Bell-Irving	26-Nov-97	50.0	m	3.1+	NA	7
Bell-Irving	26-Nov-97	56.0	f	3.1+	NA	7
Bell-Irving	26-Nov-97	62.0	m	3.1S1+	NA	10
Bell-Irving	26-Nov-97	65.0	f	3.2+	NA	11
Bell-Irving	26-Nov-97	78.0	m	3.2+	NA	6
Bell-Irving	26-Nov-97	70.0	f	3.2+	NA	7
Bell-Irving	26-Nov-97	81.0	m	3.2+	NA	9
Bell-Irving	26-Nov-97	48.5	f	4.1+	NA	8
Bell-Irving	26-Nov-97	57.0	m	4.1+	NA	8
Bell-Irving	26-Nov-97	54.0	m	4.1+	NA	8
Bell-Irving	26-Nov-97	53.0	m	4.1+	NA	6
Bell-Irving	26-Nov-97	67.0	f	4.2+	NA	6
Bell-Irving	26-Nov-97	72.0	m	4.2+	NA	9
Bell-Irving	26-Nov-97	72.0	f	4.2+	NA	5
Bell-Irving	26-Nov-97	70.0	m	4.2+	NA	5
Bell-Irving	26-Nov-97	69.0	f	4.2+	NA	6
Bell-Irving	26-Nov-97	61.0	f	5.1+	NA	5
Bell-Irving	26-Nov-97	59.0	m	5.1+	NA	7
Bell-Irving	26-Nov-97	72.0	f	5.2+	NA	5
Bell-Irving	26-Nov-97	70.0	f	5.2+	NA	4
Bell-Irving	26-Nov-97	72.0	f	5.2+	NA	4
Bell-Irving	26-Nov-97	56.0	m	R.1+	NA	NA
Bell-Irving	26-Nov-97	56.0	m	R.1+	NA	NA
Bell-Irving	26-Nov-97	70.0	f	R.2+	NA	NA
Bell-Irving	26-Nov-97	74.0	m	R.2+	NA	NA
Bell-Irving	27-Nov-97	56.0	f	3.1+	NA	7
Bell-Irving	27-Nov-97	55.0	m	3.1+	NA	3
Bell-Irving	27-Nov-97	54.0	m	3.1+	NA	5
Bell-Irving	27-Nov-97	70.0	f	4.1S1+	NA	7
Bell-Irving	27-Nov-97	74.0	f	R.2+	NA	NA
Cranberry	25-Sep-97	58.0	f	3.1+	NA	7

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1^{st} Annulus
Cranberry	25-Sep-97	75.0	m	3.2+	NA	8
Cranberry	25-Sep-97	72.0	f	3.2+	NA	8
Cranberry	25-Sep-97	65.0	f	3.2+	NA	6
Cranberry	25-Sep-97	65.0	f	3.2+	NA	6
Cranberry	25-Sep-97	72.0	f	4.1S1+	NA	9
Cranberry	25-Sep-97	72.0	f	4.2+	NA	9
Cranberry	25-Sep-97	67.0	f	4.2+	NA	9
Cranberry	06-Oct-97	79.0	m	3.2+	NA	9
Cranberry	06-Oct-97	73.0	m	3.2+	NA	7
Cranberry	06-Oct-97	70.0	f	3.2+	NA	9
Cranberry	06-Oct-97	66.0	f	3.2+	NA	7
Cranberry	06-Oct-97	65.0	f	3.2+	NA	8
Cranberry	06-Oct-97	64.0	m	3.2+	NA	8
Cranberry	06-Oct-97	57.0	m	4.1+	NA	8
Cranberry	06-Oct-97	55.0	f	4.1+	NA	7
Cranberry	06-Oct-97	57.0	m	4.1+	NA	10
Cranberry	06-Oct-97	55.0	m	4.1+	NA	8
Cranberry	06-Oct-97	71.0	f	4.2+	NA	NA
Cranberry	06-Oct-97	67.0	f	4.2+	NA	NA
Cranberry	06-Oct-97	69.0	f	4.2+	NA	10
Cranberry	06-Oct-97	76.0	f	4.2+	NA	12
Cranberry	06-Oct-97	51.0	m	R.1+	NA	
Cranberry	06-Oct-97	67.0	f	R.2+	NA	NA
Cranberry	06-Oct-97	66.0	f	R.2+	NA	NA
Cranberry	07-Oct-97	56.0	f	3.1+	NA	6
Cranberry	07-Oct-97	55.0	m	3.1+	NA	7
Cranberry	07-Oct-97	75.0	m	3.1S1+	NA	NA
Cranberry	07-Oct-97	74.0	f	3.2+	NA	8
Cranberry	07-Oct-97	69.0	m	3.2+	NA	7
Cranberry	07-Oct-97	74.0	m	3.2+	NA	11
Cranberry	07-Oct-97	69.0	f	3.2+	NA	9
Cranberry	07-Oct-97	74.0	f	3.2+	NA	9
Cranberry	07-Oct-97	69.0	f	3.2+	NA	7
Cranberry	07-Oct-97	69.0	f	3.2+	NA	7
Cranberry	07-Oct-97	80.0	m	3.2+	NA	8
Cranberry	07-Oct-97	78.0	f	3.2S1+	NA	6
Cranberry	07-Oct-97	57.0	f	4.1+	NA	9
Cranberry	07-Oct-97	50.0	f	4.1+	NA	7
Cranberry	07-Oct-97	50.0	m	4.1+	NA	6
Cranberry	07-Oct-97	64.0	f	4.1S1+	NA	5
Cranberry	07-Oct-97	73.0	m	4.2+	NA	6
Cranberry	07-Oct-97	67.0	f	4.2+	NA	8
Cranberry	07-Oct-97	71.0	f	4.2+	NA	6
Cranberry	07-Oct-97	71.0	f	4.2+	NA	7
Cranberry	07-Oct-97	67.0	f	4.2+	NA	6
Cranberry	07-Oct-97	78.0	m	4.2+	NA	9
Cranberry	07-Oct-97	79.0	f	4.2S1+	NA	8
Cranberry	07-Oct-97	78.0	f	4.3+	NA	7
Cranberry	07-Oct-97	79.0	m	4.3+	NA	NA
Cranberry	07-Oct-97	75.0	m	R.2+	NA	NA
Cranberry	07-Oct-97	60.0	f	R.2+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Cranberry	07-Oct-97	71.0	f	R.2+	NA	8
Cranberry	08-Oct-97	55.0	m	3.1+	NA	9
Cranberry	08-Oct-97	65.0	f	3.1S1+	NA	10
Cranberry	08-Oct-97	67.0	f	3.2+	NA	8
Cranberry	08-Oct-97	69.0	f	3.2+	NA	6
Cranberry	08-Oct-97	80.0	f	3.2S1+	NA	12
Cranberry	08-Oct-97	86.0	m	3.3+	NA	9
Cranberry	08-Oct-97	62.0	m	4.1+	NA	7
Cranberry	08-Oct-97	53.0	m	4.1+	NA	9
Cranberry	08-Oct-97	75.0	m	4.2+	NA	10
Cranberry	08-Oct-97	75.0	m	4.2+	NA	10
Cranberry	08-Oct-97	73.0	f	4.2+	NA	5
Cranberry	08-Oct-97	71.0	f	4.2+	NA	9
Cranberry	08-Oct-97	76.0	f	5.2+	NA	7
Cranberry	08-Oct-97	57.0	m	R.1+	NA	NA
Cranberry	08-Oct-97	51.0	m	R.1+	NA	NA
Cranberry	08-Oct-97	74.0	f	R.2+	NA	NA
Cranberry	08-Oct-97	66.0	f	R.2+	NA	NA
Cranberry	08-Oct-97	66.0	f	R.2+	NA	NA
Cranberry	09-Oct-97	55.0	f	3.1+	NA	5
Cranberry	09-Oct-97	56.0	m	3.1+	NA	7
Cranberry	09-Oct-97	75.0	m	3.1S1+	NA	8
Cranberry	09-Oct-97	66.0	f	3.2+	NA	8
Cranberry	09-Oct-97	63.0	f	3.2+	NA	10
Cranberry	09-Oct-97	73.0	f	3.2+	NA	8
Cranberry	09-Oct-97	70.0	m	3.2+	NA	10
Cranberry	09-Oct-97	74.0	f	3.2S1+	NA	9
Cranberry	09-Oct-97	61.0	m	4.1+	NA	8
Cranberry	09-Oct-97	60.0	m	4.1+	NA	9
Cranberry	09-Oct-97	58.0	m	4.1+	NA	8
Cranberry	09-Oct-97	68.0	f	4.2+	NA	7
Cranberry	09-Oct-97	74.0	f	4.2+	NA	9
Cranberry	09-Oct-97	80.0	m	4.2+	NA	8
Cranberry	09-Oct-97	78.0	f	4.2+	NA	10
Cranberry	09-Oct-97	70.0	f	4.2+	NA	8
Cranberry	09-Oct-97	65.0	f	4.2+	NA	9
Cranberry	09-Oct-97	71.0	f	4.2+	NA	12
Cranberry	09-Oct-97	73.0	f	4.2+	NA	9
Cranberry	09-Oct-97	69.0	f	4.2+	NA	9
Cranberry	09-Oct-97	71.0	f	4.2+	NA	11
Cranberry	09-Oct-97	71.0	f	4.2+	NA	7
Cranberry	09-Oct-97	53.0	f	R.1+	NA	NA
Cranberry	09-Oct-97	69.0	m	R.1S1+	NA	NA
Cranberry	09-Oct-97	73.0	f	R.2+	NA	NA
Cranberry	09-Oct-97	81.0	m	R.2+	NA	NA
Cranberry	09-Oct-97	75.0	m	R.2+	NA	NA
Cranberry	09-Oct-97	73.0	f	R.2+	NA	NA
Cranberry	09-Oct-97	77.0	f	R.2S1+	NA	NA
Cranberry	09-Oct-97	83.0	m	R.3+	NA	NA
Cranberry	09-Oct-97	67.0	f	U.1S1+	NA	NA
Cranberry	09-Oct-97	77.0	m	U.2+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Cranberry	09-Oct-97	77.0	m	U.2+	NA	NA
Cranberry	09-Oct-97	66.0	f		NA	
Cranberry	10-Oct-97	59.0	m	3.1+	NA	5
Cranberry	10-Oct-97	60.0	m	3.1+	NA	7
Cranberry	10-Oct-97	54.0	m	3.1+	NA	10
Cranberry	10-Oct-97	61.0	m	3.1+	NA	9
Cranberry	10-Oct-97	70.0	f	3.2+	NA	8
Cranberry	10-Oct-97	74.0	f	3.2+	NA	10
Cranberry	10-Oct-97	68.0	f	3.2+	NA	10
Cranberry	10-Oct-97	72.0	f	3.2+	NA	9
Cranberry	10-Oct-97	68.0	f	3.2+	NA	7
Cranberry	10-Oct-97	62.0	f	3.2+	NA	7
Cranberry	10-Oct-97	72.0	f	3.2+	NA	11
Cranberry	10-Oct-97	72.0	f	3.2+	NA	9
Cranberry	10-Oct-97	57.0	f	3.2+	NA	8
Cranberry	10-Oct-97	71.0	f	3.2+	NA	NA
Cranberry	10-Oct-97	74.0	m	3.2+	NA	11
Cranberry	10-Oct-97	67.0	f	3.2+	NA	8
Cranberry	10-Oct-97	58.0	m	3.2+	NA	NA
Cranberry	10-Oct-97	77.0	m	3.2+	NA	10
Cranberry	10-Oct-97	87.0	m	3.3+	NA	6
Cranberry	10-Oct-97	54.0	m	4.1+	NA	12
Cranberry	10-Oct-97	60.0	m	4.1+	NA	9
Cranberry	10-Oct-97	57.0	m	4.1+	NA	7
Cranberry	10-Oct-97	55.0	m	4.1+	NA	9
Cranberry	10-Oct-97	54.0	m	4.1+	NA	NA
Cranberry	10-Oct-97	62.0	m	4.1+	NA	6
Cranberry	10-Oct-97	77.0	m	4.2+	NA	6
Cranberry	10-Oct-97	72.0	f	4.2+	NA	7
Cranberry	10-Oct-97	76.0	f	4.2+	NA	9
Cranberry	10-Oct-97	79.0	m	4.2+	NA	12
Cranberry	10-Oct-97	73.0	f	4.2+	NA	8
Cranberry	10-Oct-97	75.0	f	4.2+	NA	9
Cranberry	10-Oct-97	80.0	f	4.2+	NA	8
Cranberry	10-Oct-97	71.0	f	4.2+	NA	9
Cranberry	10-Oct-97	71.0	f	4.2+	NA	9
Cranberry	10-Oct-97	74.0	m	4.2+	NA	10
Cranberry	10-Oct-97	80.0	m	5.2+	NA	9
Cranberry	10-Oct-97	54.0	m	n/s	NA	NA
Cranberry	10-Oct-97	57.0	f	R.1+	NA	NA
Cranberry	10-Oct-97	71.0	f	R.2+	NA	NA
Cranberry	10-Oct-97	70.0	f	R.2+	NA	NA
Cranberry	10-Oct-97	70.0	m	R.2+	NA	NA
Cranberry	10-Oct-97	58.0	m	U.1+	NA	NA
Cranberry	10-Oct-97	67.0	f	U.2+	NA	NA
Cranberry	10-Oct-97	70.0	f	U.2+	NA	NA
Cranberry	03-Nov-97	67.0	f	3.2+	NA	9
Cranberry	03-Nov-97	71.0	f	3.2+	NA	10
Cranberry	03-Nov-97	68.0	f	3.2+	NA	11
Cranberry	03-Nov-97	51.0	m	4.1+	NA	5
Cranberry	03-Nov-97	55.0	m	NA	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Cranberry	03-Nov-97	56.0	m	NA	NA	NA
Cranberry	03-Nov-97	76.0	f	NA	NA	NA
Cranberry	03-Nov-97	72.0	f	NA	NA	NA
Cranberry	03-Nov-97	74.0	f	NA	NA	NA
Cranberry	04-Nov-97	52.0	f	3.1+	NA	7
Cranberry	04-Nov-97	55.0	m	3.1+	NA	8
Cranberry	04-Nov-97	69.0	f	3.2+	NA	8
Cranberry	04-Nov-97	61.0	m	4.1+	NA	10
Cranberry	04-Nov-97	54.0	f	4.1+	NA	6
Cranberry	04-Nov-97	67.0	f	4.2+	NA	12
Cranberry	04-Nov-97	74.0	m	4.2+	NA	10
Cranberry	04-Nov-97	70.0	f	4.2+	NA	7
Cranberry	04-Nov-97	54.0	m	5.1+	NA	6
Cranberry	04-Nov-97	76.0	m	R.2+	NA	NA
Cranberry	04-Nov-97	74.0	f	R.2+	NA	NA
Cranberry	04-Nov-97	73.0	m	R.2+	NA	NA
Cranberry	04-Nov-97	74.0	m	R.2+	NA	NA
Cranberry	04-Nov-97	65.0	f	R.2+	NA	NA
Cranberry	04-Nov-97	75.0	m	NA	NA	NA
Cranberry	04-Nov-97	80.0	m	NA	NA	NA
Cranberry	04-Nov-97	55.0	m	NA	NA	NA
Cranberry	04-Nov-97	75.0	m	NA	NA	NA
Cranberry	04-Nov-97	56.0	m	NA	NA	NA
Cranberry	04-Nov-97	71.0	m	NA	NA	NA
Cranberry	04-Nov-97	82.0	m	NA	NA	NA
Cranberry	04-Nov-97		f	NA	NA	NA
Cranberry	05-Nov-97	57.0	m	3.1+	NA	7
Cranberry	05-Nov-97	67.0	m	3.1S1+	NA	9
Cranberry	05-Nov-97	79.0	m	3.2+	NA	8
Cranberry	05-Nov-97	77.0	f	3.2S1+	NA	NA
Cranberry	05-Nov-97	56.0	m	4.1+	NA	7
Cranberry	05-Nov-97	76.0	m	NA	NA	NA
Cranberry	06-Nov-97	56.0	m	3.1+	NA	12
Cranberry	06-Nov-97	54.0	f	3.1+	NA	9
Cranberry	06-Nov-97	76.0	f	3.2+	NA	11
Cranberry	06-Nov-97	73.0	f	3.2+	NA	8
Cranberry	06-Nov-97	57.0	m	4.1+	NA	10
Cranberry	06-Nov-97	81.0	f	5.2+	NA	4
Cranberry	06-Nov-97	73.0	f	R.2+	NA	NA
Cranberry	06-Nov-97	74.0	f	R.2+	NA	NA
Cranberry	06-Nov-97	73.0	f	NA	NA	NA
Cranberry	06-Nov-97	68.0	f	NA	NA	NA
Cranberry	06-Nov-97	55.0	m	NA	NA	NA
Cranberry	06-Nov-97	81.0	m	NA	NA	NA
Cranberry	06-Nov-97	88.0	m	NA	NA	NA
Cranberry	06-Nov-97	78.0	f	NA	NA	NA
Cranberry	06-Nov-97	71.0	f	NA	NA	NA
Cranberry	06-Nov-97	76.0	f	NA	NA	NA
Cranberry	06-Nov-97	71.0	f	NA	NA	NA
Cranberry	06-Nov-97	57.0	f	NA	NA	NA
Cranberry	06-Nov-97	82.0	m	NA	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Cranberry	06-Nov-97	82.0	m	NA	NA	NA
Cranberry	06-Nov-97	76.0	f	NA	NA	NA
Cranberry	06-Nov-97	62.0	f	NA	NA	NA
Cranberry	06-Nov-97	85.0	m	NA	NA	NA
Cranberry	06-Nov-97	NA	m	NA	NA	NA
Cranberry	06-Nov-97	91.0	m	NA	NA	NA
Cranberry	06-Nov-97	NA	f	NA	NA	NA
Cranberry	06-Nov-97	NA	f	NA	NA	NA
Cranberry	06-Nov-97	NA	m	NA	NA	NA
Cranberry	06-Nov-97	NA	f	NA	NA	NA
Cranberry	07-Nov-97	66.0	m	4.1+	NA	8
Cranberry	07-Nov-97	78.0	f	4.2S1+	NA	6
Cranberry	07-Nov-97	69.0	f	NA	NA	NA
Cranberry	07-Nov-97	60.0	f	NA	NA	NA
Cranberry	07-Nov-97	76.0	m	NA	NA	NA
Cranberry	07-Nov-97	68.0	f	NA	NA	NA
Cranberry	07-Nov-97	62.0	f	NA	NA	NA
Cranberry	07-Nov-97	66.0	m	NA	NA	NA
Cranberry	07-Nov-97	71.0	f	NA	NA	NA
Cranberry	07-Nov-97	70.0	f	NA	NA	NA
Cranberry	07-Nov-97	67.0	m	NA	NA	NA
Cranberry	07-Nov-97	72.0	f	NA	NA	NA
Cranberry	07-Nov-97	58.0	m	NA	NA	NA
Cranberry	07-Nov-97	60.0	m	NA	NA	NA
Cranberry	07-Nov-97	51.0	m	NA	NA	NA
Cranberry	07-Nov-97	73.0	f	NA	NA	NA
Cranberry	07-Nov-97	70.0	f	NA	NA	NA
Cranberry	07-Nov-97	76.0	f	NA	NA	NA
Cranberry	07-Nov-97	57.0	m	NA	NA	NA
Cranberry	07-Nov-97	74.0	f	NA	NA	NA
Cranberry	07-Nov-97	70.0	f	NA	NA	NA
Cranberry	07-Nov-97	71.0	f	NA	NA	NA
Cranberry	07-Nov-97	71.0	f	NA	NA	NA
Cranberry	07-Nov-97	67.0	f	NA	NA	NA
Cranberry	07-Nov-97	67.0	m	NA	NA	NA
Cranberry	07-Nov-97	73.0	f	NA	NA	NA
Cranberry	07-Nov-97	73.0	f	NA	NA	NA
Fishwheels	28-Jul-97	63.0	f	NA	NA	NA
Fishwheels	28-Jul-97	70.0	f	NA	NA	NA
Fishwheels	30-Jul-97	78.0	m	4.2+	NA	7
Fishwheels	30-Jul-97	72.0	f	R.2+	NA	NA
Fishwheels	30-Jul-97	86.0	f	R.2S1+	NA	NA
Fishwheels	31-Jul-97	67.0	f	3.2+	NA	9
Fishwheels	31-Jul-97	84.0	m	4.2+	NA	7
Fishwheels	31-Jul-97	84.0	m	4.3+	NA	5
Fishwheels	31-Jul-97	52.0	f	R.1+	NA	NA
Fishwheels	01-Aug-97	71.0	m	4.1S1+	NA	6
Fishwheels	01-Aug-97	66.0	f	R.2+	NA	NA
Fishwheels	02-Aug-97	56.0	f	3.1+	NA	5
Fishwheels	02-Aug-97	50.0	f	3.1+	NA	11
Fishwheels	02-Aug-97	70.0	f	NA	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	03-Aug-97	59.0	f	3.1+	NA	8
Fishwheels	03-Aug-97	71.0	f	3.2+	NA	6
Fishwheels	04-Aug-97	57.0	f	3.1+	NA	6
Fishwheels	04-Aug-97	68.0	f	3.2+	NA	7
Fishwheels	04-Aug-97	71.0	f	3.2+	NA	7
Fishwheels	05-Aug-97	73.0	f	3.1S1+	NA	6
Fishwheels	05-Aug-97	63.0	f	3.2+	NA	6
Fishwheels	05-Aug-97	67.5	f	3.2+	NA	11
Fishwheels	05-Aug-97	77.5	f	3.2+	NA	8
Fishwheels	05-Aug-97	70.0	m	4.2+	NA	6
Fishwheels	06-Aug-97	61.0	m	3.2+	NA	8
Fishwheels	06-Aug-97	79.0	m	3.2+	NA	11
Fishwheels	06-Aug-97	73.0	f	4.2+	NA	5
Fishwheels	06-Aug-97	53.0	m	R.1+	NA	NA
Fishwheels	06-Aug-97	64.0	m	R.1S1+	NA	NA
Fishwheels	06-Aug-97	70.0	m	R.1S1+	NA	NA
Fishwheels	07-Aug-97	53.0	m	3.1+	NA	5
Fishwheels	07-Aug-97	NA	f	3.2+	NA	5
Fishwheels	07-Aug-97	71.0	m	3.2+	NA	8
Fishwheels	07-Aug-97	54.0	m	4.1+	NA	4
Fishwheels	07-Aug-97	72.0	m	4.1S1+	NA	4
Fishwheels	07-Aug-97	59.0	m	4.2+	NA	7
Fishwheels	08-Aug-97	73.0	m	3.2+	NA	9
Fishwheels	08-Aug-97	64.0	f	3.2+	NA	12
Fishwheels	08-Aug-97	73.0	f	R.2+	NA	NA
Fishwheels	09-Aug-97	50.0	f	3.1+	NA	10
Fishwheels	09-Aug-97	68.0	m	3.2+	NA	8
Fishwheels	09-Aug-97	84.0	m	3.2S1+	NA	7
Fishwheels	09-Aug-97	55.0	m	4.1+	NA	7
Fishwheels	09-Aug-97	75.0	m	4.2+	NA	7
Fishwheels	09-Aug-97	54.0	f	R.1+	NA	NA
Fishwheels	10-Aug-97	55.0	m	3.1+	NA	5
Fishwheels	10-Aug-97	71.0	m	3.2+	NA	7
Fishwheels	10-Aug-97	72.0	f	3.2+	NA	8
Fishwheels	10-Aug-97	70.0	f	4.2+	NA	5
Fishwheels	10-Aug-97	77.0	m	4.2+	NA	7
Fishwheels	10-Aug-97	71.0	NA	R.2+	NA	NA
Fishwheels	10-Aug-97	67.0	f	R.2+	NA	NA
Fishwheels	10-Aug-97	77.0	f	R.2+	NA	NA
Fishwheels	11-Aug-97	67.0	f	3.2+	NA	7
Fishwheels	11-Aug-97	70.0	m	4.2+	NA	8
Fishwheels	11-Aug-97	81.0	m	4.2+	NA	10
Fishwheels	11-Aug-97	55.0	f	NA	NA	NA
Fishwheels	11-Aug-97	74.0	m	R.2+	NA	NA
Fishwheels	11-Aug-97	74.0	m	U.2+	NA	NA
Fishwheels	12-Aug-97	75.0	f	3.1S1+	NA	11
Fishwheels	12-Aug-97	71.0	m	3.2+	NA	12
Fishwheels	12-Aug-97	69.0	m	3.2+	NA	9
Fishwheels	12-Aug-97	71.0	m	3.2+	NA	7
Fishwheels	12-Aug-97	67.0	f	3.2+	NA	7
Fishwheels	12-Aug-97	NA	NA	3.2+	NA	8

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1^{st} Annulus
Fishwheels	12-Aug-97	85.0	m	3.3+	NA	6
Fishwheels	12-Aug-97	69.0	m	4.1+	NA	9
Fishwheels	12-Aug-97	72.0	f	4.2+	NA	4
Fishwheels	13-Aug-97	69.0	m	3.1S1+	NA	8
Fishwheels	13-Aug-97	72.0	m	3.2+	NA	9
Fishwheels	13-Aug-97	69.0	f	3.2+	NA	9
Fishwheels	13-Aug-97	75.0	m	3.2+	NA	9
Fishwheels	13-Aug-97	57.0	f	4.1+	NA	6
Fishwheels	13-Aug-97	70.0	m	4.2+	NA	12
Fishwheels	13-Aug-97	71.0	f	4.2+	NA	5
Fishwheels	13-Aug-97	53.0	f	R.1+	NA	NA
Fishwheels	14-Aug-97	69.0	f	2.2+	NA	9
Fishwheels	14-Aug-97	77.0	f	3.2+	NA	10
Fishwheels	15-Aug-97	77.0	m	2.2+	NA	9
Fishwheels	16-Aug-97	55.0	m	3.1+	NA	8
Fishwheels	16-Aug-97	72.0	m	3.1S1+	NA	7
Fishwheels	16-Aug-97	83.0	m	3.2+	NA	8
Fishwheels	16-Aug-97	66.0	m	3.2+	NA	11
Fishwheels	16-Aug-97	74.0	f	3.2+	NA	5
Fishwheels	16-Aug-97	63.0	m	3.2+	NA	4
Fishwheels	16-Aug-97	79.0	m	3.3+	NA	8
Fishwheels	16-Aug-97	59.0	f	4.1+	NA	9
Fishwheels	16-Aug-97	69.0	f	4.1S1+	NA	5
Fishwheels	16-Aug-97	72.0	m	4.2+	NA	9
Fishwheels	16-Aug-97	84.0	m	4.2S1+	NA	7
Fishwheels	16-Aug-97	55.0	m	R.1+	NA	NA
Fishwheels	16-Aug-97	64.0	m	R.2+	NA	NA
Fishwheels	17-Aug-97	68.0	f	2.2+	NA	12
Fishwheels	17-Aug-97	54.0	m	4.1+	NA	6
Fishwheels	17-Aug-97	74.0	f	4.2+	NA	8
Fishwheels	17-Aug-97	72.0	m	4.2+	NA	7
Fishwheels	17-Aug-97	94.0	m	4.3+	NA	6
Fishwheels	17-Aug-97	55.0	m	5.1+	NA	5
Fishwheels	18-Aug-97	50.0	m	3.2+	NA	3
Fishwheels	18-Aug-97	71.0	m	3.2+	NA	10
Fishwheels	18-Aug-97	52.0	m	4.1+	NA	6
Fishwheels	18-Aug-97	51.0	f	4.1+	NA	10
Fishwheels	18-Aug-97	75.0	f	4.2+	NA	8
Fishwheels	18-Aug-97	63.0	f	4.2+	NA	4
Fishwheels	18-Aug-97	56.0	m	5.1+	NA	5
Fishwheels	18-Aug-97	NA	NA	R.1+	NA	NA
Fishwheels	18-Aug-97	74.0	f	R.2+	NA	NA
Fishwheels	18-Aug-97	69.0	f	R.2+	NA	NA
Fishwheels	19-Aug-97	53.0	m	3.1+	NA	10
Fishwheels	19-Aug-97	69.0	f	3.2+	NA	8
Fishwheels	19-Aug-97	78.0	m	3.2+	NA	8
Fishwheels	19-Aug-97	75.0	f	3.2+	NA	7
Fishwheels	19-Aug-97	66.0	m	3.2+	NA	7
Fishwheels	19-Aug-97	73.0	f	3.2+	NA	9
Fishwheels	19-Aug-97	74.0	m	3.2+	NA	8
Fishwheels	19-Aug-97	71.0	m	3.2+	NA	12

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	19-Aug-97	66.0	m	3.2+	NA	9
Fishwheels	19-Aug-97	80.0	m	3.2+	NA	7
Fishwheels	19-Aug-97	88.0	m	3.3+	NA	8
Fishwheels	19-Aug-97	78.0	m	3.3+	NA	10
Fishwheels	19-Aug-97	48.0	m	4.1+	NA	10
Fishwheels	19-Aug-97	54.0	m	4.1+	NA	7
Fishwheels	19-Aug-97	74.0	m	4.2+	NA	8
Fishwheels	19-Aug-97	76.0	f	4.2+	NA	5
Fishwheels	19-Aug-97	53.0	m	5.1+	NA	6
Fishwheels	19-Aug-97	54.0	m	R.1+	NA	NA
Fishwheels	19-Aug-97	66.0	f	R.2+	NA	NA
Fishwheels	19-Aug-97	76.0	m	R.2+	NA	NA
Fishwheels	19-Aug-97	74.0	m	R.2+	NA	NA
Fishwheels	19-Aug-97	70.0	f	R.2+	NA	NA
Fishwheels	19-Aug-97	74.0	m	R.2+	NA	NA
Fishwheels	20-Aug-97	65.0	m	2.2+	NA	9
Fishwheels	20-Aug-97	56.0	f	3.2+	NA	8
Fishwheels	20-Aug-97	74.0	f	3.2+	NA	7
Fishwheels	20-Aug-97	86.0	m	3.3+	NA	5
Fishwheels	20-Aug-97	70.0	f	4.2+	NA	5
Fishwheels	20-Aug-97	81.0	m	4.2+	NA	6
Fishwheels	20-Aug-97	81.0	m	4.2+	NA	6
Fishwheels	20-Aug-97	81.0	f	4.2S1+	NA	7
Fishwheels	20-Aug-97	80.0	f	5.2S1+	NA	8
Fishwheels	20-Aug-97	60.0	f	R.1+	NA	NA
Fishwheels	20-Aug-97	66.0	f	R.2+	NA	NA
Fishwheels	20-Aug-97	58.0	m	NA	NA	NA
Fishwheels	20-Aug-97	52.0	m	NA	NA	NA
Fishwheels	21-Aug-97	56.0	m	2.1+	NA	12
Fishwheels	21-Aug-97	74.0	f	2.2+	NA	11
Fishwheels	21-Aug-97	55.0	m	3.1+	NA	8
Fishwheels	21-Aug-97	55.0	m	3.1+	NA	6
Fishwheels	21-Aug-97	52.0	m	3.1+	NA	6
Fishwheels	21-Aug-97	50.0	m	3.1+	NA	10
Fishwheels	21-Aug-97	76.0	m	3.2+	NA	11
Fishwheels	21-Aug-97	75.0	m	3.2+	NA	7
Fishwheels	21-Aug-97	74.0	m	3.2+	NA	8
Fishwheels	21-Aug-97	74.0	m	3.2+	NA	6
Fishwheels	21-Aug-97	75.0	m	3.2+	NA	7
Fishwheels	21-Aug-97	65.0	f	3.2+	NA	6
Fishwheels	21-Aug-97	71.0	m	3.2+	NA	9
Fishwheels	21-Aug-97	77.0	m	3.2+	NA	6
Fishwheels	21-Aug-97	54.0	f	4.1+	NA	6
Fishwheels	21-Aug-97	73.0	m	4.2+	NA	9
Fishwheels	21-Aug-97	68.0	m	4.2+	NA	6
Fishwheels	21-Aug-97	70.0	f	4.2+	NA	6
Fishwheels	21-Aug-97	53.0	m	4.2+	NA	5
Fishwheels	21-Aug-97	82.0	m	4.2S1+	NA	7
Fishwheels	21-Aug-97	88.0	m	4.3+	NA	9
Fishwheels	21-Aug-97	72.0	m	5.2+	NA	9
Fishwheels	21-Aug-97	53.0	m	R.1+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1^{st} Annulus
Fishwheels	21-Aug-97	53.0	m	R.1+	NA	NA
Fishwheels	21-Aug-97	NA	NA	R.1+	NA	NA
Fishwheels	21-Aug-97	70.0	m	R.2+	NA	NA
Fishwheels	21-Aug-97	84.0	m	R.3+	NA	NA
Fishwheels	22-Aug-97	76.0	m	2.2+	NA	11
Fishwheels	22-Aug-97	55.0	f	3.1+	NA	5
Fishwheels	22-Aug-97	48.0	m	3.1+	NA	8
Fishwheels	22-Aug-97	62.0	m	3.1+	NA	7
Fishwheels	22-Aug-97	54.0	f	3.1+	NA	7
Fishwheels	22-Aug-97	66.0	f	3.2+	NA	6
Fishwheels	22-Aug-97	68.0	f	3.2+	NA	9
Fishwheels	22-Aug-97	72.0	m	3.2+	NA	7
Fishwheels	22-Aug-97	61.0	m	3.2+	NA	8
Fishwheels	22-Aug-97	78.0	m	3.2+	NA	6
Fishwheels	22-Aug-97	78.0	f	3.3+	NA	7
Fishwheels	22-Aug-97	84.0	m	3.3+	NA	5
Fishwheels	22-Aug-97	80.0	m	4.1+	NA	8
Fishwheels	22-Aug-97	52.0	f	4.1+	NA	5
Fishwheels	22-Aug-97	56.0	m	4.1+	NA	6
Fishwheels	22-Aug-97	72.0	m	4.1S1+	NA	5
Fishwheels	22-Aug-97	70.0	f	4.2+	NA	7
Fishwheels	22-Aug-97	70.0	f	4.2+	NA	5
Fishwheels	22-Aug-97	65.0	f	4.2+	NA	6
Fishwheels	22-Aug-97	77.0	m	4.2+	NA	9
Fishwheels	22-Aug-97	77.0	m	4.2+	NA	5
Fishwheels	22-Aug-97	72.0	m	4.2+	NA	4
Fishwheels	22-Aug-97	74.0	m	4.2S1+	NA	10
Fishwheels	22-Aug-97	86.0	m	4.3+	NA	5
Fishwheels	22-Aug-97	57.0	m	5.1+	NA	6
Fishwheels	22-Aug-97	61.0	m	R.1+	NA	NA
Fishwheels	23-Aug-97	71.0	f	2.2+	NA	10
Fishwheels	23-Aug-97	53.0	m	3.1+	NA	5
Fishwheels	23-Aug-97	57.0	m	3.1+	NA	9
Fishwheels	23-Aug-97	67.0	f	3.1+	NA	9
Fishwheels	23-Aug-97	77.0	f	3.1+	NA	7
Fishwheels	23-Aug-97	74.0	f	3.2+	NA	4
Fishwheels	23-Aug-97	74.0	m	3.2+	NA	10
Fishwheels	23-Aug-97	59.0	f	3.2+	NA	6
Fishwheels	23-Aug-97	89.0	m	3.2+	NA	7
Fishwheels	23-Aug-97	76.0	m	3.2+	NA	12
Fishwheels	23-Aug-97	76.0	f	3.2S1+	NA	9
Fishwheels	23-Aug-97	62.0	f	3.3+	NA	5
Fishwheels	23-Aug-97	56.0	f	4.1+	NA	6
Fishwheels	23-Aug-97	71.0	f	4.2+	NA	5
Fishwheels	23-Aug-97	72.0	m	4.2+	NA	6
Fishwheels	23-Aug-97	75.0	f	4.2+	NA	6
Fishwheels	23-Aug-97	69.0	f	4.2+	NA	7
Fishwheels	23-Aug-97	56.0	f	5.1+	NA	4
Fishwheels	23-Aug-97	71.0	f	R.2+	NA	NA
Fishwheels	23-Aug-97	85.0	m	R.3+	NA	NA
Fishwheels	23-Aug-97	70.0	m	U.2+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	23-Aug-97	78.0	m	NA	NA	NA
Fishwheels	23-Aug-97	81.0	f	NA	NA	NA
Fishwheels	23-Aug-97	57.0	f	NA	NA	NA
Fishwheels	24-Aug-97	54.0	m	3.1+	NA	6
Fishwheels	24-Aug-97	53.0	m	3.1+	NA	6
Fishwheels	24-Aug-97	63.0	m	3.2+	NA	9
Fishwheels	24-Aug-97	71.0	m	3.2+	NA	9
Fishwheels	24-Aug-97	67.0	f	4.2+	NA	7
Fishwheels	24-Aug-97	68.0	m	4.2+	NA	12
Fishwheels	25-Aug-97	54.0	f	3.1+	NA	9
Fishwheels	25-Aug-97	71.0	m	3.2+	NA	7
Fishwheels	25-Aug-97	72.0	m	4.2+	NA	11
Fishwheels	25-Aug-97	72.0	f	4.2+	NA	5
Fishwheels	25-Aug-97	71.0	m	4.2+	NA	9
Fishwheels	25-Aug-97	57.0	f	5.1+	NA	4
Fishwheels	25-Aug-97	79.0	f	R.1S1+	NA	NA
Fishwheels	25-Aug-97	75.0	m	R.2+	NA	NA
Fishwheels	25-Aug-97	71.0	m	R.2+	NA	NA
Fishwheels	25-Aug-97	74.0	m	R.2+	NA	NA
Fishwheels	25-Aug-97	NA	NA	NA	NA	NA
Fishwheels	26-Aug-97	71.0	m	3.2+	NA	10
Fishwheels	26-Aug-97	76.0	m	4.2+	NA	6
Fishwheels	26-Aug-97	67.0	f	4.2+	NA	9
Fishwheels	26-Aug-97	56.0	f	R.1+	NA	NA
Fishwheels	26-Aug-97	84.0	f	R.2+	NA	NA
Fishwheels	26-Aug-97	65.0	f	R.2+	NA	NA
Fishwheels	26-Aug-97	73.0	f	NA	NA	NA
Fishwheels	26-Aug-97	NA	NA	NA	NA	NA
Fishwheels	26-Aug-97	79.0	m	NA	NA	NA
Fishwheels	26-Aug-97	52.0	f	NA	NA	NA
Fishwheels	26-Aug-97	54.0	m	NA	NA	NA
Fishwheels	26-Aug-97	77.0	m	NA	NA	NA
Fishwheels	26-Aug-97	71.0	m	NA	NA	NA
Fishwheels	26-Aug-97	50.0	m	NA	NA	NA
Fishwheels	26-Aug-97	75.0	m	NA	NA	NA
Fishwheels	26-Aug-97	86.0	m	NA	NA	NA
Fishwheels	26-Aug-97	49.0	m	NA	NA	NA
Fishwheels	26-Aug-97	67.0	m	NA	NA	NA
Fishwheels	26-Aug-97	70.0	f	NA	NA	NA
Fishwheels	26-Aug-97	58.0	m	NA	NA	NA
Fishwheels	26-Aug-97	51.0	m	NA	NA	NA
Fishwheels	26-Aug-97	73.0	f	NA	NA	NA
Fishwheels	26-Aug-97	68.0	f	NA	NA	NA
Fishwheels	26-Aug-97	69.0	f	NA	NA	NA
Fishwheels	26-Aug-97	55.0	m	NA	NA	NA
Fishwheels	26-Aug-97	57.0	m	NA	NA	NA
Fishwheels	27-Aug-97	55.0	m	3.1+	NA	7
Fishwheels	27-Aug-97	70.0	f	3.2+	NA	8
Fishwheels	27-Aug-97	57.0	f	4.1+	NA	6
Fishwheels	27-Aug-97	77.0	m	4.2+	NA	8
Fishwheels	27-Aug-97	72.0	m	R.2+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	27-Aug-97	70.0	f	R.2+	NA	NA
Fishwheels	27-Aug-97	73.0	f	R.2+	NA	NA
Fishwheels	27-Aug-97	71.0	m	R.2+	NA	NA
Fishwheels	28-Aug-97	79.0	f	2.2+	NA	11
Fishwheels	28-Aug-97	55.0	f	3.1+	NA	8
Fishwheels	28-Aug-97	57.0	f	3.1+	NA	7
Fishwheels	28-Aug-97	62.0	f	3.1+	NA	3
Fishwheels	28-Aug-97	74.0	f	3.2+	NA	7
Fishwheels	28-Aug-97	72.0	f	3.2+	NA	9
Fishwheels	28-Aug-97	83.0	f	3.3+	NA	6
Fishwheels	28-Aug-97	56.0	m	4.1+	NA	6
Fishwheels	28-Aug-97	74.0	f	5.2+	NA	4
Fishwheels	28-Aug-97	91.0	m	R.3+	NA	NA
Fishwheels	28-Aug-97	55.0	m	U.1+	NA	NA
Fishwheels	29-Aug-97	59.0	f	3.1+	NA	9
Fishwheels	29-Aug-97	60.0	m	3.1+	NA	7
Fishwheels	29-Aug-97	77.0	f	3.2+	NA	11
Fishwheels	29-Aug-97	68.0	m	3.2+	NA	6
Fishwheels	29-Aug-97	54.0	f	4.1+	NA	11
Fishwheels	29-Aug-97	75.0	f	4.2+	NA	8
Fishwheels	29-Aug-97	73.0	f	4.2+	NA	12
Fishwheels	29-Aug-97	53.0	m	R.1+	NA	NA
Fishwheels	29-Aug-97	64.0	f	R.2+	NA	NA
Fishwheels	30-Aug-97	73.0	f	3.2+	NA	9
Fishwheels	30-Aug-97	54.0	f	4.1+	NA	5
Fishwheels	30-Aug-97	76.0	f	4.2+	NA	9
Fishwheels	30-Aug-97	74.0	f	4.2+	NA	8
Fishwheels	31-Aug-97	72.0	m	3.2+	NA	10
Fishwheels	31-Aug-97	74.0	f	3.2+	NA	7
Fishwheels	31-Aug-97	71.0	f	3.2+	NA	10
Fishwheels	31-Aug-97	76.0	f	3.2+	NA	11
Fishwheels	31-Aug-97	94.0	m	3.3+	NA	7
Fishwheels	31-Aug-97	58.0	m	4.1+	NA	8
Fishwheels	31-Aug-97	62.0	f	4.1+	NA	9
Fishwheels	31-Aug-97	72.0	m	4.2+	NA	5
Fishwheels	31-Aug-97	64.0	f	4.2+	NA	6
Fishwheels	31-Aug-97	67.0	f	4.2+	NA	8
Fishwheels	31-Aug-97	78.0	f	4.2+	NA	6
Fishwheels	31-Aug-97	86.0	f	4.2S1+	NA	8
Fishwheels	31-Aug-97	84.0	m	4.3+	NA	7
Fishwheels	31-Aug-97	85.0	f	4.3+	NA	8
Fishwheels	31-Aug-97	80.0	m	5.2+	NA	6
Fishwheels	31-Aug-97	80.0	f	5.2+	NA	6
Fishwheels	31-Aug-97	70.0	m	5.2+	NA	4
Fishwheels	31-Aug-97	67.0	f	R.2+	NA	NA
Fishwheels	31-Aug-97	76.0	f	R.2+	NA	NA
Fishwheels	31-Aug-97	90.0	m	R.3+	NA	NA
Fishwheels	01-Sep-97	76.0	m	2.2+	NA	9
Fishwheels	01-Sep-97	60.0	m	2.2+	NA	13
Fishwheels	01-Sep-97	68.0	m	2.2+	NA	10
Fishwheels	01-Sep-97	48.0	m	3.1+	NA	12

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	01-Sep-97	55.0	m	3.1+	NA	5
Fishwheels	01-Sep-97	63.0	m	3.1+	NA	13
Fishwheels	01-Sep-97	58.0	m	3.1+	NA	13
Fishwheels	01-Sep-97	56.0	f	3.1+	NA	8
Fishwheels	01-Sep-97	54.0	m	3.1+	NA	6
Fishwheels	01-Sep-97	51.0	m	3.1+	NA	4
Fishwheels	01-Sep-97	62.0	m	3.1+	NA	11
Fishwheels	01-Sep-97	63.0	m	3.1+	NA	10
Fishwheels	01-Sep-97	60.0	f	3.1+	NA	12
Fishwheels	01-Sep-97	57.0	m	3.1+	NA	5
Fishwheels	01-Sep-97	55.0	m	3.1+	NA	6
Fishwheels	01-Sep-97	58.0	m	3.1+	NA	4
Fishwheels	01-Sep-97	73.0	m	3.2+	NA	6
Fishwheels	01-Sep-97	70.0	f	3.2+	NA	7
Fishwheels	01-Sep-97	70.0	m	3.2+	NA	10
Fishwheels	01-Sep-97	68.0	m	3.2+	NA	10
Fishwheels	01-Sep-97	74.0	m	3.2+	NA	8
Fishwheels	01-Sep-97	69.0	m	3.2+	NA	8
Fishwheels	01-Sep-97	71.0	m	3.2+	NA	7
Fishwheels	01-Sep-97	77.0	m	3.2+	NA	6
Fishwheels	01-Sep-97	70.0	m	3.2+	NA	7
Fishwheels	01-Sep-97	65.0	f	3.2+	NA	8
Fishwheels	01-Sep-97	74.0	m	3.2+	NA	4
Fishwheels	01-Sep-97	71.0	m	3.2+	NA	9
Fishwheels	01-Sep-97	55.0	m	4.1+	NA	7
Fishwheels	01-Sep-97	57.0	m	4.1+	NA	10
Fishwheels	01-Sep-97	57.0	f	4.1+	NA	9
Fishwheels	01-Sep-97	57.0	m	4.1+	NA	6
Fishwheels	01-Sep-97	51.0	m	4.1+	NA	5
Fishwheels	01-Sep-97	73.0	m	4.1S1+	NA	6
Fishwheels	01-Sep-97	72.0	m	4.1S1+	NA	6
Fishwheels	01-Sep-97	69.0	m	4.1S1+	NA	5
Fishwheels	01-Sep-97	67.0	m	4.2+	NA	10
Fishwheels	01-Sep-97	70.0	m	4.2+	NA	8
Fishwheels	01-Sep-97	71.0	m	4.2+	NA	10
Fishwheels	01-Sep-97	71.0	m	4.2+	NA	4
Fishwheels	01-Sep-97	71.0	m	4.2+	NA	4
Fishwheels	01-Sep-97	81.0	m	4.2+	NA	12
Fishwheels	01-Sep-97	74.0	f	4.2+	NA	6
Fishwheels	01-Sep-97	78.0	m	4.2S1+	NA	9
Fishwheels	01-Sep-97	59.0	m	R.1+	NA	NA
Fishwheels	01-Sep-97	53.0	m	R.1+	NA	NA
Fishwheels	01-Sep-97	69.0	m	R.2+	NA	NA
Fishwheels	01-Sep-97	64.0	f	R.2+	NA	NA
Fishwheels	01-Sep-97	69.0	m	R.2+	NA	NA
Fishwheels	01-Sep-97	74.0	m	R.2+	NA	NA
Fishwheels	01-Sep-97	75.0	m	R.2+	NA	NA
Fishwheels	02-Sep-97	56.0	m	3.1+	NA	5
Fishwheels	02-Sep-97	53.0	m	3.1+	NA	4
Fishwheels	02-Sep-97	48.0	f	3.1+	NA	10
Fishwheels	02-Sep-97	55.0	m	3.1+	NA	8

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Fishwheels	02-Sep-97	71.0	m	3.1S1+	NA	6
Fishwheels	02-Sep-97	65.0	f	3.1S1+	NA	8
Fishwheels	02-Sep-97	76.0	f	3.1S1+	NA	7
Fishwheels	02-Sep-97	72.0	f	3.2+	NA	9
Fishwheels	02-Sep-97	71.0	f	3.2+	NA	8
Fishwheels	02-Sep-97	75.0	f	3.2+	NA	6
Fishwheels	02-Sep-97	89.0	f	3.3+	NA	6
Fishwheels	02-Sep-97	87.0	m	3.3+	NA	8
Fishwheels	02-Sep-97	56.0	m	4.1+	NA	6
Fishwheels	02-Sep-97	56.0	f	4.1+	NA	5
Fishwheels	02-Sep-97	55.0	m	4.1+	NA	7
Fishwheels	02-Sep-97	75.0	f	4.2+	NA	5
Fishwheels	02-Sep-97	70.0	f	4.2+	NA	9
Fishwheels	02-Sep-97	74.0	f	4.2+	NA	7
Fishwheels	02-Sep-97	91.0	m	4.3+	NA	7
Fishwheels	02-Sep-97	66.0	f	5.1S1+	NA	6
Fishwheels	02-Sep-97	75.0	m	5.2+	NA	7
Fishwheels	02-Sep-97	75.0	f	5.2+	NA	6
Fishwheels	02-Sep-97	75.0	f	R.2+	NA	NA
Fishwheels	02-Sep-97	67.0	m	R.2+	NA	NA
Fishwheels	02-Sep-97	75.0	f	U.2+	NA	NA
Fishwheels	03-Sep-97	58.0	m	3.1+	NA	6
Fishwheels	03-Sep-97	66.0	f	3.2+	NA	8
Fishwheels	03-Sep-97	73.0	f	3.2+	NA	6
Fishwheels	03-Sep-97	66.0	f	3.2+	NA	9
Fishwheels	03-Sep-97	72.0	f	3.2+	NA	10
Fishwheels	03-Sep-97	80.0	m	3.2S1+	NA	9
Fishwheels	03-Sep-97	90.0	m	3.3+	NA	9
Fishwheels	03-Sep-97	72.0	m	4.2+	NA	7
Fishwheels	03-Sep-97	75.0	f	4.2+	NA	6
Fishwheels	03-Sep-97	58.0	f	R.1+	NA	NA
Fishwheels	03-Sep-97	79.0	f	R.2+	NA	NA
Kincolith	10-May-96	85.0	NA	3.2S1	NA	4
Kincolith	10-May-96	85.0	NA	4.2SS1	NA	6
Kincolith	11-May-96	66.0	NA	4.2	NA	4
Kincolith	11-May-96	85.0	NA	3.3	NA	7
Kincolith	11-May-96	86.5	NA	4.3	NA	5
Kincolith	17-May-96	82.0	NA	NA	NA	NA
Kincolith	20-May-96	72.5	NA	NA	NA	NA
Kincolith	21-May-96	78.0	NA	NA	NA	NA
Kincolith	21-May-96	79.0	NA	NA	NA	NA
Kincolith	21-May-96	90.0	NA	NA	NA	NA
Kincolith	21-May-96	95.0	NA	NA	NA	NA
Kincolith	22-May-96	83.0	NA	NA	NA	NA
Kincolith	25-May-96	84.0	NA	4.3	NA	5
Kincolith	25-May-96	94.0	NA	4.4	NA	5
Kincolith	03-Jun-96	88.0	NA	R.3	NA	NA
Kincolith	05-Jun-96	64.0	NA	R.2	NA	NA
Kincolith	05-Jun-96	68.0	NA	3.2	NA	7
Kincolith	05-Jun-96	77.0	NA	3.3	NA	7
Kincolith	06-Jun-96	76.0	NA	R.1S1	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1^{st} Annulus
Kincolith	13-Jun-96	92.0	NA	3.4	NA	5
Kincolith	21-Apr-97	64.0	f	4.3	NA	6
Kincolith	21-Apr-97	70.0	m	3.3	3.3	9
Kincolith	22-Apr-97	70.0	f	4.3	4.3	5
Kincolith	22-Apr-97	70.0	m	5.2	NA	8
Kincolith	22-Apr-97	71.0	m	4.2S1	NA	11
Kincolith	22-Apr-97	75.0	f	3.2S3	NA	8
Kincolith	24-Apr-97	66.0	m	3.3	3.3	11
Kincolith	24-Apr-97	74.0	m	4.2S1	4.4	9
Kincolith	25-Apr-97	64.0	f	R.3	3.3	NA
Kincolith	25-Apr-97	69.0	f	R.4	5.4	NA
Kincolith	25-Apr-97	69.0	m	4.3	4.3	7
Kincolith	25-Apr-97	70.0	f	4.4	4.4	7
Kincolith	30-Apr-97	70.0	f	4.3	NA	10
Kincolith	02-May-97	66.0	f	4.3	4.3	7
Kincolith	05-May-97	63.0	f	5.3	NA	7
Kincolith	06-May-97	63.0	f	4.3	4.3	9
Kincolith	07-May-97	73.0	m	3.3	NA	NA
Kincolith	07-May-97	78.0	f	3.3	NA	NA
Kincolith	07-May-97	78.0	f	3.3	NA	NA
Kincolith	07-May-97	80.0	f	3.1SS1	NA	NA
Kincolith	07-May-97	82.0	f	4.3	NA	NA
Kincolith	07-May-97	82.0	m	3.1SS1	NA	NA
Kincolith	07-May-97	84.0	f	3.2S1	NA	NA
Kincolith	08-May-97	74.0	f	3.1S1	NA	NA
Kincolith	08-May-97	78.0	f	3.1S1	NA	NA
Kincolith	08-May-97	79.0	f	3.3	NA	NA
Kincolith	08-May-97	80.0	f	3.3	NA	NA
Kincolith	08-May-97	82.0	f	3.3	NA	NA
Kincolith	08-May-97	83.0	f	3.1S1	NA	NA
Kincolith	08-May-97	84.0	f	3.3	NA	NA
Kincolith	08-May-97	84.0	f	3.3	NA	NA
Kincolith	10-May-97	76.0	f	4.2SSS1	4.6	5
Kincolith	13-May-97	72.0	f	3.3	3.3	8
Kiteen	10-Oct-97	74.0	f	3.2+	NA	8
Kiteen	10-Oct-97	72.0	f	3.2+	NA	9
Kwinageese	18-Nov-97	70.0	f	3.2+	NA	10
Kwinageese	18-Nov-97	68.0	f	3.2+	NA	6
Kwinageese	18-Nov-97	71.0	f	3.2+	NA	10
Kwinageese	18-Nov-97	83.0	m	4.2+	NA	7
Kwinageese	18-Nov-97	66.0	f	4.2+	NA	13
Kwinageese	18-Nov-97	73.0	f	4.2+	NA	10
Kwinageese	18-Nov-97	74.0	f	4.2+	NA	12
Kwinageese	18-Nov-97	75.0	f	R.2S1+	NA	NA
Meziadin	25-Sep-97	77.5	f	4.2+	NA	6
Meziadin	19-Oct-97	76.5	m	4.2+	NA	8
Meziadin	20-Oct-97	80.0	m	4.2+	NA	8
Meziadin	25-Nov-97	67.0	f	4.1+	NA	10
Meziadin	25-Nov-97	85.0	m	4.1S1+	NA	10
Meziadin	25-Nov-97	71.0	f	4.2+	NA	6
Meziadin	25-Nov-97	74.0	m	R.2+	NA	NA

River	Date	Length (cm)	Sex	Scale Age	Otolith Age	Circuli Count to 1st Annulus
Tseax	08-Apr-97	76.0	m	R.3	3.3	NA
Low.Nass[1]	14-Apr-97	79.0	f	4.3	4.3	NA
Low.Nass	15-Apr-97	85.0	m	3.3+	3.3+	NA
Low.Nass	15-Apr-97	87.0	f	4.3+	4.3+	NA
Low.Nass	17-Apr-97	81.0	f	3.3	3.3	NA
Low.Nass	17-Apr-97	88.0	m	3.3+	3.3+	NA
Low.Nass	18-Apr-97	70.0	f	3.3	3.3	NA
Low.Nass	19-Apr-97	85.0	m	4.3	4.3	NA
Low.Nass	21-Apr-97	80.0	f	3.3	3.3	NA
Low.Nass	21-Apr-97	83.0	f	3.3	3.3	NA
Low.Nass	21-Apr-97	89.0	m	3.3	3.3	NA
Low.Nass	07-Apr-97	77.0	m	R.3	3.3	NA
Low.Nass	13-May-97	57.0	f	3.3	3.3	9
Low.Nass	13-May-97	63.0	m	3.2	3.2	7
Low.Nass	15-May-97	58.0	f	3.2	3.2	8
Low.Nass	15-May-97	63.0	f	3.2	3.2	8
Low.Nass	15-May-97	68.0	f	3.3	3.3	7
Low.Nass	16-May-97	59.0	f	4.1S1	4.3	5
Low.Nass	16-May-97	61.0	f	3.3	3.3	10
Low.Nass	16-May-97	65.0	f	4.3	4.3	6
Low.Nass	18-May-97	66.0	f	4.3	4.3	8
Low.Nass	28-May-97	65.0	f	3.3	NA	6
Low.Nass	28-May-97	67.0	f	R.3	NA	NA
Low.Nass	04-May-97	62.0	f	3.3	3.3	8
Low.Nass	04-May-97	66.0	f	3.3	3.3	8
Low.Nass	05-Jun-97	78.7	m	4.3	4.3	NA
Low.Nass	05-Jun-97	83.8	m	4.3	4.3	NA
Low.Nass	13-May-97	67.0	f	4.3	4.3	NA
Ishkheenickh	04-May-97	94.0	m	3.2S1	NA	NA
Ishkheenickh	06-May-97	80.0	f	3.3	NA	NA
Ishkheenickh	06-May-97	84.0	m	4.3	NA	NA
Ishkheenickh	06-May-97	91.0	f	R.2S1	NA	NA
Ishkheenickh	06-May-97	83.0	m	R.2S1	NA	NA
Ishkheenickh	07-May-97	86.0	f	R.3	NA	NA
Ishkheenickh	08-May-97	72.0	m	3.2	NA	NA
Ishkheenickh	08-May-97	77.0	f	3.3	NA	NA
Ishkheenickh	08-May-97	84.0	f	3.3	NA	NA
Ishkheenickh	08-May-97	82.0	f	3.3	NA	NA
Ishkheenickh	08-May-97	90.0	m	3.3	NA	NA
Ishkheenickh	08-May-97	72.0	m	3.1S1	NA	NA
Ishkheenickh	08-May-97	84.0	f	4.2S1	NA	NA

1. Low Nass refers to the Nass River mainstem downstream of New Aiyansh.

Appendix B. A summary of the scale age, otolith age and circuli counts to the first annulus for juvenile steelhead collected in 1997.

River	Date	Length (cm)	Scale Age	Otolith Age	Circuli Count
Bell-Irving	1997/09/10	4.1	0+	NA	3
Bell-Irving	1997/08/31	4.4	0+	NA	8
Bell-Irving	1997/09/10	4.4	0+	NA	6
Bell-Irving	1997/09/11	4.4	0+	NA	5
Bell-Irving	1997/09/11	4.4	0+	NA	4
Bell-Irving	1997/08/30	4.4	0+	NA	3
Bell-Irving	1997/09/11	4.6	0+	NA	5
Bell-Irving	1997/08/30	4.6	0+	NA	6
Bell-Irving	1997/08/30	4.8	0+	NA	5
Bell-Irving	1997/09/10	4.8	0+	NA	6
Bell-Irving	1997/09/10	4.9	0+	NA	8
Bell-Irving	1997/09/10	5.3	0+	NA	8
Bell-Irving	1997/09/10	5.4	0+	NA	8
Bell-Irving	1997/09/10	5.6	0+	NA	5
Bell-Irving	1997/09/10	5.9	0+	NA	7
Bell-Irving	1997/09/12	7.8	0+	0+	9
Bell-Irving	1997/08/31	7.9	0+	NA	8
Bell-Irving	1997/09/12	6.0	1+	NA	6
Bell-Irving	1997/09/12	6.4	1+	NA	3
Bell-Irving	1997/09/12	6.4	1+	NA	4
Bell-Irving	1997/08/31	6.4	1+	NA	4
Bell-Irving	1997/09/08	6.7	1+	1+	4
Bell-Irving	1997/09/10	6.8	1+	1+	5
Bell-Irving	1997/09/11	6.9	1+	1+	5
Bell-Irving	1997/09/13	7.0	1+	1+	9
Bell-Irving	1997/09/12	7.1	1+	NA	6
Bell-Irving	1997/09/10	7.2	1+	1+	4
Bell-Irving	1997/09/12	7.2	1+	NA	5
Bell-Irving	1997/09/08	7.2	1+	1+	4
Bell-Irving	1997/09/08	7.3	1+	NA	5
Bell-Irving	1997/09/10	7.3	1+	1+	8
Bell-Irving	1997/09/12	7.4	1+	1+	6
Bell-Irving	1997/09/08	7.4	1+	1+	6
Bell-Irving	1997/09/13	7.5	1+	1+	8
Bell-Irving	1997/09/10	7.5	1+	NA	5
Bell-Irving	1997/08/31	7.7	1+	1+	5
Bell-Irving	1997/09/12	7.8	1+	NA	5
Bell-Irving	1997/09/08	7.8	1+	NA	5
Bell-Irving	1997/08/31	7.8	1+	1+	7
Bell-Irving	1997/08/31	7.8	1+	NA	4
Bell-Irving	1997/08/29	7.8	1+	1+	8
Bell-Irving	1997/09/10	7.9	1+	1+	9
Bell-Irving	1997/09/11	7.9	1+	1+	5
Bell-Irving	1997/09/10	7.9	1+	1+	6
Bell-Irving	1997/09/10	7.9	1+	1+	5
Bell-Irving	1997/09/11	8.0	1+	NA	5
Bell-Irving	1997/08/31	8.0	1+	1+	7
Bell-Irving	1997/08/31	8.0	1+	1+	6

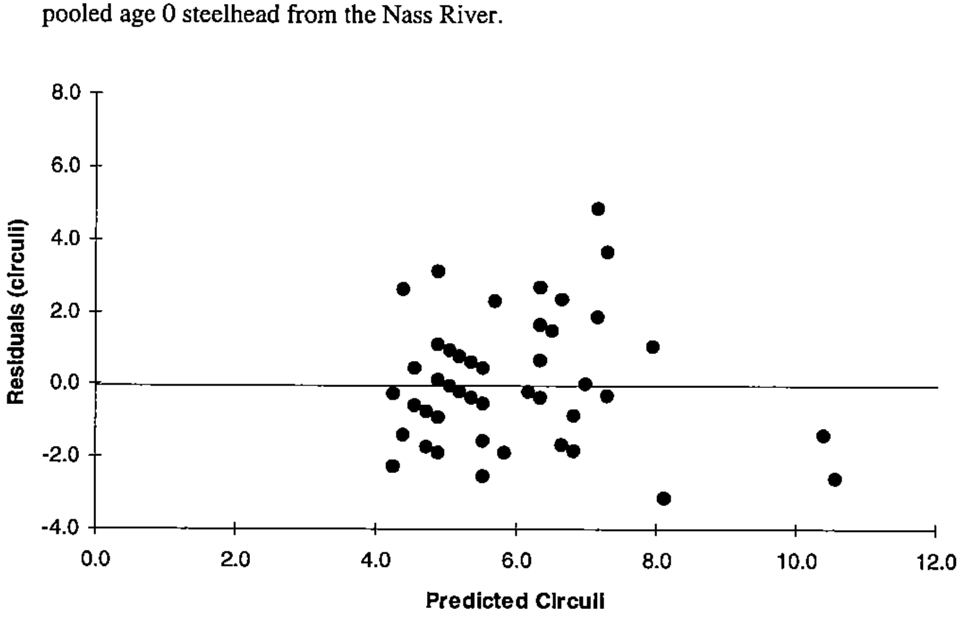
River	Date	Length (cm)	Scale Age	Otolith Age	Circuli Count
Bell-Irving	1997/09/08	8.0	1+	1+	5
Bell-Irving	1997/09/10	8.0	1+	NA	4
Bell-Irving	1997/09/08	8.1	1+	1+	6
Bell-Irving	1997/09/11	8.1	1+	1+	5
Bell-Irving	1997/08/30	8.1	1+	1+	8
Bell-Irving	1997/08/31	8.2	1+	NA	6
Bell-Irving	1997/09/10	8.2	1+	1+	5
Bell-Irving	1997/09/10	8.2	1+	NA	5
Bell-Irving	1997/09/08	8.3	1+	NA	6
Bell-Irving	1997/08/30	8.3	1+	1+	6
Bell-Irving	1997/08/31	8.4	1+	1+	6
Bell-Irving	1997/09/11	8.4	1+	1+	4
Bell-Irving	1997/08/31	8.6	1+	1+	7
Bell-Irving	1997/09/11	8.6	1+	NA	6
Bell-Irving	1997/09/08	8.8	1+	1+	5
Bell-Irving	1997/09/08	8.9	1+	1+	5
Bell-Irving	1997/09/08	8.9	1+	1+	6
Bell-Irving	1997/09/11	9.2	1+	NA	5
Bell-Irving	1997/08/30	9.2	1+	1+	6
Bell-Irving	1997/08/29	9.3	1+	1+	7
Bell-Irving	1997/08/30	9.3	1+	NA	10
Bell-Irving	1997/09/08	9.6	1+	1+	7
Bell-Irving	1997/08/30	9.6	1+	1+	9
Bell-Irving	1997/08/31	9.7	1+	1+	7
Bell-Irving	1997/08/29	9.8	1+	1+	7
Bell-Irving	1997/08/29	9.8	1+	1+	8
Bell-Irving	1997/09/10	10.4	1+	NA	9
Bell-Irving	1997/09/10	10.5	1+	NA	10
Bell-Irving	1997/08/30	8.2	2+	NA	4
Bell-Irving	1997/08/30	8.6	2+	2+	7
Bell-Irving	1997/09/11	9.3	2+	NA	5
Bell-Irving	1997/09/10	9.7	2+	2+	4
Bell-Irving	1997/09/11	9.7	2+	2+	6
Bell-Irving	1997/09/11	9.7	2+	2+	6
Bell-Irving	1997/08/30	10.0	2+	2+	4
Bell-Irving	1997/09/08	10.1	2+	NA	6
Bell-Irving	1997/09/11	10.4	2+	2+	4
Bell-Irving	1997/09/13	10.5	2+	2+	5
Bell-Irving	1997/08/30	10.7	2+	2+	4
Bell-Irving	1997/09/11	10.7	2+	2+	7
Bell-Irving	1997/09/09	10.8	2+	2+	5
Bell-Irving	1997/09/10	10.9	2+	2+	8
Bell-Irving	1997/09/11	11.0	2+	NA	8
Bell-Irving	1997/08/30	11.2	2+	2+	5
Bell-Irving	1997/08/30	11.2	2+	NA	8
Bell-Irving	1997/09/11	11.4	2+	NA	9
Bell-Irving	1997/08/30	11.5	2+	NA	5
Bell-Irving	1997/09/09	11.5	2+	2+	6
Bell-Irving	1997/09/13	11.5	2+	2+	7
Bell-Irving	1997/09/08	11.5	2+	2+	8
Bell-Irving	1997/08/30	11.5	2+	2+	5

River	Date	Length (cm)	Scale Age	Otolith Age	Circuli Count
Bell-Irving	1997/09/12	11.5	2+	2+	6
Bell-Irving	1997/09/12	11.8	2+	2+	5
Bell-Irving	1997/09/13	11.8	2+	2+	7
Bell-Irving	1997/09/12	11.9	2+	2+	8
Bell-Irving	1997/09/11	11.9	2+	NA	10
Bell-Irving	1997/09/10	12.1	2+	NA	10
Bell-Irving	1997/08/31	12.9	2+	2+	10
Bell-Irving	1997/08/29	13.2	2+	2+	6
Bell-Irving	1997/08/30	13.3	2+	2+	7
Bell-Irving	1997/08/30	13.4	2+	NA	7
Bell-Irving	1997/08/30	13.5	2+	2+	8
Bell-Irving	1997/08/30	13.8	2+	2+	6
Bell-Irving	1997/08/30	13.8	2+	2+	5
Bell-Irving	1997/09/13	15.5	R	2+	NA
Bell-Irving	1997/09/13	17.0	2+	2+	8
Bell-Irving	1997/09/12	11.1	3+	3+	4
Bell-Irving	1997/08/30	12.6	3+	3+	8
Bell-Irving	1997/09/13	12.7	3+	3+	5
Bell-Irving	1997/08/30	13.2	3+	NA	5
Bell-Irving	1997/08/31	13.3	3+	3+	6
Bell-Irving	1997/09/12	13.7	3+	3+	6
Bell-Irving	1997/09/12	14.1	3+	NA	4
Bell-Irving	1997/08/30	14.1	3+	3+	4
Bell-Irving	1997/08/30	14.2	3+	3+	9
Bell-Irving	1997/09/12	14.9	3+	NA	11
Bell-Irving	1997/08/30	14.9	3+	3+	4
Bell-Irving	1997/08/30	15.4	3+	3+	7
Bell-Irving	1997/08/29	15.7	3+	3+	8
Bell-Irving	1997/09/12	15.8	3+	3+	5
Bell-Irving	1997/08/29	16.1	3+	3+	7
Bell-Irving	1997/08/29	16.4	3+	3+	7
Bell-Irving	1997/09/13	19.3	3+	3+	7
Bell-Irving	1997/09/13	22.2	3+	3+	4
Bell-Irving	1997/09/13	22.5	3+	3+	6
Bell-Irving	1997/08/30	15.4	4+	4+	6
Cranberry	1997/09/15	4.0	0+	0+	4
Cranberry	1997/09/15	4.2	0+	0+	4
Cranberry	1997/09/15	4.2	0+	0+	4
Cranberry	1997/09/15	4.3	0+	0+	3
Cranberry	1997/09/15	4.4	0+	0+	4
Cranberry	1997/09/15	4.4	0+	0+	4
Cranberry	1997/09/15	4.6	0+	0+	5
Cranberry	1997/09/15	4.7	0+	0+	5
Cranberry	1997/09/15	4.8	0+	0+	5
Cranberry	1997/09/15	4.8	0+	0+	5
Cranberry	1997/09/15	6.9	1+	1+	7
Cranberry	1997/09/15	7.1	1+	1+	9
Cranberry	1997/09/15	7.2	1+	1+	9
Cranberry	1997/09/15	7.5	1+	1+	5
Cranberry	1997/09/15	7.6	1+	1+	7
Cranberry	1997/09/15	7.8	1+	1+	7

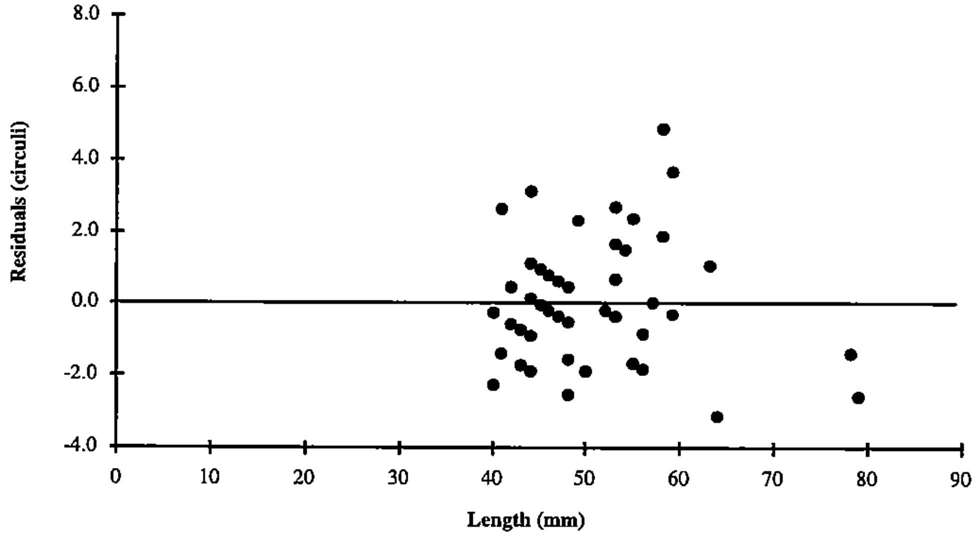
River	Date	Length (cm)	Scale Age	Otolith Age	Circuli Count
Cranberry	1997/09/15	8.0	2+	2+	5
Cranberry	1997/09/15	8.2	2+	2+	11
Cranberry	1997/09/15	9.7	2+	2+	10
Cranberry	1997/09/15	7.8	3+	3+	7
Kwinageese	1997/09/13	4.1	0+	0+	7
Kwinageese	1997/09/13	4.4	0+	0+	5
Kwinageese	1997/09/13	4.5	0+	0+	5
Kwinageese	1997/09/13	4.6	0+	0+	5
Kwinageese	1997/09/13	4.7	0+	0+	6
Kwinageese	1997/09/13	5.3	0+	0+	6
Kwinageese	1997/09/13	5.4	0+	0+	8
Kwinageese	1997/09/13	5.5	0+	0+	9
Kwinageese	1997/09/13	5.8	0+	0+	9
Kwinageese	1997/09/13	6.3	0+	0+	9
Kwinageese	1997/09/13	9.9	1+	1+	11
Kwinageese	1997/09/13	10.0	1+	1+	11
Kwinageese	1997/09/13	10.1	1+	1+	9
Kwinageese	1997/09/13	11.2	1+	1+	11
Kwinageese	1997/09/13	11.6	1+	1+	12
Kwinageese	1997/09/13	9.4	2+	2+	6
Kwinageese	1997/09/13	10.3	2+	2+	7
Kwinageese	1997/09/13	12.0	2+	2+	7
Kwinageese	1997/09/13	12.2	2+	2+	9
Kwinageese	1997/09/13	15.4	2+	2+	10
Meziadin	1997/09/14	4.8	0+	0+	4
Meziadin	1997/09/14	6.4	1+	1+	9
Meziadin	1997/09/14	6.5	1+	1+	10
Meziadin	1997/09/14	6.8	1+	1+	7
Meziadin	1997/09/14	7.2	1+	1+	8
Meziadin	1997/09/14	7.4	1+	1+	9
Meziadin	1997/09/14	7.5	1+	1+	9
Meziadin	1997/09/14	7.7	1+	1+	9
Meziadin	1997/09/14	7.8	1+	1+	11
Meziadin	1997/09/14	8.5	1+	1+	9
Meziadin	1997/09/14	9.1	1+	1+	8
Meziadin	1997/09/14	9.4	1+	1+	8
Meziadin	1997/09/14	9.8	1+	1+	11
Meziadin	1997/09/14	10.9	1+	1+	9
Meziadin	1997/09/14	18.8	2+	2+	16
Meziadin	1997/09/14	15.8	3+	3+	9
Meziadin	1997/09/14	17.2	3+	3+	7
Meziadin	1997/09/14	18.0	3+	3+	8
Seaskinnish	1997/09/15	4.5	0+	0+	6
Seaskinnish	1997/09/15	4.8	0+	0+	6
Seaskinnish	1997/09/15	5.2	0+	0+	6
Seaskinnish	1997/09/15	5.3	0+	0+	7
Seaskinnish	1997/09/15	5.3	0+	0+	9
Seaskinnish	1997/09/15	5.6	0+	0+	6
Seaskinnish	1997/09/15	5.7	0+	0+	7
Seaskinnish	1997/09/15	5.8	0+	0+	12
Seaskinnish	1997/09/15	5.9	0+	0+	11

River	Date	Length (cm)	Scale Age	Otolith Age	Circuli Count
Seaskinnish	1997/09/15	6.4	0+	0+	5
Seaskinnish	1997/09/15	9.5	1+	1+	6
Seaskinnish	1997/09/15	9.7	1+	1+	8
Seaskinnish	1997/09/15	9.9	1+	1+	9
Seaskinnish	1997/09/15	10.6	1+	1+	12
Seaskinnish	1997/09/15	9.6	2+	2+	12
Seaskinnish	1997/09/15	10.9	2+	2+	8
Seaskinnish	1997/09/15	10.9	2+	2+	9
Seaskinnish	1997/09/15	11.0	2+	2+	9
Seaskinnish	1997/09/15	11.8	2+	2+	12
Seaskinnish	1997/09/15	12.6	2+	2+	12
Tseax	1997/09/16	4.0	0+	0+	4
Tseax	1997/09/16	4.0	0+	0+	2
Tseax	1997/09/16	4.2	0+	0+	5
Tseax	1997/09/16	4.2	0+	0+	5
Tseax	1997/09/16	4.3	0+	0+	4
Tseax	1997/09/16	4.4	0+	0+	3
Tseax	1997/09/16	4.8	0+	0+	3
Tseax	1997/09/16	5.0	0+	0+	4
Tseax	1997/09/16	5.3	0+	0+	6
Tseax	1997/09/16	5.5	0+	0+	5
Tseax	1997/09/16	8.8	1+	1+	8
Tseax	1997/09/16	9.6	1+	1+	7
Tseax	1997/09/16	9.8	1+	1+	6
Tseax	1997/09/16	10.8	1+	1+	7
Tseax	1997/09/16	10.9	1+	1+	10
Tseax	1997/09/16	11.1	1+	1+	10
Tseax	1997/09/16	11.4	1+	1+	10
Tseax	1997/09/16	8.4	2+	2+	6
Tseax	1997/09/16	11.4	2+	2+	4
Tseax	1997/09/16	17.9	3+	3+	8

Appendix C. Residuals plotted against predicted circuli counts for the length-circuli count relationship for pooled age 0 steelhead from the Nass River.



Appendix D. Residuals plotted against the observed length for the length-circuli count relationship for pooled age 0 steelhead from the Nass River.



Appendix E. Mean daily water temperatures for the Bell-Irving, Bowser, Cranberry, Kwinageese, Meziadin and Tseax rivers, and Oweegee, Seaskinnish, Snowbank, Teigen creeks.

Date	Mean Daily Water Temperature									
	Bell-Irving	Bowser	Cranberry	Kwinageese	Meziadin	Oweegee	Seaskinnish	Snowbank	Teigen	Tseax
6-Aug.	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.34
7-Aug.	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.25
8-Aug.	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.52
9-Aug.	NA	NA	NA	NA	NA	NA	NA	NA	NA	11.66
10-Aug.	NA	NA	15.36	20.04	17.05	NA	NA	NA	NA	11.77
11-Aug.	11.78	7.97	14.14	18.83	16.34	19.36	NA	9.97	13.73	11.88
12-Aug.	9.49	8.08	13.76	18.25	17.58	18.20	20.00	8.76	11.32	11.78
13-Aug.	9.29	7.56	14.74	19.10	18.07	18.62	19.77	9.01	11.74	12.14
14-Aug.	9.09	7.43	14.87	18.19	18.12	18.35	18.70	8.56	10.75	12.05
15-Aug.	9.01	7.45	13.95	17.68	16.20	17.96	18.48	8.88	10.45	11.78
16-Aug.	9.44	7.34	14.00	18.13	17.25	17.66	18.97	8.82	10.67	11.83
17-Aug.	9.16	7.35	13.43	17.64	16.93	17.43	18.95	8.99	10.77	11.74
18-Aug.	9.52	7.61	13.45	17.68	16.25	17.40	19.05	9.22	11.24	11.79
19-Aug.	9.00	8.07	13.59	17.50	17.00	17.28	19.08	8.64	10.57	11.70
20-Aug.	9.41	8.21	14.05	17.91	17.57	17.24	19.27	9.03	11.05	11.66
21-Aug.	9.74	8.17	14.46	18.20	18.06	17.52	20.00	9.11	11.03	11.89
22-Aug.	8.84	8.07	13.80	17.03	18.11	16.99	19.27	8.66	10.49	11.58
23-Aug.	8.09	7.62	13.46	16.87	17.14	16.31	18.80	8.45	10.14	11.44
24-Aug.	8.30	7.01	12.80	16.66	15.98	16.24	18.50	8.44	10.00	11.47
25-Aug.	8.65	6.93	13.33	17.32	15.75	16.34	18.49	8.62	10.14	11.49
26-Aug.	8.90	7.33	13.69	17.55	16.39	16.86	18.50	8.43	10.45	11.50
27-Aug.	8.26	7.38	12.97	16.35	16.32	16.20	18.00	7.46	9.50	11.42
28-Aug.	7.70	7.13	11.94	15.04	16.22	15.21	17.19	6.67	8.95	11.25
29-Aug.	8.20	6.89	11.77	14.89	15.65	15.06	16.71	7.37	9.45	11.21
30-Aug.	8.92	6.86	12.41	15.66	15.82	15.42	17.21	8.22	10.33	11.29
31-Aug.	8.86	7.36	12.30	15.47	16.15	15.15	17.17	8.19	9.81	11.23
1-Sept.	8.76	7.59	12.04	15.55	16.25	15.02	17.00	8.20	9.69	11.12
2-Sept.	8.82	7.79	12.45	16.01	16.52	15.15	17.24	8.23	9.81	11.15
3-Sept.	8.11	7.78	12.64	15.85	16.54	14.85	17.22	8.07	9.63	11.14
4-Sept.	7.92	7.35	12.30	15.24	16.15	14.35	17.01	7.50	9.02	11.12
5-Sept.	8.11	7.29	10.90	14.87	15.86	13.97	16.19	7.55	8.84	11.01
6-Sept.	7.41	7.15	11.30	14.67	15.91	13.56	15.78	7.35	8.44	10.97
7-Sept.	NA	7.21	10.76	14.18	15.65	13.27	15.43	7.22	8.52	10.86
8-Sept.	NA	7.10	11.71	15.34	15.88	13.45	16.65	7.39	9.56	11.11
9-Sept.	NA	6.95	12.66	15.55	16.05	13.56	17.51	7.50	10.03	11.31
10-Sept.	NA	7.17	11.97	14.56	16.02	13.12	16.90	7.54	9.10	11.14
11-Sept.	NA	7.02	11.13	14.02	15.65	12.82	15.90	7.48	9.18	10.94
12-Sept.	NA	NA	11.31	13.09	15.23	12.59	15.67	7.41	8.68	10.87
13-Sept.	NA	NA	10.97	13.02	15.16	12.32	15.39	7.23	8.57	10.89
14-Sept.	8.01	6.88	10.11	12.76	14.96	12.13	14.61	7.20	8.32	10.70
15-Sept.	7.56	6.84	10.28	12.96	14.55	11.94	14.50	7.09	8.29	10.66
16-Sept.	7.44	6.82	9.86	12.63	14.10	11.43	13.74	6.87	7.68	10.61
17-Sept.	6.85	6.50	9.21	11.74	13.86	10.97	13.28	6.34	6.68	10.45
18-Sept.	6.16	6.17	8.99	11.19	13.23	10.38	12.77	6.02	6.50	10.35
19-Sept.	6.92	6.49	9.87	11.83	13.03	10.47	13.47	6.12	7.57	10.47
20-Sept.	6.90	6.39	9.97	11.41	13.27	10.33	13.49	5.95	7.68	10.47

Date	Mean Daily Water Temperature									
	Bell-Irving	Bowser	Cranberry	Kwinageese	Meziadin	Oweegee	Seaskinnish	Snowbank	Teigen	Tseax
21-Sept.	6.84	5.81	10.24	11.68	13.23	10.39	13.39	6.18	8.05	10.48
22-Sept.	7.02	5.64	9.53	11.92	12.93	10.46	13.01	6.49	8.12	10.32
23-Sept.	7.47	5.98	10.11	12.25	12.67	10.61	13.51	6.86	8.51	10.64
24-Sept.	7.27	5.74	11.15	12.63	13.01	10.92	14.58	6.98	8.78	10.87
25-Sept.	7.30	5.62	10.51	12.37	12.99	11.07	14.31	7.23	8.62	10.81
26-Sept.	6.81	5.69	9.50	12.00	12.37	10.72	13.54	6.83	7.98	10.62
27-Sept.	7.10	6.00	9.43	11.76	12.27	10.58	13.12	6.54	8.26	10.45
28-Sept.	6.32	5.91	9.24	10.88	12.23	10.08	12.70	6.03	7.30	10.35
29-Sept.	5.98	5.79	7.83	9.97	11.77	9.68	11.95	5.64	7.41	10.16
30-Sept.	5.80	5.81	7.77	10.07	11.44	9.25	11.50	5.20	6.34	10.02
1-Oct.	5.56	5.54	7.21	9.64	10.89	8.81	10.49	5.18	7.24	9.78
2-Oct.	5.73	5.32	6.97	9.40	10.75	8.56	10.37	5.13	6.05	9.79
3-Oct.	5.34	5.16	6.75	9.09	10.49	8.24	9.93	4.75	5.50	9.77
4-Oct.	4.07	5.06	5.40	8.52	10.35	7.30	9.05	3.47	3.93	9.51
5-Oct.	3.57	4.99	5.24	8.26	10.07	6.95	8.83	3.37	4.04	9.46
6-Oct.	3.98	5.01	5.80	8.09	9.90	6.57	8.42	3.56	4.28	9.36
7-Oct.	4.19	5.00	5.88	8.04	9.78	6.39	8.42	3.70	4.34	9.37
8-Oct.	3.69	4.80	5.31	7.52	9.50	5.97	7.94	3.34	3.56	9.26
9-Oct.	NA	4.65	4.70	6.98	8.86	5.40	7.23	2.85	3.00	9.08
10-Oct.	NA	4.53	4.46	6.80	8.48	4.84	7.01	2.04	2.50	9.05
11-Oct.	NA	4.21	4.19	6.37	8.16	3.87	6.71	1.15	1.35	9.00
12-Oct.	NA	3.86	3.69	5.65	7.69	3.10	5.85	1.12	1.42	8.73
13-Oct.	NA	3.37	3.07	4.78	6.54	2.53	4.43	0.51	0.26	7.83
14-Oct.	NA	3.62	4.02	5.64	6.92	3.32	5.03	1.87	2.60	7.86
15-Oct.	2.87	3.65	4.87	5.25	7.54	3.45	5.78	1.93	3.08	7.99
16-Oct.	3.31	3.87	5.07	5.30	7.75	3.50	6.66	2.06	3.90	8.19
17-Oct.	3.75	4.11	5.02	5.76	7.90	3.66	6.79	2.64	4.80	8.49
18-Oct.	3.68	4.06	4.49	5.74	7.77	3.73	6.58	2.81	3.97	8.66
19-Oct.	3.28	NA	3.86	5.44	7.62	3.50	6.02	2.69	3.26	8.55
20-Oct.	3.37	NA	NA	NA	NA	3.54	6.28	2.65	3.08	8.63
21-Oct.	NA	NA	NA	NA	NA	3.55	6.80	NA	NA	8.77
22-Oct.	NA	NA	NA	NA	NA	NA	6.96	NA	NA	8.66