Zymoetz River Steelhead: Summary of Current Data and Status Review, 1997

by

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Skeena Fisheries Report SK-102

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EXECUTIVE SUMMARY

Introduction

This report reviews the existing literature and file data concerning the life history, biology and fishery for steelhead trout (*Oncorhynchus mykiss*) in the Zymoetz River. Known locally as the Copper River, the Zymoetz lies 8 km northeast of Terrace, B.C. and provides sport fishing opportunities for B.C. residents and visitors.

The Zymoetz River arises in a chain of headwater lakes (McDonell, Dennis, and Aldrich lakes) 29 km southwest of Smithers, and flows 109 km to the confluence with the Skeena River. The river has two major tributaries; the Clore River and the Kitnayakwa River. The primary human activities in the Zymoetz River watershed are recreation, forest harvesting, mining, and linear development (electric transmission lines and gas pipelines). Forest harvesting began in the late 1950s with the construction of a mainline forestry road up the river, and continues today.

Freshwater and Ocean Life History

Skeena steelhead are genetically distinct from other stocks of steelhead in B.C., and represent a distinct group of steelhead, dissimilar to the other coastal and interior steelhead stocks identified in B.C. and the northwestern United States (Parkinson 1984). Juvenile morphometric analysis of the Zymoetz and two other Skeena River summer steelhead stocks (Kispiox and Morice), showed between-stock differences in morphology, supporting the notion that Skeena River steelhead exist as quantifiably discrete stocks (Cox-Rogers 1981).

Scales provided 361 age estimates over 10 separate years between 1972 and 1985. Within these, were 18 distinct life history patterns were identified reflecting combinations of freshwater age, salt water age, repeat spawning, and the seasonal timing of entry to salt water.

The average smolt age of Zymoetz River steelhead was 3.6 years. The frequency of freshwater residence was similar among returning male and female steelhead. The proportion of age 3 smolts in 1978 and earlier years (72%) was significantly lower than in later years (92%). Almost 80% of Zymoetz River steelhead spent two winters in salt water. Salt water age at first spawning varied between years, but there was no trend over time. The total age of Zymoetz River steelhead ranged from five to eleven years. Repeat spawners composed 16% of Zymoetz River steelhead. Steelhead that had spawned once before composed 14% of the Zymoetz sample, whereas steelhead spawning for the third time composed 2% of the sample. Repeat spawning was significantly more common among female steelhead, of which almost 20% spawned more than one time, in comparison to just 11% of the males. The incidence of repeat spawning varied between years. The incidence of repeat spawning in 1978 and earlier (23.6%) was significantly greater than that in later years (8.6%).

A total of 366 fork length measurements of Zymoetz River steelhead have been recorded in MELP files. Zymoetz River steelhead averaged 76.5 cm in fork length. Male steelhead were just 0.4 cm longer on average than female steelhead, however, male fork length was distributed bimodally, with a higher frequency of larger and smaller fish than among females.

Critical Habitats

Steelhead overwinter in McDonell Lake and in areas of the mainstem between Limonite Creek and the Clore River. The Clore River provides some overwintering habitat. Most Zymoetz summer steelhead spawn in the upper 20 km of the Zymoetz River. Only 15% of the fish spawned at the outlet of McDonell Lake: thirty percent of the fish appear to spawn in tributary streams including Serb Creek, Willow Creek, Coal Creek, and the mainstem Zymoetz River in the vicinity of Coal-Sandstone creeks.

Juvenile steelhead rear throughout the Zymoetz River and the accessible portions of its tributaries. The highest densities of juvenile steelhead have been measured in reaches 6 and 7 of the Zymoetz River and within Coal and Trapline creeks.

Clore River, and Treasure, Trapline, Thomas, and Sandstone creeks have lower densities of juvenile steelhead. Red Canyon and Mullwain creeks contain rainbow trout juveniles that may be steelhead. Although in total there are probably over 100 tributaries to the Zymoetz and Clore rivers, their relatively short accessible length reduces the relative importance to steelhead production. The Zymoetz mainstem may not be as productive per unit area, but provides the bulk of the steelhead habitat in the watershed.

Review of Past Enhancement Attempts

In 1980 Serb Creek was diverted to improve and extend spawning and rearing habitat, and gravel was placed to rehabilitate the outlet of McDonell Lake. In 1981 small ‘fishways’ were blasted around an obstruction in the canyon at approximately 7 km on the mainstem Zymoetz Brood stock collection and hatchery operations were undertaken from 1980 through to 1985 to enhance Zymoetz River steelhead. Wild brood stock were used for this project, designed to increase steelhead production by stocking fry to under-recruited streams in the upper watershed. Survival to return was estimated at 0.28%. Only 360 hatchery fish were reported caught in the Zymoetz River, just 1% of the total steelhead catch. On average, only 27 hatchery fish were reported captured each year, which suggests that there has been no long-term benefit and that large-scale enhancement by stocking is not advisable.

Review of Adult Assessments

Records of steelhead tagging and recapture in the Zymoetz River were provided by MELP for the years from 1979 to 1995. A total of 106 steelhead were tagged and attributed to the Zymoetz River population. Among these, 14.4% were tagged in marine approach waters (DFO Statistical Areas 3 and 4), 2.9% were tagged in the Skeena River, and 80% were tagged in the Zymoetz River. A total of 52 steelhead tagged steelhead attributed to the Zymoetz stock were recaptured (49% of those tagged). Only 6% of the tags were recovered in approach waters, 10% were recovered in the Skeena River, and 84% were recovered in the Zymoetz River.

Adult Run Timing

Tagging studies and commercial and sport catches provide information on the timing of adult migration. Commercial catches of steelhead in the Skeena River and approach waters show that adult steelhead enter the Skeena River during July and August, with half of the run arriving between July 27 and August 16. Steelhead begin to enter the Zymoetz by mid-July, but the first major run does not usually occur until the third or fourth week of August, with fish continuing to enter through the fall. Steelhead hold in the Skeena River prior to entering the Zymoetz River.

Tagging data provide additional information on run timing. For tags applied in the marine approach waters, the average date of application was August 3, while for tags applied in the Skeena River, the average date of application was September 3. The tagging data suggest that steelhead migration through Skeena River approach waters (DFO Statistical Areas 3 and 4) peaks during the first week of August, with 25% of the run have migrated by mid-July and 75% having migrated by mid-August.

Steelhead migration rate has been estimated from radio-tagging data. A fish captured and radio tagged in the lower Skeena River sport fishery entered the Zymoetz August 18 travelling 28 km at 1.4 - 1.8 km/day. Based on the movements of 55 radio-tagged steelhead captured in seine fisheries in areas 3,4,5, the mean freshwater migration rate of steelhead downstream of the Zymoetz River was 10.4 km/day

Harvest, Catch And Angler Effort

The Steelhead Harvest Analysis (SHA) provides an annual measure of angling effort and steelhead catch province-wide, and records angler origin, catch type (hatchery or wild), and whether the catch was killed or released. Data are available for the Zymoetz and Clore rivers for the period from 1967 to 1995, although only data collected since 1983 provide angler origin.

The average annual steelhead angler catch was 61 fish in the Clore River, 1,511 fish in the Zymoetz River, and 1,568 fish for both rivers combined. Steelhead catch varied almost twenty-fold from a maximum catch of 4,377 in 1986/1987 to a minimum of 258 in 1980/1981. Steelhead angler days (effort) averaged 79 days in the Clore River, 2,942 days in the Zymoetz River, and 3,016 days for both rivers combined. Steelhead angler catch per day averaged 0.8 per day in the Clore River, 0.57 per day in the Zymoetz River, and 0.67 per day for both rivers combined.

From 1993 to 1995, British Columbian residents made up the majority of anglers fishing the Zymoetz River. Resident anglers spent 86% of the total angler days on the river, and non-Canadians accounted for only 11%, with non-resident Canadians accounting for just 3%. The residency composition of Zymoetz anglers has not changed much since 1983. Skeena residents spend 72% of the total angling days on the Zymoetz, reflecting the proximity of this fishery to Terrace.

Angling Guide Activity

Data on angling guide activity are available from a database maintained by MELP from 1990 to 1996. During these years, the Zymoetz River was considered a classified water from September 1 to October 31. Class I licensing applied upstream of Limonite Creek and Class II licensing applied downstream.

Guided angler days averaged 42 in the Class I section and 59 in the Class II section over the period of record. Guided angling days decreased from a high of 197 in 1990/91 to a minimum of 6 in 1993/94. Guiding effort was exercised by only 6 different guides from 1990 to 1996. Two guides accounted for 72% of the guiding effort. For the last four years of the period of examination, the angling day quota was 58 angler days in the Class I section, and 177 days in the Class II section. Illegal guiding effort may be as large as recorded guiding effort by the licensed guides.

Creel Survey Data

Creel census data were collected in five studies over the period 1974 to 1990 on the Zymoetz River. In 1974 residents comprised 78.5%, non-resident Canadians 7.8%, and non-residents 13.7%. In 1978 and 1979 resident anglers dominated the fishery. Catch success in the Zymoetz River was 0.21 and 0.15 steelhead/day in 1978 and 1979 respectively. On the Clore River catch success was 0.32 and 0.27 steelhead/day in 1978 and 1979 respectively. In 1989 a creel census recorded 749 days of effort. The greatest effort was recorded during the first half of September. Almost all (94%) of the anglers were non-guided: only 6% were guided.
Catch success was greatest from September 15 to September 30, when river conditions were best for angling. CPUE ranged from 0.042 steelhead per angler hour from August 15 to August 31, to 0.111 steelhead per angler hour from October 1 to October 15.

Review of Current Angling Regulations

The Zymoetz River lies within Management Unit 6-9 of the Skeena Region (6). For the 1997/1998 angling season, angling regulations restrict steelhead fishing areas, times and methods in the Zymoetz River. The Zymoetz River is a “classified water” from September 1 to October 31. This classification requires that anglers purchase a license in addition to the basic angling license the steelhead stamp. The Zymoetz River has no specific steelhead kill closure, however, for the past several years a kill ban has been instituted by public notice for the entire Skeena watershed to protect steelhead runs from harvest. Within the Zymoetz River, angling is banned from McDonell Lake downstream 3 km to signs, between signs in Zymoetz Canyon, and above the signs at the transmission line crossing (below Zymoetz Canyon), between January 1 and June 15. These regulations protect overwintering and spawning adult steelhead from harassment by anglers. Gear restrictions ban the use of all baits. Angling upstream of the transmission line crossing at 6 km was restricted beginning in 1997.

Recreational Fisheries

The Zymoetz River provides high quality angling and has recorded an annual steelhead catch in the top ten of B.C. rivers. Angling effort is concentrated near the confluence of the Clore River to a point 10 km upstream. At the start of the season in August the sport fishery focuses on the lower river downstream of the canyon. The upper Zymoetz River receives the greatest angling pressure later in the summer and early fall, after which angling pressure focuses again on the lower river.

Fishing opportunities have declined over the past 20 years. Changes in channel morphology in the Zymoetz River following the floods of 1974 and 1978 and in the Clore River in fall 1992 altered preferred angling locations. Angling is dependent on turbidity, which is sometimes too great to permit angling.

There is an extensive sports fishery in the lower Skeena River that may harvest steelhead migrating to the Zymoetz River. This fishery may incur a high rate of mortality on migrating steelhead, as shown in a radio telemetry study on the lower Skeena sport fishery, where 40% of steelhead were fatally hooked.

First Nations Uses/ Harvest

Zymoetz River steelhead are harvested within First Nations fisheries in the Skeena River. No First Nations fisheries are active within the Zymoetz River. Historically, members of the Kitsumkalum Band harvested fish in the lower Zymoetz, however the harvest has been inactive for at least ten years. Native harvest of Zymoetz River steelhead has not been quantified. However, the harvest rate on these stocks is probably small compared to steelhead stocks further up-river, as the majority of native food fisheries catch steelhead upstream of the Zymoetz in the mainstem Skeena.

Review of Minimum Escapement Requirements

Minimum escapement estimates were calculated by MELP using stream productivity models and inferring survival from empirical studies elsewhere in B.C.. This analysis predicted the number of spawners required at maximum sustained yield was 1,971, which represents 8.7 % of the total Skeena minimum escapement of 22,685. The MSY escapement would produce 3,789 recruits.

Summary of Current Stock Status

The escapement and catch of Zymoetz River steelhead has never been quantified, hence a direct assessment of stock status is not possible. Stock status was assessed indirectly by examining indices of catch in the sport fishery and comparing them to other stocks, by examining basin-wide trends in stock status, and by comparing these trends to information on harvest and changes in habitat condition. A number of assumptions were made in making these comparisons that demand caution in interpreting the following analysis.

The catch of Zymoetz River steelhead was >4% of the catch in Skeena Region, based on data from the SHA for the period 1986/87 to 1995/96 (the last then years of the analysis). Among those steelhead streams with summer run stocks, which are for the most part located upstream of the Skeena/Zymoetz confluence, the Zymoetz catch comprised 8.8% of the total steelhead catch. This catch fraction is 30% larger than the proportion of the basin occupied by the Zymoetz Watershed (6.8%; 3,200 km^2 versus 47,200 km^2), suggesting that the Zymoetz River provides better steelhead habitat than is typically found throughout the basin. In contrast, the Zymoetz River provides 9.6% of the total usable steelhead fry rearing habitat in the Skeena basin, which suggests that the Zymoetz River under-produces by ~10%.

Although no direct commercial fishery exists for Zymoetz steelhead, they are harvested in the Skeena River and approach waters during the sockeye fishery. Over the period 1967 to 1995, the commercial fishery catch has averaged 26,000 steelhead. Simulation models suggest that Zymoetz River steelhead may experience a harvest rate of 42% in Area 4 (Skeena River mouth and approach waters) while in aggregate the Skeena summer steelhead experienced a harvest of only 36%. This harvest rate does not include commercial interceptions of emigrating kelts, so the actual harvest rate is greater than 36%. The interception of kelts in the commercial fishery is a factor that may explain the decline in repeat spawning among Zymoetz River steelhead between the 1970s and 1980s. Changes in marine productivity and spawning conditions may also explain the decline in repeat spawning.

Trends in angler catch were compared between the Zymoetz River and other Skeena River tributaries. Angler catch in the seven major summer steelhead rivers (the Skeena, Zymoetz, Bulkley, Morice, Kispiox, Babine, and Sustut rivers) were all significantly correlated. A major departure by the Zymoetz River steelhead catch data from the trend in the other rivers was identified. Zymoetz River steelhead angler catch declined to a low in 1980/1981, while the catch in the other rivers increased. This may reflect the impacts of a major flood in the Zymoetz in 1974, which has independently been identified as an impact by anglers. Zymoetz steelhead catch has decreased compared to the catch in other Skeena River tributaries. The trend may reflect a higher harvest rate in commercial fisheries, or habitat degradation, or both.

Fish habitat quality in the Zymoetz River has declined since at least 1974. Riparian habitat has been substantially reduced in the Zymoetz watershed, first by fire, but later through forest harvesting and the loss of 25 to 30% of the off-channel habitat from road construction.

Management Recommendations

This review of stock status has identified commercial fishery harvest as the primary factor influencing Zymoetz River steelhead abundance. Native fisheries operate primarily upstream of the Zymoetz and so do not have an important effect, and sport fisheries operate only during the summer and fall, and are restricted to catch and release. Habitat degradation is apparent which may explain the general decline in catch abundance.

The primary management recommendation is to eliminate the commercial harvest of steelhead. This action would increase present steelhead escapements by 48% and allow the full seeding of upstream habitat.

Future land use will strongly affect the quality of fish habitat in the Zymoetz River watershed. The Bulkley Land and Resource Management Plan has been accepted by the Provincial cabinet and includes special management zones for the upper Zymoetz River watershed. Although a portion of the watershed lies outside of this planning area within the Kalum Forest District (where there is as of yet no similar plan), four management units in the upper Zymoetz River have special status that confers more rigorous environmental protection.

There are several sites within the watershed requiring habitat restoration. The Zymoetz River from 8 and 34 km upstream of the Skeena confluence; has the greatest number of forestry-related impacts and the highest priority for restoration. The Clore and Kitnayakwa watersheds also have a high numbers of impacts.

Implementation of the Bulkley Land and Resource Management Plan and watershed restoration actions will protect and improve habitat in the Zymoetz basin. These actions will supplement enhance the effects of other potential management actions such as reduced commercial fishery interception.

Future Study Recommendations

Our knowledge of the life history and habitat use of the Zymoetz River steelhead, and the fishery for them, has increased since the late 1970s to the point that the MELP can prepare effective policies to manage the habitat and fishery. Additional information on spawning and rearing areas would assist management if the data were sufficiently quantitative to describe the relative importance of each habitat. Rearing habitat in the Zymoetz River has not been completely described. Density data are lacking on major tributaries such as Mullwain and Red Canyon creeks, the Clore and Burnie rivers upstream of their confluence, and on the Zymoetz River and tributaries upstream of McDonell Lake.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

This report reviews the existing literature and file data concerning the life history, biology and fishery for steelhead trout (*Oncorhynchus mykiss*) in the Zymoetz River. Known locally as the Copper River, the Zymoetz lies 8 km northeast of Terrace, B.C. and provides sport fishing opportunities for B.C. residents and visitors.

Location, Geography and Access

The Zymoetz River arises in a chain of headwater lakes (McDonell, Dennis, and Aldrich lakes) 29 km southwest of Smithers, and flows 109 km to the confluence with the Skeena River (Figure 1). A sixth order stream draining 2,980 km^2, the Zymoetz is 110 km long and has a mean annual discharge of 105 m^3/s (Water Survey of Canada gauging station 08EF005). The river has two major tributaries; the Clore River, which enters 37 km upstream of the Skeena confluence, and the Kitnayakwa River, which enters 46 km upstream of the Skeena confluence. The Clore River is the largest tributary and in turn receives considerable discharge from the Burnie River, whose headwaters lie in Burnie Lake at the foot of the Howson Range, 61 km upstream of the Zymoetz/Clore confluence.

The Zymoetz River is relatively steep and is punctuated by two canyons, 6.4 and 9.6 km upstream of the Skeena confluence. Access by fish to the Zymoetz is impaired by gradient-induced barriers on the mainstem in these canyons, and prevented by blockages (falls, chutes, and beaver dams) on some tributaries.

Access to the Zymoetz River is by the Copper River Forest Service Road (a main haul road) on west side of the river which extends to the fossil beds approximately 50 km upstream. Historically this road provided access upstream to the mainstem Zymoetz River past Limonite Creek, however the road has been washed out. After departing the Zymoetz River, the Copper River Forest Service Road follows the PNG gas pipeline route through the Limonite drainage and over the Telkwa Pass.

Access to the upper Zymoetz River is via the Kleanza Mainline, which joins Highway 16 15 km north of Terrace. The Kleanza Mainline crosses the headwaters of Nogold Creek and descends to the Zymoetz River mainstem 58 km upstream of the Skeena confluence. This road proceeds on the west side of the Zymoetz to Two Falls Creek (as of 1995, Bustard 1995). The headwaters of the Zymoetz River can be accessed from Smithers via the Hudson Bay Mountain Road and the McDonell Lake Forest Service Road, which runs along the north side of the McDonell Lakes chain to Sandstone Creek.

Figure 1. Location map showing the Zymoetz River watershed and major tributary streams.

Review of Environmental Events in the Watershed

The primary human activities in the Zymoetz River watershed are recreation, forest harvesting, mining, and linear development (electric transmission lines and gas pipelines). Forest harvesting began in the late 1950s with the construction of a mainline forestry road up the river, and continues today. The watershed lies within two Forest Districts, the Kalum District in the western portion of the watershed and the Bulkley District in the eastern portion of the watershed. The boundary of the two districts is at Red Canyon Creek. Skeena Cellulose Inc. (formerly REPAP) has chart areas in the watershed and additional harvests are made under small business licenses issued by the Ministry of Forests.

Impacts to habitat from floods are discussed and identified in MELP memoranda and reports. The floods are periodic and extreme, reaching magnitudes thirty times greater than the mean annual discharge of 105 m^3/s (Figure *2*). The 1974 flood caused severe damage to the roads, river banks and a gas pipeline. Damage to the pipeline required immediate repair, and three weeks of unsupervised repair was required (MELP memorandum to D. Bustard from Bob Allen, November 25, 1974 File #40-05-00).

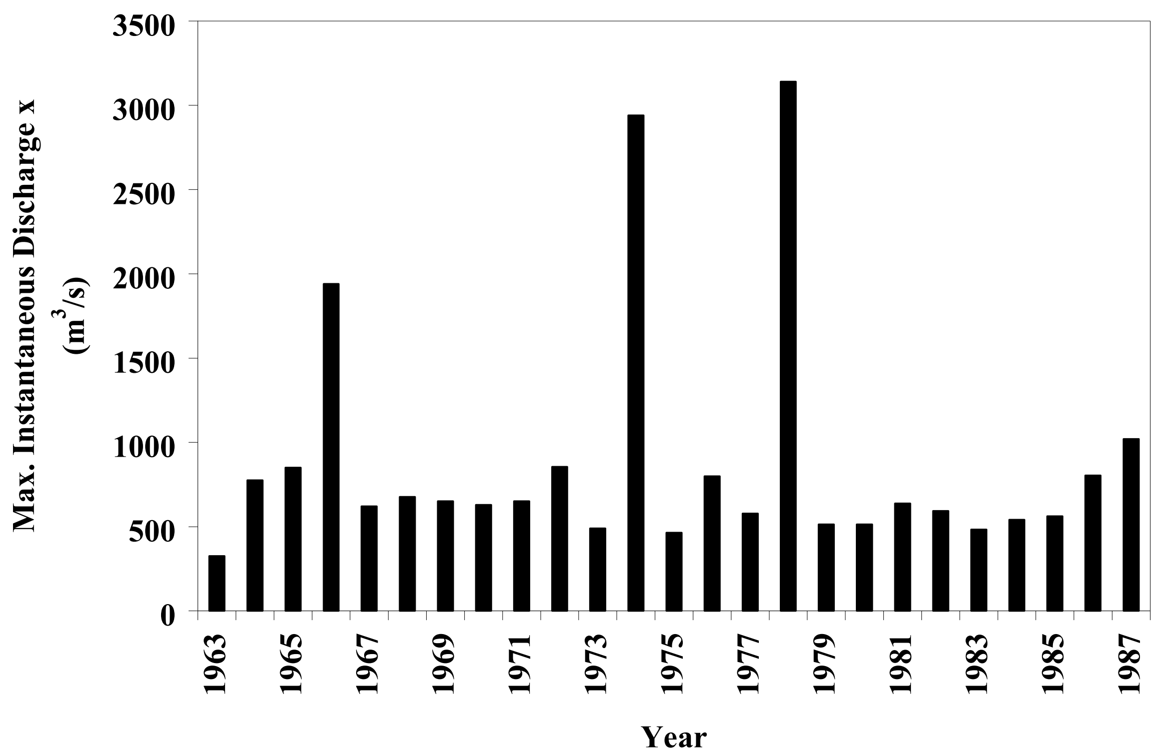


Figure 2. Maximum instantaneous discharge in the Zymoetz River (Water Survey of Canada Gauging Station EF005).

At mile 28 the road washed out and the pipeline was exposed beside the main channel of the Zymoetz River. A 40 ft. wide right-of-way was cleared for the road on an island and a 3 to 4 m deep trench was constructed for the pipeline. Upstream of this, the Zymoetz River was diverted into a channel about 40 ft wide in the forest, drying the original channel and possibly killing incubating salmon eggs. The repair works resulted in the compaction of substrate, massive sedimentation, the loss of riparian vegetation, and the dewatering of fish habitat. Since the period of stream gauging (from 1963 to 1987), floods have been noted in 1991 and 1992 (J. Culp, pers. comm., 1997). A major bank slump occurred in the Clore River in 1989 and caused visible sedimentation downstream (Whelpley 1989). Although some remediation efforts were apparent in fall 1998, sediment continues to enter the Clore River from this source (D. Gordon, pers. comm., 1998).

2. FRESHWATER AND OCEAN LIFE HISTORY REVIEW

General Life History

Skeena steelhead are genetically distinct from other stocks of steelhead in B.C., and represent a distinct group of steelhead, dissimilar to the other coastal and interior steelhead stocks identified in B.C. and the northwestern United States (Parkinson 1984). Juvenile morphometric analysis of the Zymoetz and two other Skeena River summer steelhead stocks (Kispiox and Morice), showed between-stock differences in body morphology, supporting the notion that Skeena River steelhead exist as quantifiably discrete stocks (Cox-Rogers 1981). Further genetic analysis may indicate that Zymoetz River steelhead have unique genetic traits, however, these traits may not be adaptive and may reflect weak selection or drift due to reproductive isolation (Parkinson 1984). The following life history characteristics may represent adaptation to the environment of the Zymoetz River, or a phenotypic response.

Although specific studies on the entire life history of Zymoetz River steelhead have not been completed, the life history probably follows that of steelhead trout in general, and where specific data are lacking it is assumed that standard life history patterns are followed. Adult Zymoetz River steelhead migrate to freshwater during the fall and spring months and spawn during late May and June. Steelhead eggs are buried in gravel during spawning and incubate through June and July, with fry emerging from the gravel during August. Steelhead fry rear in freshwater and begin to smolt after 3 to 6 winters.

Zymoetz River steelhead are believed to be a mixture of summer run and winter run fish, however they are predominantly summer run (R. Tetreau, MELP, pers. comm., 1997). Anglers report two distinct runs of steelhead, a winter and spring run of fish (J. Culp, G. Llewellyn, and B. Hill, pers. comm., 1997), in agreement with an early radio telemetry study (Whelpley 1989). This evidence demonstrates that some steelhead enter the Zymoetz River during the spring. There is no definitive evidence that these fish are true winter run fish, which overwinter in the marine environment and enter freshwater in the spring and spawn almost immediately. Female summer steelhead are bright-looking until spawning and may lead anglers to believe they have captured winter run fish. The spring run may be summer run steelhead that reside and overwinter in the Skeena River, and resume migration up the Zymoetz River in the spring. This migration pattern is observed in some other races of Skeena River steelhead, based on radio telemetry (Alexander *et al.* 1996). If the Zymoetz River does hold a distinct run of winter fish, the run is small and they appear to segregate spatially from the summer run component, with the summer run fish migrating to and spawning in the upper watershed (Beere 1995).

Sex Ratio

The sex ratio in the Zymoetz River catch sample across many years was 1.38:1 (58% females versus 42% males, n=361). Steelhead sport catches usually show a higher proportion of females (Narver and Withler 1971), but this difference may result from differences in catchability between sexes (Withler 1966). The higher proportion of females in the angler catch may represent the higher incidence of repeat spawning within this sex, particularly for summer steelhead (see Age Structure below). In studies where traps were used to enumerate steelhead populations, the sex ratio was close to 1:1 (e.g. Shapovalov and Taft 1954).

Age Structure

The Ministry of Environment, Lands and Parks scale archive provides 361 records from which to evaluate the life history of Zymoetz River steelhead. These records were collected over 10 separate years between 1972 and 1985 and provide a sample of the Zymoetz River steelhead population. Among these scales 18 distinct life history patterns were identified (including fish with a + salt water designation), reflecting combinations of freshwater age, salt water age, repeat spawning, and the seasonal timing of entry to salt water (Table 1).

Ages are reported following the European formulation used by the North Pacific Fisheries Commission (Koo 1962) with the following formulae: freshwater annuli +. salt water annuli + S salt water annuli +; where the + sign designates growth following the last annulus within the life history phase and the S represents the timing of a previous spawning. Note that the + and the S may or may not be present, dependent on the life history of the fish. By this method a 3.2S1+ fish spent three winters in freshwater and two winters in the salt water, then spawned for the first time, after which it spent one winter and part of the following year in salt water before returning to spawn again. Following Narver (1969), the total age of such a fish would be described at 3.4 and in its eight year of life, and the total age can be described at age 8.

The average smolt age of Zymoetz River steelhead was 3.6 years (S.E. = 0.03, range 3 to 5 years). Over half (63.7%) of Zymoetz River steelhead spend four winters in freshwater, 35.5% spend three years, and 0.8% spend five (Table 2, Figure 3a). The frequency of freshwater residence was similar among returning male and female steelhead. Females showed a higher proportion within the group with four freshwater annuli (65.9% for females and 60.8% for males), however the difference was not significantly different (ARC-sin test for proportions, d.f.= 229, P=0.4).

In the Skeena region juvenile steelhead emerge in August, near the end of the growing season, and migrate to sea in the spring. As a result they spend fewer full years in freshwater than indicated by the number of annuli formed on their scales. Salmon and trout fry can be small enough going into the first winter that they do not show a first annulus, so scale readings can mis-represent age 1+ fish as 0+ (Jensen and Johnson 1982).

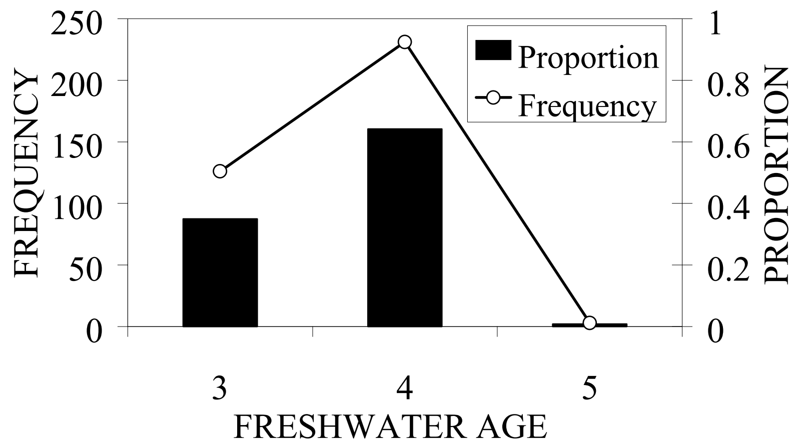
Freshwater age varied between years. Scales were collected in ten years from 1972 to 1985, but the number of samples collected ranged from 1 to 114 per year (Table 3). To examine changes in freshwater, we grouped the samples into two groups with roughly equal sample sizes, and compared the proportion of age 3 smolts in 1978 and earlier years (n=173) to that in 1979 and later years (n=185).

Table 1. Life history composition by sex for a sample of 361 Zymoetz River steelhead captured from 1974 to 1985.

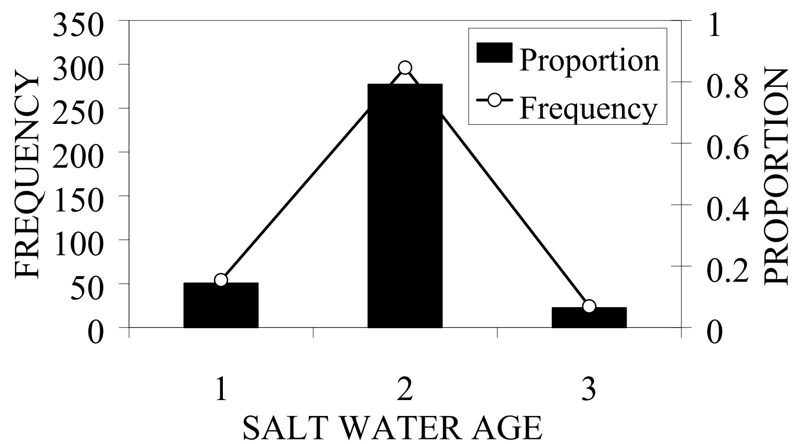
Life History		Male Number (percent)		Female Number (percent)		Combined Number (percent)	
Maiden Fish	3.1 +	4	(1.1%)	11	(3%)	15	(4.2%)
	3.2 +	52	(14.4%)	35	(9.7%)	87	(24.1%)
	3.3 +	3	(0.8%)	9	(2.5%)	12	(3.3%)
	4.1 +	6	(1.7%)	23	(6.4%)	29	(8%)
	4.2	0	(0%)	2	(0.6%)	2	(0.6%)
	4.2 +	99	(27.4%)	47	(13%)	146	(40.4%)
	4.3 +	2	(0.6%)	8	(2.2%)	10	(2.8%)
	5.2 +	1	(0.3%)	1	(0.3%)	2	(0.6%)
	Subtotal	167	(46.3%)	136	(37.7%)	303	(83.9%)
Second Return	3.2S1 +	10	(2.8%)	3	(0.8%)	13	(3.6%)
	4.1S1 +	1	(0.3%)	4	(1.1%)	5	(1.4%)
	4.2S1 +	25	(6.9%)	7	(1.9%)	32	(8.9%)
	5.1S1 +	0	(0%)	1	(0.3%)	1	(0.3%)
	Subtotal	36	(10%)	15	(4.2%)	51	(14.1%)
Third Return	3.1S1S	1	(0.3%)	0	(0%)	1	(0.3%)
	4.1S1S1 +	0	(0%)	1	(0.3%)	1	(0.3%)
	4.1S2 +	0	(0%)	1	(0.3%)	1	(0.3%)
	4.2S1S +	1	(0.3%)	0	(0%)	1	(0.3%)
	4.2S1S1	1	(0.3%)	0	(0%)	1	(0.3%)
	4.2S1S1 +	2	(0.6%)	0	(0%)	2	(0.6%)
	Subtotal	5	(1.4%)	2	(0.6%)	7	(1.9%)
Combined		208	(57.6%)	153	(42.4%)	361	(100%)

Table 2. Freshwater age and salt water age (at first spawning) by sex for a sample of 361 Zymoetz River steelhead captured from 1974 to 1985.

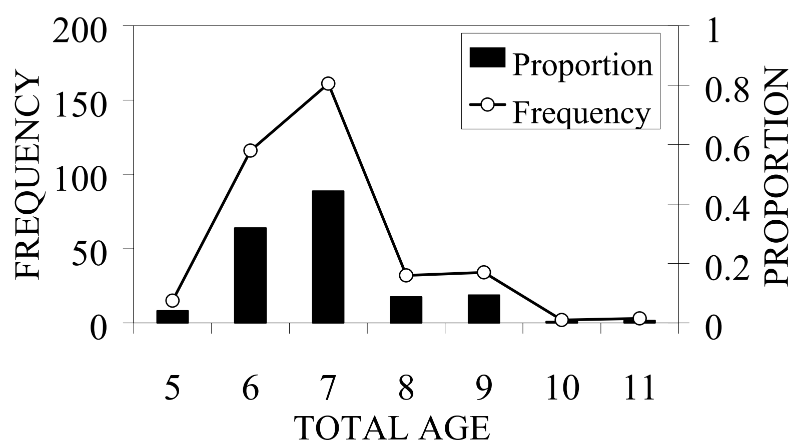
		Saltwater Age (at first spawning)							
Sex	Freshwater Age	1		2		3		Combined	
		Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
Females	3	114	(89.1%)	13	(10.2%)	1	(0.8%)	128	(100%)
	4	187	(81.3%)	37	(16.1%)	6	(2.6%)	230	(100%)
	5	2	(66.7%)	1	(33.3%)	0	(0%)	3	(100%)
	Combined	303	(83.9%)	51	(14.1%)	7	(1.9%)	361	(100%)
Males	3	11	(3%)	38	(10.5%)	9	(2.5%)	58	(16.1%)
	4	29	(8%)	56	(15.5%)	8	(2.2%)	93	(25.8%)
	5	1	(0.3%)	1	(0.3%)	0	(0%)	2	(0.6%)
	Combined	41	(11.4%)	95	(26.3%)	17	(4.7%)	153	(42.4%)
Combined	3	16	(4.4%)	100	(27.7%)	12	(3.3%)	128	(35.5%)
	4	36	(10%)	184	(51%)	10	(2.8%)	230	(63.7%)
	5	1	(0.3%)	2	(0.6%)	0	(0%)	3	(0.8%)
	Combined	53	(14.7%)	286	(79.2%)	22	(6.1%)	361	(100%)



a) Freshwater age



b) Salt water age



c) Total age

Figure 3. Freshwater age, salt water age (at first spawning), and total age distribution of steelhead returning to spawn in the Zymoetz River (n=361).

Table 3. Freshwater age of Zymoetz River steelhead by year of return.

Year of Return	Freshwater Age 3		4		5		Combined	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
1972	1	(100%)	0	(0%)	0	(0%)	1	(100%)
1974	13	(72.2%)	4	(22.2%)	1	(5.6%)	18	(100%)
1975	7	(21.2%)	24	(72.7%)	2	(6.1%)	33	(100%)
1976	0	(0%)	3	(100%)	0	(0%)	3	(100%)
1977	1	(25%)	3	(75%)	0	(0%)	4	(100%)
1978	24	(21.1%)	90	(78.9%)	0	(0%)	114	(100%)
1979	21	(30.9%)	47	(69.1%)	0	(0%)	68	(100%)
1982	0	(0%)	1	(100%)	0	(0%)	1	(100%)
1983	50	(47.6%)	55	(52.4%)	0	(0%)	105	(100%)
1985	9	(81.8%)	2	(18.2%)	0	(0%)	11	(100%)
Unknown	2	(66.7%)	1	(33.3%)	0	(0%)	3	(100%)
Combined	128	(35.5%)	230	(63.7%)	3	(0.8%)	361	(100%)

The proportion of age 3 smolts in 1978 and earlier years (72%) was significantly lower (ARC-sin test for proportions, d.f.=357, $P<0.01$) than in later years (92%).

Almost 80% of Zymoetz River steelhead spend two winters in salt water (Table 2, Figure 3b). Only 14.7% spend one winter in salt water and only 6.1% spend three years in salt water. The sexes differ in the number of years spent in salt water before first spawning, with males being more equally distributed across all salt water ages. Over 90% of females spend two years in salt water (191 out of 208), in contrast to males who spend just 62.1% (95 out of 153). Four times more male steelhead spend one or three winters in salt water than do female steelhead.

Salt water age at first spawning varied between years. Scales were collected in ten years from 1972 to 1985, but the number of samples collected ranged from 1 to 114 per year, and the proportion of 1 salt fish varied from 0 to 100% (Table 4). To examine changes in freshwater, we grouped the samples into two groups with roughly equal sample sizes, and compared the proportion 1 salt fish in 1978 and earlier years (n=173) to that in 1979 and later years (n=185). The proportion of 1 salt fish was 79% in both periods (ARC-sin test for proportions, d.f.=357, P=0.5).

The total age of Zymoetz River steelhead ranged from five to eleven years (Figure 3c). Note that total age describes the year of life for a fish when its scale is taken, and so equals the number of freshwater and salt water annuli combined, and the number of previous spawnings, plus one year to account for the time that will be spent over winter prior to the final spawning. Over 44% of the Zymoetz River steelhead were in their seventh year of life, having spent six winters in fresh and salt water combined. Approximately 90% of the fish were eight years of age or younger, and 99% were nine years of age or younger. All steelhead nine years of age or greater were repeat spawners, and steelhead eight years and older were 84% repeat spawners.

Repeat spawners composed 16% of Zymoetz River steelhead (Tables 3a, 3b, and 3c), similar to the proportion found within Vancouver Island streams (16%; Narver and Withler 1971) and within the Kispiox River (17.9%; Whately 1977). Steelhead that had spawned once before composed 14% of the Zymoetz sample, whereas steelhead spawning for the third time composed 2% of the sample. Repeat spawning was significantly more common among female steelhead, of which almost 20% spawned more than one time, in comparison to just 11% of the males (χ^2=5.7, d.f.=2, P=0.05, Table 5a).

Freshwater age distribution showed subtle differences between repeat spawners and maiden fish (Table 5b). Among maiden fish the proportion of age 4 smolts was 61.3%; this increased to 72.5% among second return spawners and 85.7% among third return spawners. Although these differences were not significant (χ^2=3.9, d.f.=2, P=0.14), the patterns warrant further investigation in the future should a larger sample become available.

Table 4. Salt water age of Zymoetz River steelhead by year of return.

Year of Return	Salt water age (at first spawning) 3		4		5		Combined	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
1972	1	(100%)	0	(0%)	0	(0%)	1	(100%)
1974	0	(0%)	13	(72.2%)	5	(27.8%)	18	(100%)
1975	5	(15.2%)	27	(81.8%)	1	(3%)	33	(100%)
1976	0	(0%)	2	(66.7%)	1	(33.3%)	3	(100%)
1977	0	(0%)	4	(100%)	0	(0%)	4	(100%)
1978	20	(17.5%)	91	(79.8%)	3	(2.6%)	114	(100%)
1979	21	(30.9%)	45	(66.2%)	2	(2.9%)	68	(100%)
1982	0	(0%)	1	(100%)	0	(0%)	1	(100%)
1983	5	(4.8%)	94	(89.5%)	6	(5.7%)	105	(100%)
1985	1	(9.1%)	6	(54.5%)	4	(36.4%)	11	(100%)
Unknown	0	(0%)	3	(100%)	0	(0%)	3	(100%)
Combined	53	(14.7%)	286	(79.2%)	22	(6.1%)	361	(100%)

Table 5. Repeat spawning of Zymoetz River steelhead by sex, freshwater age, and salt water age at first spawning.

a) by sex

	Previous Spawnings							
Sex	Maiden Fish		2nd Return		3rd Return		Combined	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
Female	167	(80.3%)	36	(17.3%)	5	(2.4%)	208	(100%)
Male	136	(88.9%)	15	(9.8%)	2	(1.3%)	153	(100%)
Combined	303	(83.9%)	51	(14.1%)	7	(1.9%)	361	(100%)

b) by freshwater age

	Previous Spawnings							
Freshwater Age	Maiden Fish		2nd Return		3rd Return		Combined	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
3	114	(37.6%)	13	(25.5%)	1	(14.3%)	128	(35.5%)
4	187	(61.7%)	37	(72.5%)	6	(85.7%)	230	(63.7%)
5	2	(0.7%)	1	(2%)	0	(0%)	3	(0.8%)
Combined	303	(100%)	51	(100%)	7	(100%)	361	(100%)

c) by saltwater age

	Previous Spawnings							
Saltwater Age	Maiden Fish		2nd Return		3rd Return		Combined	
	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
1	44	(14.5%)	6	(11.8%)	3	(42.9%)	53	(14.7%)
2	237	(78.2%)	45	(88.2%)	4	(57.1%)	286	(79.2%)
3	22	(7.3%)	0	(0%)	0	(0%)	22	(6.1%)
Combined	303	(100%)	51	(100%)	7	(100%)	361	(100%)

Repeat spawners exhibited different salt water ages than maiden fish (χ^2=7.9, d.f.=2, P=0.02). Second return spawners spent fewer years in salt water before the first spawning than did maiden fish. Steelhead spending one winter in salt water before spawning were uncommon among maiden fish (14.5 %) and fish that had spawned twice (11.5%), but comprised almost half of those fish returning to spawn for a third time (42.9%, Table 5c). The distribution of salt water age at first spawning among maiden and repeat spawners suggests that those fish deferring first reproduction tend to reproduce only once.

The incidence of repeat spawning varied between years, however, a different number of samples was collected in each year, complicating the interpretation of these data. Repeat spawning ranged from zero in 1972, 1974, and 1982 to 33.3% in 1976 (Table 6). However, in 1972 only one scale sample was taken, and in five of the ten years fewer than 20 scales were taken. In the two years when the most scale samples were collected, repeat spawning was 5% (1985) and 30% (1978) but was not significantly different (ARC-sin test for proportions, d.f.= 218, P=0.12).

Table 6. Incidence of repeat spawning by Zymoetz River steelhead by year, 1972 to 1985.

Year	Scale Samples Taken	Percentage of Repeat Spawners
1972	1	(0%)
1974	18	(0%)
1975	33	(15.2%)
1976	3	(33.3%)
1977	4	(25%)
1978	114	(29.8%)
1979	68	(14.7%)
1982	1	(0%)
1983	105	(4.8%)
1985	11	(9.1%)
Unknown	3	(33.3%)
Combined	361	(16.1%)

To examine changes in the proportion of repeat spawners over time, we grouped the samples into two groups of roughly equal sample size, and compared the frequency of repeat spawning in 1978 and earlier years (n=173) to that in 1979 and later years (n=185). The incidence of repeat spawning in 1978 and earlier (23.6%) was significantly greater (ARC-sin test for proportions, d.f.=357, P<0.01) than that in later years (8.6%).

Body Size

A total of 366 fork length measurements of Zymoetz River steelhead have been recorded in MELP files, however, only 349 of these have corresponding scale ages. Based on the smaller sub sample, Zymoetz River steelhead averaged 76.5 cm in fork length (S.E. = 0.5) and ranged from 43.0 to 100.3 cm (Table 7). Male steelhead were just 0.4 cm longer on average than female steelhead, an insignificant difference (t=0.35, d.f.=228, P=0.73) that suggests the sexes are of similar size. However, the variation in age among male steelhead (S.E. = 1.0) was greater than for females (S.E.= 0.5) and was significantly different (Levene's Test for Equality of Variances: F= 46.315, P< 0.001). Male steelhead comprised both the smallest and largest members of the population and were most abundant in the 80 cm to 85 cm size range with a median length of 79.5 cm and a modal length of 78.7 cm (Figure 4). Female steelhead were most abundant in the 70 cm to 75 cm size range with a median length of 76.2 cm and a modal length of 73.7 cm. Male fork length was distributed bimodally, with one cluster between 55 cm and 65 cm and another between 75 cm and 95 cm.

Zymoetz River steelhead can reach large sizes, comparable to those found in other Skeena River tributaries. One female steelhead was captured just upstream of the Clore River in 1973 and weighed 13.9 kg (30.5 lbs) (B. Hebden, pers. comm., 1995). This fish weighed 83% of the largest steelhead captured by angling in freshwater and recorded in the scientific literature (16.3 kg, Hart 1973).

Body size at return was positively related to salt water age. For both sexes and all freshwater ages combined, fork length after one winter in salt water was 61.3 cm, and increased to 78.4 cm after two winters and to 89.0 cm after three winters (Table 7). Size increased with increasing salt water age for both sexes and every freshwater age.

Freshwater age did not influence the body size of returning Zymoetz River steelhead. In an ANOVA of steelhead fork length with factors of freshwater age and salt water age, only salt water age was significant (F=98.6, d.f.=2, 348, P<0.01). Interactions between freshwater and salt water age were not significant (d.f.=3, 348, P=0.22).

Table 7. Mean fork length (cm) of Zymoetz River steelhead by sex and by freshwater and salt water age.

		Salt water Age											
Sex	Freshwater Age	1			2			3			Combined		
		Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n	Mean	S.E.	n
Females	3	61.3	7.3	5	76.7	0.8	58	82.1	3.4	3	75.8	1.0	66
	4	62.9	1.8	7	77.3	0.5	122	87.7	3.7	2	76.7	0.6	131
	5			0	66.0		1	0.0		0	66.0		1
	Combined	62.2	3.0	12	77.1	0.4	181	84.3	2.6	5	76.3	0.5	198
Males	3	57.3	1.0	11	80.8	0.7	38	91.1	2.4	9	77.9	1.5	58
	4	62.3	1.7	28	81.1	0.8	53	89.7	2.1	8	76.0	1.3	89
	5	66.0		1	83.8		1	0.0		0	74.9	8.9	2
	Combined	61.0	1.3	40	81.0	0.6	92	90.4	1.6	17	76.7	1.0	149
Combined	3	58.5	2.3	16	78.3	0.6	96	88.8	2.2	12	76.8	0.9	124
	4	62.4	1.4	35	78.5	0.5	175	89.3	1.7	10	76.4	0.6	220
	5	66.0		1	74.9	8.9	2	0.0		0	71.9	5.9	3
	Combined	61.3	1.2	52	78.4	0.4	273	89.0	1.4	22	76.5	0.5	347

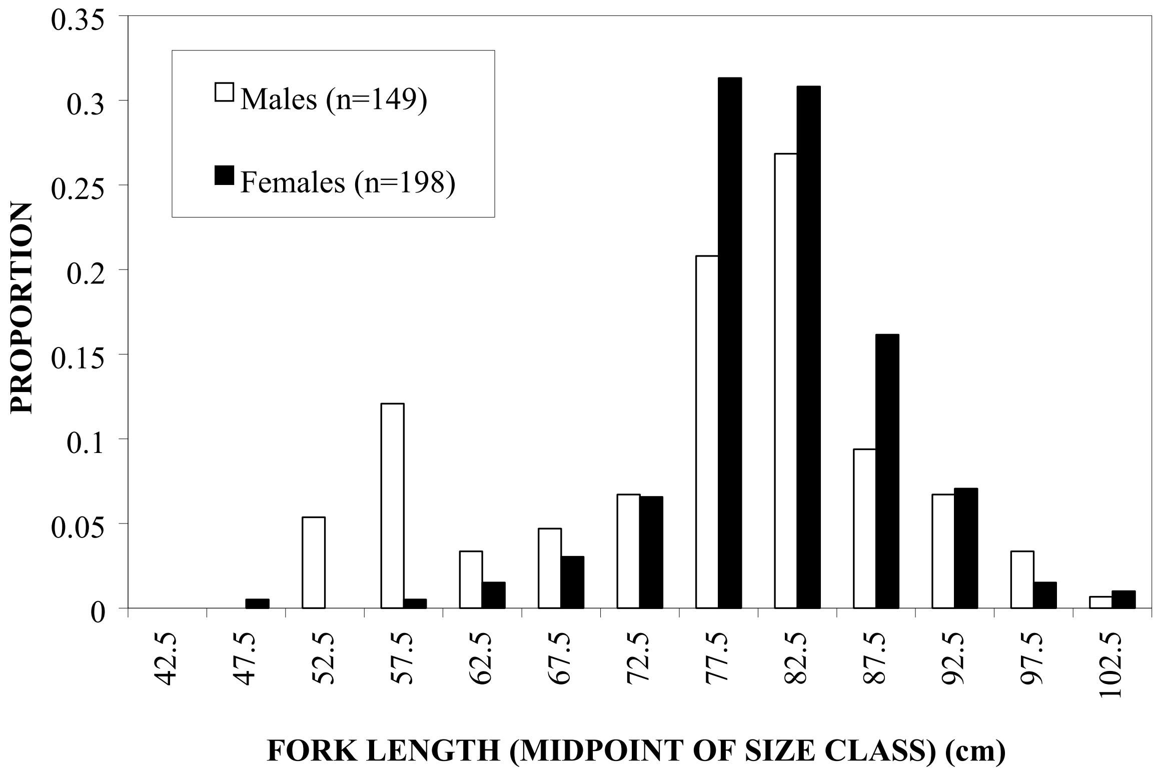


Figure 4. Distribution of fork length for male and female Zymoetz River steelhead.

3. CRITICAL HABITATS

Overwintering

Historically, steelhead were suspected to overwinter in McDonell Lake (Seredick 1969), and this was proven through radio-telemetry (Lough 1980). More recently, radio-telemetry has shown that steelhead overwinter in areas of the mainstem between Limonite Creek and the Clore River (Beere 1995). Of 14 fish radio-tagged in 1994, 71% overwintered in the upper 20 km of river. Some steelhead overwinter in portions of the Zymoetz River between Treasure and Red Canyon creeks (Bustard 1995). Of six steelhead radio tagged in August 1978 between km 32 and 38 (near the Clore confluence), one overwintered in the mainstem near Red Canyon Creek, and one overwintered in McDonell Lake (Lough 1980). Overwintering locations are shown in Figure 5.

Lough (1983) found that of 12 fish tagged on the Clore 58% spawned in the Clore and 42% spawned in the Zymoetz, suggesting that the Clore provides some overwintering habitat. Steelhead also overwinter in the lower canyon in any deep ice-free water (M. Beere, pers. comm., 1997). Zymoetz River summer steelhead may also overwinter in the Skeena River and move into Zymoetz River in the spring. Prior to spawning, suspected winter-run adults hold below the first canyon, which is the upper limit of migration for these fish (B. Hill, pers. comm., 1997).

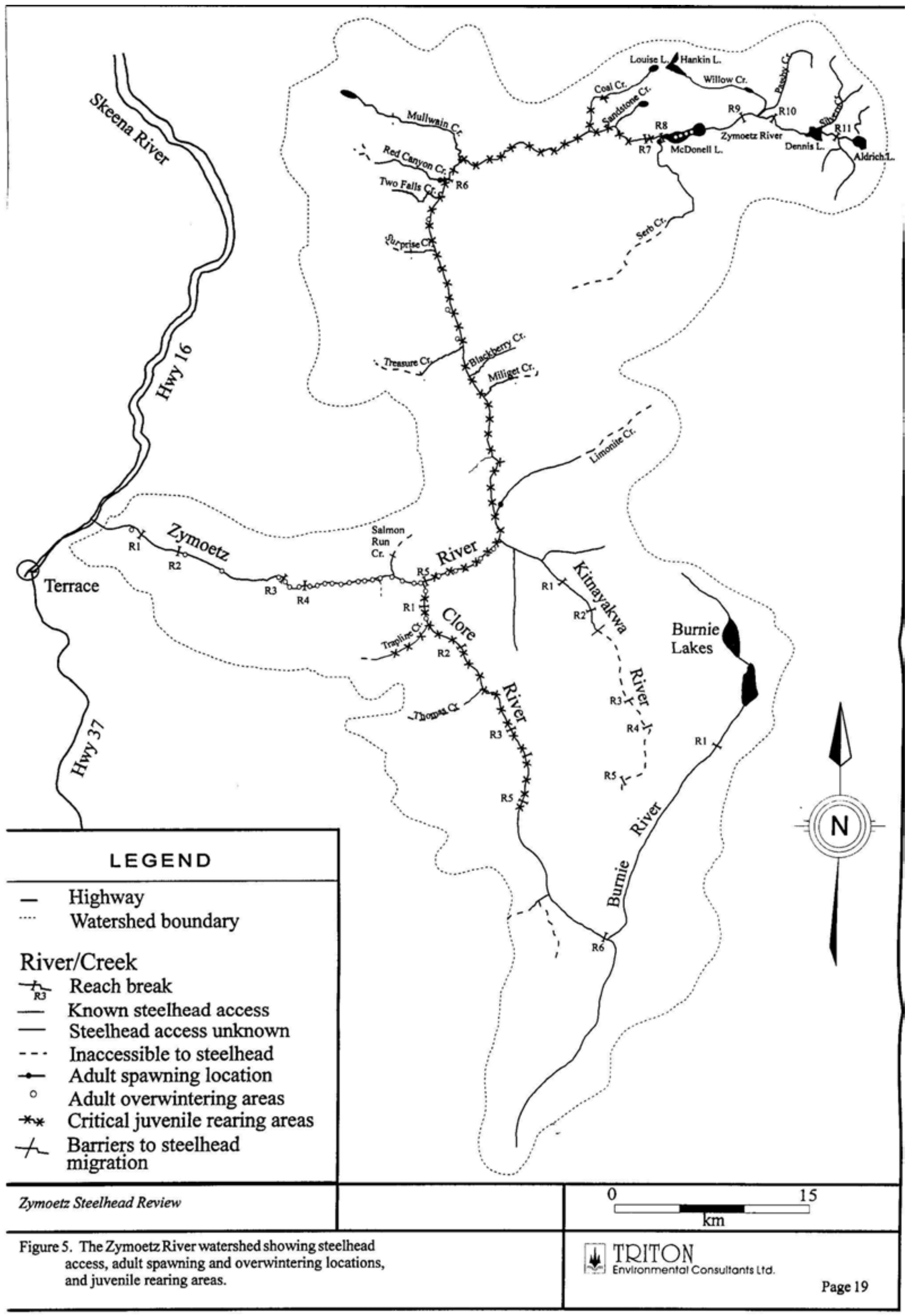
Spawning

Zymoetz River steelhead hold during the winter in McDonell Lake and spawn heavily in a 100 meter long section of the Zymoetz River located 100 meters below the outlet of below McDonell Lake (Seredick 1969, Pinsent and Chudyk 1973, Humphries and Morley 1978, Ptolemy 1979, Wadley 1981). They also spawn in the section of the river between Dennis and McDonell lakes and between Dennis and Aldrich lakes.

Spawning at these locations was observed in late May and June. These lakes probably moderate temperature, discharge and sediment load to habitats downstream, which may enjoy a higher egg-to-fry survival than reaches less influenced by lake outflow.

Based on the movements of 14 radio-tagged steelhead in 1994, Beere (1995) concluded that most Zymoetz summer steelhead use the upper 20 km of the Zymoetz River. Only 15% of the fish spawned at the outlet of McDonell Lake (Figure 5). Thirty percent of the fish were found in tributary streams and were assumed to have spawned there. Spawning tributaries included Serb Creek, Willow Creek, Coal Creek, and the mainstem Zymoetz River in the vicinity of Coal and Sandstone creeks (Figure 5).

Figure 5. The Zymoetz River watershed showing steelhead access, adult spawning and overwintering locations, and juvenile rearing areas.



Lough (1983) noted that radio-tagged fish spawned in or near the lower end of Coal Creek and that Coal and Sandstone creeks supported juvenile rainbow trout, suggesting that steelhead spawned there. However, Humphries and Morley (1978) found that the mouth of Sandstone Creek was blocked to upstream migration by adult salmonids. Lough (1983) also noted the McDonell Lake outlet, mainstem and side channels below Clore River and tributaries and side channels from Red Canyon Creek to Coal Creek, and Red Canyon Creek as spawning areas.

The Zymoetz River mainstem between the Clore (32 km) and Red Canyon Creek (79 km) has minimal spawning value (Lough 1983). The tributaries in this section are steep with little potential for spawning, except in the lower ends. An exception to this is Treasure Creek, which has anadromous access for up to 4.5 km and is populated by juvenile rainbow (suspected steelhead) (Bustard 1995).

Within the Clore River, steelhead have access to at least 26 km (Bustard 1996) and MELP is not aware of any access upstream past Pillars Canyon at 40 km (M. Beere, pers. comm., 1997). Steelhead may spawn in several tributaries to the Clore River including Thomas, Elf, and Trapline creeks (Bustard 1996). Within the Kitnayakwa River steelhead have access upstream to 12 km (Bustard 1994), but there is little evidence of steelhead migrating more than 3.5 km upstream, where a road related rockslide created a barrier in the lower river (M. Beere, pers. comm., 1997).

Other potential spawning locations are the Surprise and Blackberry creek confluences, Limonite Creek (Bustard 1995), upstream of McDonell Lake near the Willow and Passby creek confluences (Humphries and Morley 1978), Passby Creek (FISS maps), the outflow to Dennis Lake (FISS maps, Beere 1995), Willow Creek as far as Hankin Lake (MELP stream files, Smithers), and Miliget and Blackberry creeks (Maher 1961 in Bustard 1995).

Incidental spawning has been observed throughout the system including canyon habitats (behind boulders). Spawning of winter run steelhead in the lower river was observed in late June by Gene Llewellyn, (Whelpley 1989), however, mid May to early June is the normal timing of spawning (M. Beere, pers. comm., 1997). Lough (1983) noted that although spawning took place in mid-May to early June, some steelhead held until July 10. In 1969 most steelhead had spawned between May 25 and 29 in the upper Zymoetz River (Seredick 1969).

Rearing

Juvenile steelhead rear throughout the Zymoetz River and the accessible portions of its tributaries. There is no single comprehensive survey of aquatic habitat for steelhead in the Zymoetz River. There are eleven surveys that describe individual reaches and tributaries using techniques ranging from qualitative habitat description to detailed physical measurements (Table 8). Nine of these studies include some form of fish sampling, ranging from presence/absence sampling to density estimates. There are several other unpublished memoranda in MELP files that provide some overview habitat information, but these do not specifically address juvenile habitat and so are not included here. As a whole, the eleven studies provide a thorough assessment of the potential distribution of steelhead trout in the drainage. Distribution within some tributaries is still unknown, partly because of interannual variability in escapement. Furthermore, the ability of steelhead to rear in streams far from the primary spawning areas creates uncertainty, for juvenile steelhead cannot be readily distinguished from resident rainbow trout.

Table 8. Sources and content of juvenile fish and habitat assessments in the Zymoetz watershed from 1977 to 1997.

Year	Area	Method	Source
1977	Zymoetz River (reaches 7 and 8)	Density estimate; detailed habitat data	Ptolemy 1979
1978	Zymoetz River (reaches 7 to 10)	Habitat data only	Humphries and Morley 1978
1980	Zymoetz River (reaches 7 to 10)	Habitat data only	Wadley 1981
1982	Zymoetz River (reaches 9 to 10); Coal Creek, Sandstone Creek, Passby Creek, Willow Creek, Silvern Creek	Density estimate; detailed habitat data	Tredger 1984
1991	Zymoetz River (reaches 6 to 8); Clore River (reaches 2,3 and 5), Burnie River Reach 1, Thomas, Trapline Treasure, Coal and Sandstone creeks	Density estimate; detailed habitat data	Bustard 1992
1992	Zymoetz River (reaches 6 to 8); Coal and Trapline creeks	Density estimate; detailed habitat data	Bustard 1993
1993	Zymoetz River (reaches 6 to 8); Coal and Trapline creeks	Density estimate; some habitat data	Beere 1993.
1994	Kitnayakwa River (reaches 3 and 5): Tributary 13	Presence/absence; inventory habitat data	Bustard 1994
1994	Tributaries to Zymoetz River (Reach 6): Tributaries 24, 25, 29, 31, 45, 26, 47, 59 (Two Falls Cr.) ,81, Treasure Creek	Presence/absence; inventory habitat data	Bustard 1995
1995, 1996	Clore River (reaches 3 and 6); Thomas, Trapline, Moraine, and Elf creeks, Tributary 48, Tributary 39	Presence/absence; inventory habitat data	Bustard 1996
1997	Red Canyon, Mullwain	Presence/absence; inventory habitat data to RIC* standards	Triton 1998

* Resources Inventory Council

Data collected by Tredger (1984) provide density estimates in the headwaters of the Zymoetz River for 1982 and 1983. Tredger's (1984) work was intended to measure the success of fry stocking, but does not provide a reliable estimate of wild fry or parr density in the headwater streams because of the potential (but unknown) effects of stocked fry on the behavior, distribution and abundance of wild fry.

The most temporally and spatially consistent data was collected using the multiple removal method from 1991 to 1993 in reaches 6 and 7 by Bustard (1992, 1993) and Beere (1993) (Figure 5). These data provide estimates of steelhead fry and parr density over a three year period, allowing us to assess interannual and spatial variation. During the same three years, density measurements were made on Treasure and Coal creeks, and these allow a comparison of mainstem and tributary productive capacity. However, tributary sampling was not exhaustive (consisting of only one site per tributary) and statistical comparisons with the mainstem do not provide much confidence that the observed differences are real.

Within Reach 6 mean steelhead fry densities varied from 0.54/m^2 in 1991 to 0.18/m^2 in 1992 (Table 9). Within Reach 7 mean steelhead fry densities ranged from 0.65/m^2 in 1991 to 0.29/m^2 in 1992. After natural log transformation of fry density, an ANOVA with year and reach as factors revealed that both were significant ($F=7.3$, d.f.=3, 45, $P=0.001$), although reach was just barely so ($P=0.049$). *Post-hoc* comparisons showed that fry density in 1991 was significantly different (higher) than in 1992 or 1993 (Scheffe multiple range test, $P<0.05$). A similar statistical test of parr density (natural log transformed) revealed rather different results. Parr density was not significantly different between years, but was significantly different between reaches (higher in Reach 6, $F=10.6$, d.f. =1, 44, $P=0.002$). For all three years combined, parr density in Reach 6 was 2.6 times greater than in Reach 7 (0.067 versus 0.025/m^2).

An earlier assessment of these data by Beere (1993) proposed that interannual variation in fry and parr density may be explained adult escapement. Years of poor adult escapement such as the 1992 brood year (the 1991 summer steelhead escapement) may explain the low fry densities in 1992. The significant spatial differences in fry and parr distribution between reaches can be explained by habitat type and steelhead life history. Bustard (1995) noted extensive channel shifting in Reach 6 between 1991 and 1992. In contrast, Reach 7 was more stable, and it was here that fry were relatively more abundant that parr. Reach 7 is further upstream and closer to the spawning areas at the outlet of McDonell Lake, and so is closer to the primary fry incubation area and more buffered from environmental extremes than Reach 7.

Life history differences were also apparent on a microhabitat scale. Within reaches 6 and 7 of the Zymoetz River, side channels provided the best rearing habitat for parr, whereas fry were equally abundant in side channel and mainstem habitats (Table 10, Bustard 1993).

Table 9. Summary of juvenile steelhead density estimates in the Zymoetz River mainstem and tributaries, from 1991 to 1993. Areas where more than one sample was collected show standard errors in parentheses.

	Steelhead fry (no./m^2)	Steelhead parr (no./m^2)

Sampling Area	Steelhead fry (no./m²) 1991	1992	1993	Steelhead parr (no./m²) 1991	1992	1993
Reach 6 (Clore River to Treasure Creek)	0.54 (0.12)	0.18 (0.04)	0.23 (0.05)	0.10 (0.02)	0.05 (0.01)	0.04 (0.02)
Reach 7 (Treasure Creek to Red Canyon Creek)	0.65 (0.10)	0.32 (0.11)	0.29 (0.08)	0.02 (0.01)	0.04 (0.01)	0.01 (0.00)
Red Canyon Creek to Serb Creek (Site Z19 in Reach 8)	0.40	0.02	0.05	0.02	0.02	0.00
Treasure Creek	0.15	0.00	0.06	0.01	0.04	0.03
Coal Creek	1.77	0.52	0.92	0.11	0.19	0.14

Data taken from Bustard (1992, 1993) and Beere (1993).

Table 10. Juvenile steelhead density in side channel and mainstem habitat of the Zymoetz River.

Year	Fry (no./m²) Side channel	Fry (no./m²) Mainstem	Parr (no./m²) Side channel	Parr (no./m²) Mainstem
1991	0.54	0.62	0.083	0.047
1992	0.26	0.23	0.048	0.035

Data taken from Bustard 1993.

Steelhead fry densities within Reach 8, and Treasure and Coal creeks varied from those in reaches 6 and 7 (Table 9). Treasure Creek steelhead fry and parr densities were lower than mean values in reaches 6 and 7 of the Zymoetz River. Coal Creek fry and parr densities were higher than mean values in reaches 6 and 7 of the Zymoetz River. Only a single sample was measured within Coal and Treasure creeks, so a statistical comparison with reaches 6 and 7 is not useful. It is worth noting, however, that fry densities at the single site in Coal Creek exceeded those measured at any site in the Zymoetz River in 1991 and 1993, and that parr densities exceed those at any site in the Zymoetz River in 1992 and 1993. This suggests that Coal Creek has a high capacity to rear steelhead trout, as noted by Bustard (1993). Sampling by Bustard (1992) in 1991 included the aforementioned sites as well as sites in the Clore River, and Trapline, Thomas, and Sandstone creeks. During 1991 the Clore River had lower juvenile steelhead densities than those in reaches 6 and 7 of the Zymoetz (fry: $0.59/m^2$ in the Zymoetz versus $0.44/m^2$ in the Clore, parr: $0.067/m^2$ in the Zymoetz versus $0.04/m^2$ in the Clore).

Trapline Creek held densities of steelhead fry and parr greater than those in reaches 6 and 7 of the Zymoetz, so this stream also appears to have a high capacity to rear steelhead trout. Thomas Creek had zero steelhead fry densities and low parr densities, and Sandstone Creek was inhabited primarily by cutthroat trout (Bustard 1992).

Two large tributary streams were recently inventoried and appear to provide substantial steelhead habitat. Red Canyon and Mullwain creeks were sampled in 1997 and rainbow trout juveniles (possibly steelhead) were found in both (Triton 1998). No barriers to adult steelhead migration were observed on Mullwain Creek, which has a mainstem length of 20 km. Red Canyon Creek has 6.6 km of mainstem habitat up to a series of cascades to 30 m in height that would bar steelhead from reaches further upstream.

Although in total there are probably over 100 tributaries to the Zymoetz and Clore rivers (Bustard (1995) identified 87 to Reach 6 alone), their relatively short accessible length reduces the relative importance to steelhead production. The Zymoetz mainstem may not be as productive per unit area, but it is 109 km long, and so provides the bulk of juvenile steelhead habitat in the watershed.

In summary, the mainstem Zymoetz from the Clore River to Serb Creek is a major rearing area for juvenile steelhead, with high densities of juvenile steelhead (Bustard 1995). However, some of the tributaries support higher densities of juvenile steelhead, in particular Coal Creek. Other important tributaries for rearing include Treasure and Trapline creeks. Tributaries to the Zymoetz River upstream of McDonell Lake have good physical habitat (Humphries and Morley 1978), and may support steelhead fry and parr, however, no sampling has been done to confirm this.

4. REVIEW OF PAST ENHANCEMENT ATTEMPTS

In 1980 Serb Creek was diverted to improve and extend spawning and rearing habitat. Ptolemy (1979) advised against the project on the basis of the small potential gain in steelhead production. It was later determined that adult steelhead spawn in Serb Creek. Gravel was placed to rehabilitate the outlet of McDonell Lake in 1980 (R. Tetreau, pers. comm., 1997).

In 1981 a project was undertaken to improve access past a ~2 m high waterfall in the canyon at approximately 7 km on the mainstem Zymoetz (J. Culp, pers. comm., 1997). A drill was lowered into the canyon and small 'fishways' were blasted around the obstruction. Access past the waterfall was improved, based on the observation that steelhead no longer held in a large pool below the falls once the fishways were built (J. Culp, pers. comm., 1997). This is probably the same spot noted as a possible location for a fish ladder in MELP stream files. Both the Steelhead Society (B. Hill, pers. comm., 1997) and MELP (R. Tetreau, pers. comm., 1997) noted that the removal of this barrier may have been unwise, allowing a genetically inferior component of the stock access to the upper river.

In 1979 Regional Fisheries Biologist Mike Whately described the Zymoetz River steelhead fishery as a disaster, based on impacts to habitat from two major floods, road and pipeline repair, and forest harvesting, and assigned proposed enhancement efforts there the highest priority in the Skeena Region. Brood stock collection and hatchery operations were undertaken from 1980 through to 1985 to enhance Zymoetz River steelhead. Wild brood stock were used for this enhancement project, which was designed to increase steelhead production by stocking fry to under-recruited streams in the upper watershed (Anon. 1981). A total of 287,500 fry were stocked upstream of McDonell Lake from 1981 to 1985 (Table 11).

Table 11. Summary of steelhead fry releases to the Zymoetz River.

Year	Size range (g)	Release date	Release location	Number released	Tag type	Estimated return	Return years
1981	1.2-4.2	Sep-81	Passby	5,000		600	86-88
1981	1.2-4.2	Sep-81	Willow	5 500		600	86-88
1981	1.2-4.2	Sep-81	Silvern	5,000		600	86-88
1981	1.2-4.2	Sep-81	Sandstone	8,000		600	86-88
1981	1.2-4.2	Sep-81	Coal	16,000		600	86-88
1981	1.2-4.2	Sep-81	u/s Dennis	10,000	LM	600	86-88
1981	1.2-4.2	Sep-81	u/s McDonell	51,500	LM	600	86-88
1983	1.6	Sep-83	Passby	42,000		850	88-90
1983	1.6	Sep-83	Willow	10,000		850	88-90
1983	1.6	Sep-83	Silvern	6,000		850	88-90
1983	1.6	Sep-83	Sandstone	8,000		850	88-90
1983	1.6	Sep-83	Fossil	2,000		850	88-90
1983	1.6	Sep-83	u/s Dennis	3,000		850	88-90
1983	1.6	Sep-83	u/s McDonell	46,000		850	88-90
1985	3.2	Sep-85	Passby	34,000	ADCWT	450	90-92
1985	3.2	Sep-85	Willow	4,000		450	90-92
1985	3.2	Sep-85	Silvern	4,000		450	90-92
1985	3.2	Sep-85	u/s Dennis	4,000		450	90-92
1985	3.2	Sep-85	u/s Passby	10,000		450	90-92
1985	3.2	Sep-85	u/s McDonell	10,000		450	90-92
1985	3.2	Sep-85	Tribs. between Passby & Silvern	1,000		450	90-92
TOTAL				287,500		13,300	

Notes: Abbreviations: u/s = upstream, d/s = downstream, LM = left maxillary fin clip, ADCWT = adipose fin clip with coded-wire tag.

Colonization sites were selected on the basis of habitat quality, as determined by professional judgement, and access (Wadley 1981). The Zymoetz River downstream of McDonell Lake was dismissed as a potential release / stocking site because of the potential for competition between stocked and wild fry. Competition was not considered at the other stocking sites, even where wild fry and smolts were abundant. The stocking was forecast to provided an additional escapement of 1,000 to 2,000 adult summer steelhead based on the Provincial biostandards of the day (Whately 1979).

The survival of fry released in 1981 was estimated from electrofishing recaptures of marked juveniles in the stream of release. Fry abundance was measured for two consecutive years following the release. The released fry were marked with a maxillary clip and released to the Zymoetz River between McDonell Lake and Dennis Lake during September 1981. The abundance of marked yearlings was estimated in the same section of river through electrofishing with the multiple removal method during August 1982 and 1983 (Tredger 1984). The fry-to-yearling survival of 4.3 g fry (reared at Abbottsford hatchery) was 17.7 to 20.6% and the survival of 1 g fry (incubated in an incubation box at Fossil Creek, at the Kitnayakwa/Zymoetz confluence) was 11 to 15%. Wild steelhead, coho salmon, Dolly Varden (*Salvelinus malma*), and sculpins (*Cottus sp.*) were captured during the sampling, suggesting that stocked fry and wild fish may have competed for habitat and food. The survival of stocked fry through to adult return was assessed by examining the 1987 commercial harvest from Area 4 for marked adult steelhead. Although the estimates are of unknown confidence, a point estimate of 0.28% was derived (Schultze and Lough 1987). The contribution of hatchery steelhead the Skeena sport fishery was estimated to be 296 to 1,929 fish, based on marked adult recaptures in the commercial fishery.

Returning hatchery steelhead were captured by anglers and reported in the Steelhead Harvest Analysis (SHA). These data are of questionable accuracy, but provide the only time series of steelhead catch data for the Zymoetz River. Releases of fry resulted in reports of hatchery fish in the Zymoetz River sport fishery, and 360 hatchery fish were reported caught (Table 12). Of these, only two (<1%) were captured in the Clore River, suggesting that strays were rare.

Of particular interest is the capture of 32 hatchery fish in the 1981/1982 season. Based on the fry release records, adult steelhead were not expected to return until 1986, and reports of captures during 1981/1982 may be an expectation of capture by steelhead anglers, rather than an actual catch. The SHA reports hatchery fish catches in other streams where no enhancement has been reported (D. Atagi, pers. comm., 1998). For the period of record (from 1967 to 1995) the SHA reports hatchery steelhead in 42 of 126 Skeena Region streams where steelhead were reported captured (34%), though hatchery fish have been released to only a few streams. The SHA tends to overinflate steelhead catch and estimates of hatchery contribution to the catch, and the reporting of hatchery fish in streams where there has been no enhancement may reflect natural fin clips or biased reporting or both (D. Atagi, pers. comm., 1998).

From 1981 to 1983, prior to the expected return of hatchery fish, the reported catch of hatchery fish averaged 2.3% of the total catch. Hatchery steelhead returns from 1986 to

1988 were 1% of the total steelhead catch. On average, only 27 hatchery fish were reported captured each year. This suggests that there has been no long-term benefit to this enhancement action.

Table 12. Wild and hatchery steelhead captured in the Zymoetz River by sport fishing, from 1967 to 1995 (SHA data).

Year	Wild Catch	Hatchery Catch	% Hatchery
1967-68	1,495	0	0.0%
1968-69	1,322	0	0.0%
1969-70	1,580	0	0.0%
1970-71	1,905	0	0.0%
1971-72	2,471	0	0.0%
1972-73	2,569	0	0.0%
1973-74	2,121	0	0.0%
1974-75	1,489	0	0.0%
1975-76	1,432	0	0.0%
1976-77	1,115	0	0.0%
1977-78	1,167	0	0.0%
1978-79	1,054	0	0.0%
1979-80	606	0	0.0%
1980-81	258	0	0.0%
1981-82	1,307	32	2.4%
1982-83	724	12	1.6%
1983-84	1,117	32	2.8%
1984-85	1,570	5	0.3%
1985-86	3,287	40	1.2%
1986-87	4,377	60	1.4%
1987-88	2,348	4	0.2%
1988-89	3,004	24	0.8%
1989-90	1,492	19	1.3%
1990-91	925	8	0.9%
1991-92	370	51	12.1%
1992-93	695	10	1.4%
1993-94	1,013	94	8.5%
1994-95	1,503	6	0.4%
1995-96	1,166	3	0.3%
AVG.*	1,568	27	0.3%

- Hatchery catch average and hatchery % of total catch from 1981 to 1996.

5. REVIEW OF ADULT ASSESSMENTS

Records of steelhead tagging and recapture in the Zymoetz River were provided by MELP for the years 1979 to 1995. Steelhead were tagged with spaghetti, anchor, floy, and/or radio tags. A total of 106 steelhead were tagged and later attributed to the Zymoetz River population (Table 13). A Zymoetz stock identity was assigned to tagged steelhead if they were tagged or recaptured within the Zymoetz River. The location and date of tagging was provided for only 105 steelhead. Among these, 14.4% were tagged in marine approach waters (DFO Statistical Areas 3 and 4), 2.9% were tagged in the Skeena River, and 80% were tagged in the Zymoetz River.

A total of 52 steelhead tagged steelhead attributed to the Zymoetz stock were recaptured (49% of those tagged), but the location and date of recovery was recorded for only 50 of these. Based on this smaller sample, 6% of the tags were recovered in approach waters, 10% were recovered in the Skeena River, and 84% were recovered in the Zymoetz River (Table 14). Note that steelhead referred to here as recaptured include both those fish physically recaptured and those located via radio telemetry.

Only two tagged steelhead (1.9% of the number of total fish tagged) were recaptured twice. One of these fish was first tagged on August 15, 1992 at Kitson Island, was later recaptured at China Bar on the Skeena River at some unknown date during 1992, and was recaptured a second time on March 17, 1993 at an unknown location in the Zymoetz River. The other fish was first tagged on September 3, 1992 at Smith Island, was first recaptured at Mile 11 on the Zymoetz River sometime in 1993, and was recaptured the second time near the Skeena/Zymoetz confluence on March 23, 1993.

Of those steelhead with known tagging and recapture locations (n=43), 58% were tagged in the approach waters and recaptured in the Zymoetz River (Table 15). Note that fish tagged in the approach waters and later recaptured were all recaptured in the Zymoetz River. Of the fish tagged in the Zymoetz River and recaptured, 56% were recaptured in the Zymoetz River and 44% were recaptured in the Skeena River. Those fish recaptured in the Skeena River were a combination of kelts returning to the sea after spawning and adults returning for another spawning over a year later. One fish was recaptured in the Zymoetz on September 13, 1993 after being tagged in the Bulkley River on November 2, 1992. In our analysis this steelhead was combined with fish tagged in the Skeena River.

The time between tagging and recapture varied between the locations where tags were applied. Fish tagged in the Skeena approaches were captured an average of 122 days later in the Zymoetz River: this average represents fish captured during the fall in holding areas and during the spring on the spawning grounds (Table 16). Fish tagged in the Zymoetz averaged 273 days before being captured in the Skeena: these fish represented kelts that had spawned and were intercepted by commercial nets, as well as fish captured one year later during a subsequent spawning migration. Only one fish tagged in the Zymoetz was recaptured in marine waters during a commercial opening in August.

Table 13. Number of Zymoetz River steelhead tagged by year and tagging location, from 1979 to 1995, based on MELP data records.

	Tagging Location							
	Approach Waters*		Skeena River		Zymoetz River		Combined	
Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1979	0	(0%)	0	(0%)	4	(3.8%)	0	(0%)
1981	0	(0%)	0	(0%)	1	(1%)	0	(0%)
1983	0	(0%)	0	(0%)	8	(7.6%)	0	(0%)
1987	0	(0%)	0	(0%)	2	(1.9%)	0	(0%)
1989	0	(0%)	1	(1%)	0	(0%)	0	(0%)
1990	0	(0%)	1	(1%)	2	(1.9%)	0	(0%)
1991	0	(0%)	0	(0%)	31	(29.5%)	0	(0%)
1992	7	(6.7%)	0	(0%)	0	(0%)	1	(1%)
1993	3	(2.9%)	1	(1%)	31	(29.5%)	0	(0%)
1994	4	(3.8%)	0	(0%)	1	(1%)	0	(0%)
1995	1	(1%)	0	(0%)	4	(3.8%)	0	(0%)
Combined	15	(14.3%)	3	(2.9%)	84	(80%)	1	(1%)

* DFO Statistical Areas 3 and 4

Table 14. Number of tagged Zymoetz River steelhead recaptured* by year and tagging location, based on MELP data records.

	Approach Waters		Skeena River		Zymoetz River		Combined	
Year	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1979	0	(0%)	0	(0%)	2	(4%)	2	(4%)
1980	0	(0%)	0	(0%)	1	(2%)	1	(2%)
1981	1	(2%)	0	(0%)	0	(0%)	1	(2%)
1982	1	(2%)	0	(0%)	0	(0%)	1	(2%)
1983	0	(0%)	3	(6%)	0	(0%)	3	(6%)
1984	1	(2%)	2	(4%)	1	(2%)	4	(8%)
1987	0	(0%)	0	(0%)	1	(2%)	1	(2%)
1989	0	(0%)	0	(0%)	1	(2%)	1	(2%)
1990	0	(0%)	0	(0%)	1	(2%)	1	(2%)
1992	0	(0%)	0	(0%)	2	(4%)	2	(4%)
1993	0	(0%)	0	(0%)	22	(44%)	22	(44%)
1994	0	(0%)	0	(0%)	1	(2%)	1	(2%)
1995	0	(0%)	0	(0%)	6	(12%)	6	(12%)
1996	0	(0%)	0	(0%)	4	(8%)	4	(8%)
Total	3	(6%)	5	(10%)	42	(84%)	50	(100%)

* Includes physical recaptures and steelhead located using radio telemetry.

Table 15. Comparison of the locations of Zymoetz River steelhead tagging and recapture* based on MELP data records.

	Recapture Site					
	Zymoetz River		Skeena River		Combined	
Tagging Location	Number Recovered	% of Total	Number Recovered	% of Total	Number Recovered	% of Total
Zymoetz River	10	56%	8	44%	18	42%
Approach Waters	25	100%		0%	25	58%
Combined	35		8		43	100%

* Includes physical recaptures and steelhead located using radio telemetry.

Table 16. Comparison of the time between tagging and recapture* of Zymoetz River steelhead, based on MELP data records.

Tag location:	Tagged in Skeena or approaches	Tagged in Zymoetz River		
Re-capture location	Zymoetz	Skeena	Zymoetz	Marine
	Days between tagging and recapture			
Average	122	273	120	-
S.E.	23.0	82.8	57.0	-
n	24	6	15	1
Min.	1	47	1	466
Max.	430	466	762	466

* Includes physical recaptures and steelhead located using radio telemetry.

6. ADULT RUN TIMING

Tagging studies and commercial and sport catches provide information on the timing of adult migration. Commercial catches of steelhead in the Skeena River and approach waters show that adult steelhead enter the Skeena River during July and August, with half of the run arriving between July 27 and August 16 (from 1985 to 1995, DFO test data reported in Alexander *et al.* 1996). Steelhead begin to enter the Zymoetz by mid-July, but the first major run does not usually occur until the third or fourth week of August, with fish continuing to enter through the fall (Lough 1980). The earliest known catch of a summer steelhead on the Zymoetz River was by Gene Llewellyn on July 4 (year unknown), 6 km upstream of the Zymoetz/Skeena confluence (Whelpley 1989).

Observations by Jim and Chris Culp, Zymoetz River angling guides, suggest there is a spring and summer run of steelhead, with fish trickling in throughout the year. Based on their observations, the summer run is largest, with a peak migration to the lower river in mid-August, with some fish arriving as early as late July. These fish migrate to the upper river relatively quickly and overwinter in the upper watershed. In November another distinct run arrives and overwinters in the lower river. The earlier running fish migrate further up the Zymoetz River, a pattern observed amongst Skeena steelhead as a whole (Alexander *et al.* 1996). Some anglers have identified 'fall' run steelhead in the Zymoetz River, however these are probably summer run fish that have spent some time in the lower Skeena River before entering the Zymoetz River. Migratory timing observed by anglers is biased because the time of entry into the tributary streams (where most steelhead anglers fish) is later than the time of freshwater entry.

Tagging data provide additional information on run timing. These tags were applied during tagging studies with different objectives (to determine run timing, overwintering and spawning area location, and spawning timing) and so reflect the dates that MELP personnel selected for tag application. As a result, the tagging date varied dependent on where tags were applied. Fifteen steelhead were tagged in Skeena approach waters, consisting of DFO statistical Area 3 (subareas 1,3, and 4) and Area 4 (subareas 1,7,12,13, and 15). For tags applied in the marine approach waters, the average date of tagging was August 3 (n=15, S.E. 4.9 days, Table 17). For tags applied in the Skeena River, the average date of tagging was September 3 (n=4, S.E. 21.9 days). For tags applied in the Zymoetz River, the average date of tagging was August 8 (n=84, S.E. 11.5 days). The high variance (given the large sample size) in date of tagging for those tags applied in the Zymoetz River reflects two distinct periods of tagging within the data. One period was from October to December, when overwintering and spawning areas were studied, and the other period was from March to May, when spawning areas and timing were studied.

Table 17. Migration timing of Zymoetz River steelhead based on the date of tagging in marine approach waters (Areas 3 and 4), Skeena River, and the Zymoetz River, based on MELP data records.

	Approach Waters	Skeena River	Zymoetz River

Mean	August 3	September 3	August 8
SE (days)	4.9	21.9	11.5
N	15	4	84
Minimum	June 30	July 27	March 17
Maximum	September 3	November 2	December 10

Tagging dates in the Zymoetz River were not necessarily reflective of upstream migration timing, for some tags were applied to holding fish. Only four tags were applied to Zymoetz steelhead in the Skeena River, and these had a wide range in date of tagging. Therefore, tags applied in the Zymoetz and Skeena rivers were not used to assess the time of freshwater entry. Migration timing was inferred for Zymoetz River steelhead using only those tags applied in the marine approach waters.

To help visualize migration timing, a curve drawing routine was applied to the migration timing data (inferred from tag application date). A method known as probability distribution estimation was used that weights each individual datum by measuring the distance to all other data points and contrasting these differences with a constant called a kernel to smooth the line (Silverman 1986). The kernel can be varied, somewhat like the bin size varies in a histogram. The probability distribution for migration timing inferred from steelhead tag application is show in Figure 6. From this plot peak migration timing through Skeena approach waters is the first week of August, with 25% of the run having migrated in mid-July and 75% having migrated in mid-August. The extremes of the distribution are described by only one datum, and so are poorly known and thus not calculated.

Steelhead run-timing has been estimated by MELP using tag recovery data, as described in a Pacific Stock Assessment Review Committee (PSARC) paper prepared by Ward *et al.* (1993). These data show that both Zymoetz and the aggregate Skeena summer run stock peak in arrival during the calendar week August 3 to 9, similar to the timing calculated in this review. The PSARC report also shows that Zymoetz fish tend to arrive slightly earlier than the Skeena aggregate stock, in agreement with the skew towards early-arriving fish calculated in the present review. Our data were more skewed than the PSARC data because the latter were normalized. Both the PSARC review and this study suggest that Zymoetz River steelhead arrive earlier than the aggregated Skeena River stock, however our results suggest that the difference may be more substantial than implied by the normalized run-timing curves presented by Ward *et al.* (1993). However, note that Lough (1981) showed that from the end of July until the middle of August the percentage of tagged steelhead destined for the middle Skeena increased while those destined to tributaries upstream decreased. This suggests that summer steelhead timing is later in the Zymoetz River than in the Morice and Bulkley rivers.

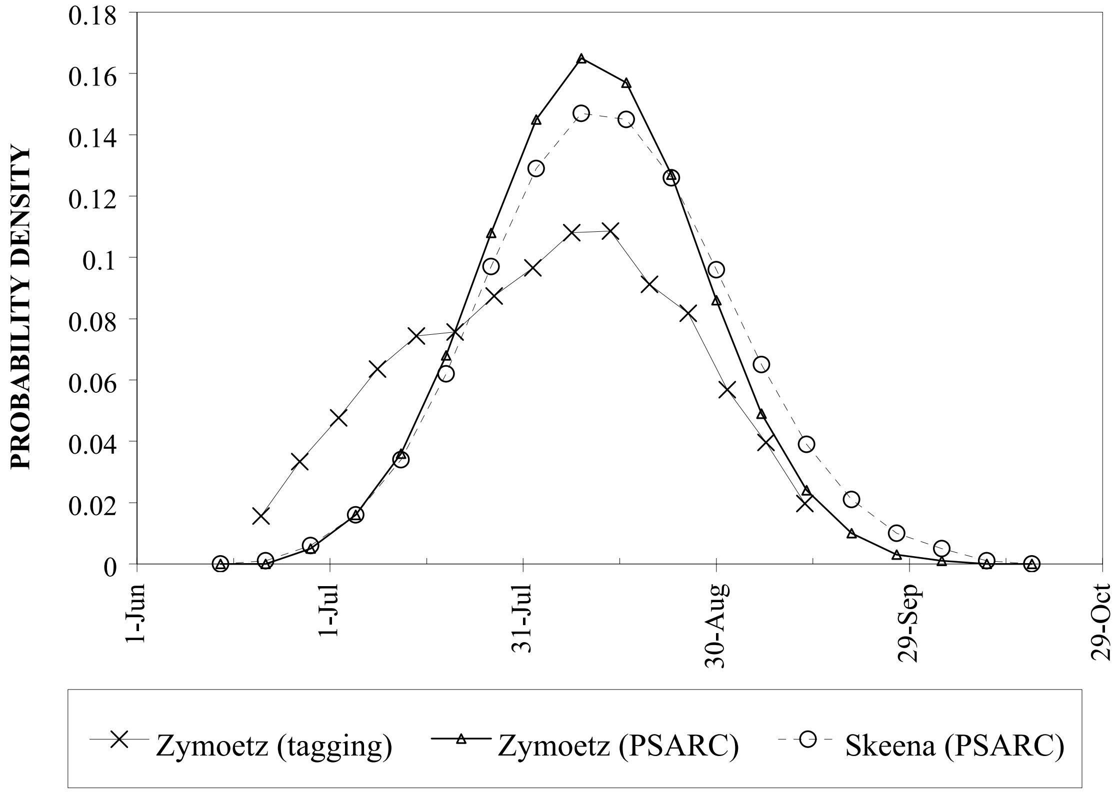


Figure 6. The timing of migration in Skeena approach waters (Areas 3 and 4) by Zymoetz River and Skeena River steelhead, inferred from dates of steelhead tagging by MELP, and from data provided in a PSARC paper (Ward *et al.* 1993).

Steelhead migration rate has been estimated from radio-tagging data. A fish captured and radio tagged in the lower Skeena River sport fishery entered the Zymoetz August 18 travelling 28 km at 1.4 - 1.8 km/day - this fish held in the mouth over 40 hours before continuing upstream (Lough 1979). Based on the movements of 55 radio-tagged steelhead captured in seine fisheries in DFO Statistical Areas 3, 4, and 5, the mean freshwater migration rate of steelhead downstream of the Zymoetz River was 10.4 km/day (range 2 - 20 km/day, Spence 1989). Migration rates within the Zymoetz River average from –0.3 to 4.6 km/day, with a mean of 4.6 km/day (Beere 1995).

Whelpley (1989) monitored the movement of 11 radio-tagged steelhead in the lower Zymoetz River from November 26, 1988 - April 5, 1989. Most fish moved very little. One fish was recaptured and killed on February 26 by a local angler. Two fish were tagged on November 26 near the Zymoetz River bridge and were found upstream in the Skeena near Usk and Little Oliver Creek on December 6. The Usk fish returned to the Zymoetz River on December 12 and remained there until May, but the other fish was never relocated. Several fish dropped back into the Skeena, possibly because of turbidity caused by Clore River slide. No tagged fish were observed migrating past the lower canyon (Whelpley 1989).

7. HARVEST, CATCH AND ANGLER EFFORT

The Steelhead Harvest Analysis (SHA) provides an annual measure of angling effort and steelhead catch province-wide, and records angler origin, catch type (hatchery or wild), and whether the catch was killed or released. Data are available for the Zymoetz and Clore rivers from 1967 to 1995, although only data collected since 1983 provide angler origin.

The average annual steelhead angler catch was 61 fish in the Clore River, 1,511 fish in the Zymoetz River, and 1,568 fish for both rivers combined (Table 18). Steelhead catch varied almost twenty-fold from a maximum catch of 4,377 in 1986/1987 to a minimum of 258 in 1980/1981. Steelhead angler day effort averaged 79 days in the Clore River, 2,942 days in the Zymoetz River, and 3,016 days for both rivers combined. Steelhead angler catch per day averaged 0.80 fish per day in the Clore River, 0.57 fish per day in the Zymoetz River, and 0.67 fish per day for both rivers combined.

Table 18. Steelhead angler catch, anglers days, and catch per angler day in the Zymoetz and Clore rivers over the period 1967 - 1995. Data compiled from the Steelhead Harvest Analysis Database.

	Clore River			Zymoetz River			Combined		
	Catch	Angler Days	Catch per Day	Catch	Angler Days	Catch per Day	Catch	Angler Days	Catch per Day
Mean	61	79	0.80	1,511	2,942	0.57	1,568	3,016	0.67
S.E.	10	12	0.11	164	281	0.05	169	286	0.06
Median	46	52	0.68	1,416	3,100	0.56	1,432	3,169	0.60
Min.	0	3	0.00	258	661	0.19	258	673	0.09
Max.	210	231	2.46	4,269	5,562	1.17	4,377	5,769	1.46

Two periods of low catch were apparent; 1980/1981 and 1991/1992 (Figure 7). Since 1992 steelhead catch has doubled, concurrent with an implementation of catch and release restrictions. The total number of angler days has varied eight-fold from 1983 to 1995. Angler day effort reached a maximum of 5,722 in 1986, coinciding with a large return year for steelhead to the Skeena River. Angler day effort decreased up until 1991, consistent with declining returns, and although it increased at 40% per year since that time, it is presently only 25% of its high during the early 1970s. This apparent reduction in effort may partly reflect changing biases and error rates in the SHA, and the effects of more restrictive angling regulations.

The recent increase in angling effort probably reflects increased catch success that results from catch and release regulations and increased steelhead returns. Local anglers have noticed the increase in angling effort: increases from the occasional angler in 1992 to more than 30 anglers per day in 1996 have been reported (Jim Culp, pers. comm., 1997).

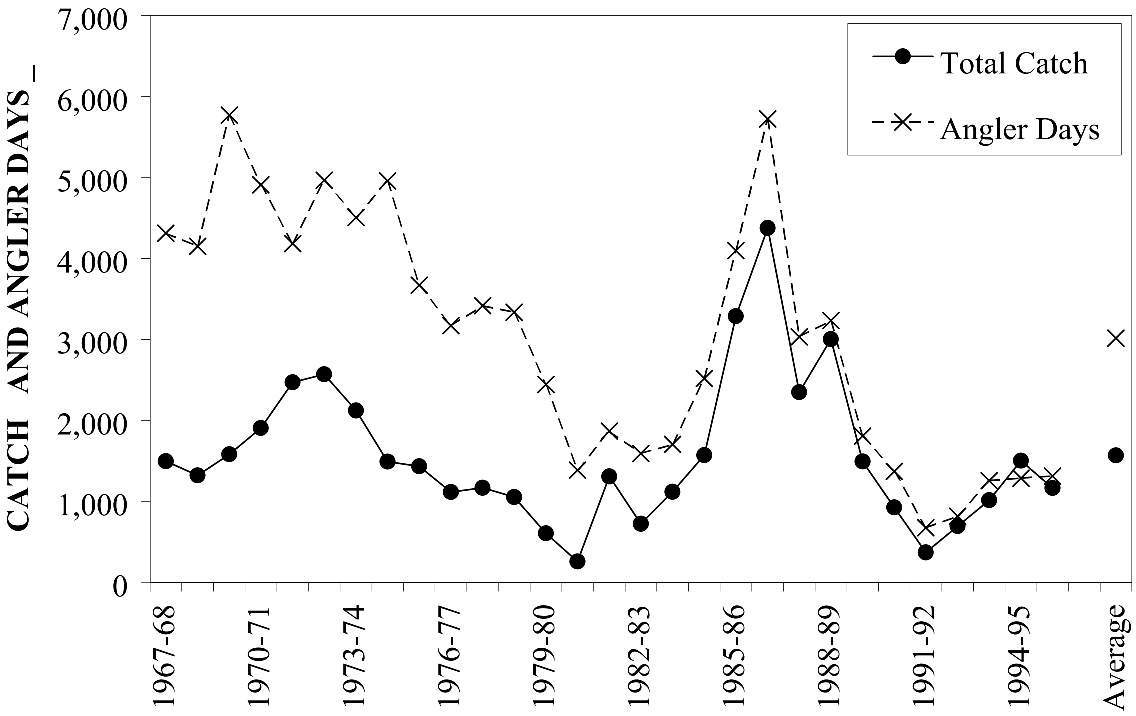


Figure 7. Annual number of angler days and steelhead catch on the Zymoetz River, from 1967 to 1995.

From 1993 to 1995, British Columbian residents made up the majority of anglers fishing the Zymoetz River. Resident anglers account for 86% of the total angler days on the river, and non-Canadians account for only 11%, with non-resident Canadians accounting for just 3% (Table 19, Figure 8). The residency composition of Zymoetz anglers has not changed noticeably since 1983. Skeena residents spend 72% of the total angling days on the Zymoetz, reflecting the proximity of this fishery to Terrace.

Steelhead catch per angler day has been quite consistent on the Zymoetz River, ranging between years from 0.49 to 1.05 fish per day for all angler groups combined (Figure 9). Over the period of record there were no consistent differences between residents and non-residents in angling success rates. Steelhead catch per angler day showed a gradual increasing trend from the 1970s until present day (Figure 9). This may reflect increased angler efficiency, or errors in angler effort induced by the changing biases in the SHA. Hatchery fish comprised a small component of the total catch of Zymoetz River steelhead. Hatchery fish began to appear in 1981, and were most abundant in 1986 and 1993 (Figure 10).

Table 19. Catch, effort (days fished) and angler catch per day (CPUE) by angler residency status from 1983 to 1995, for the Zymoetz and Clore rivers combined. Data taken from the SHA.

Fiscal year	Data	British Columbian	Non Canadian	Non-resident Canadian	Combined
1983-84	Total catch	127	30	37	102
	Days fished	198	33	43	155
	CPUE	0.45	0.91	0.47	0.49
1984-85	Total catch	149	39	3	112
	Days fished	238	48	20	180
	CPUE	0.83	0.90	0.08	0.73
1985-86	Total catch	253	203	102	235
	Days fished	321	229	111	293
	CPUE	0.77	1.98	0.92	0.95
1986-87	Total catch	393	386	70	365
	Days fished	538	372	135	477
	CPUE	0.86	1.05	0.52	0.87
1987-88	Total catch	221	152	55	196
	Days fished	265	297	51	253
	CPUE	1.08	0.92	1.08	1.05
1988-89	Total catch	277	252	11	250
	Days fished	310	203	34	269
	CPUE	0.67	0.63	0.32	0.64
1989-90	Total catch	146	111	63	136
	Days fished	171	191	81	164
	CPUE	0.72	0.58	0.78	0.71
1990-91	Total catch	93	112	51	93
	Days fished	140	174	41	137
	CPUE	0.72	0.33	1.24	0.69
1991-92	Total catch	56	17	-	46
	Days fished	92	60	-	84
	CPUE	0.35	0.14	-	0.30
1992-93	Total catch	113	6	11	87
	Days fished	129	37	9	102
	CPUE	0.48	0.16	1.22	0.53
1993-94	Total catch	155	85	0	127
	Days fished	196	79	3	157
	CPUE	0.92	1.08	0.00	0.82
1994-95	Total catch	241	42	13	188
	Days fished	197	65	40	161
	CPUE	0.62	0.65	0.33	0.59
1995-96	Total catch	145	31	88	117
	Days fished	159	64	77	131
	CPUE	0.94	0.25	1.14	0.82
Combined	Total catch	191	126	39	166
	Days fished	241	157	50	209
	CPUE	0.74	0.75	0.62	0.73

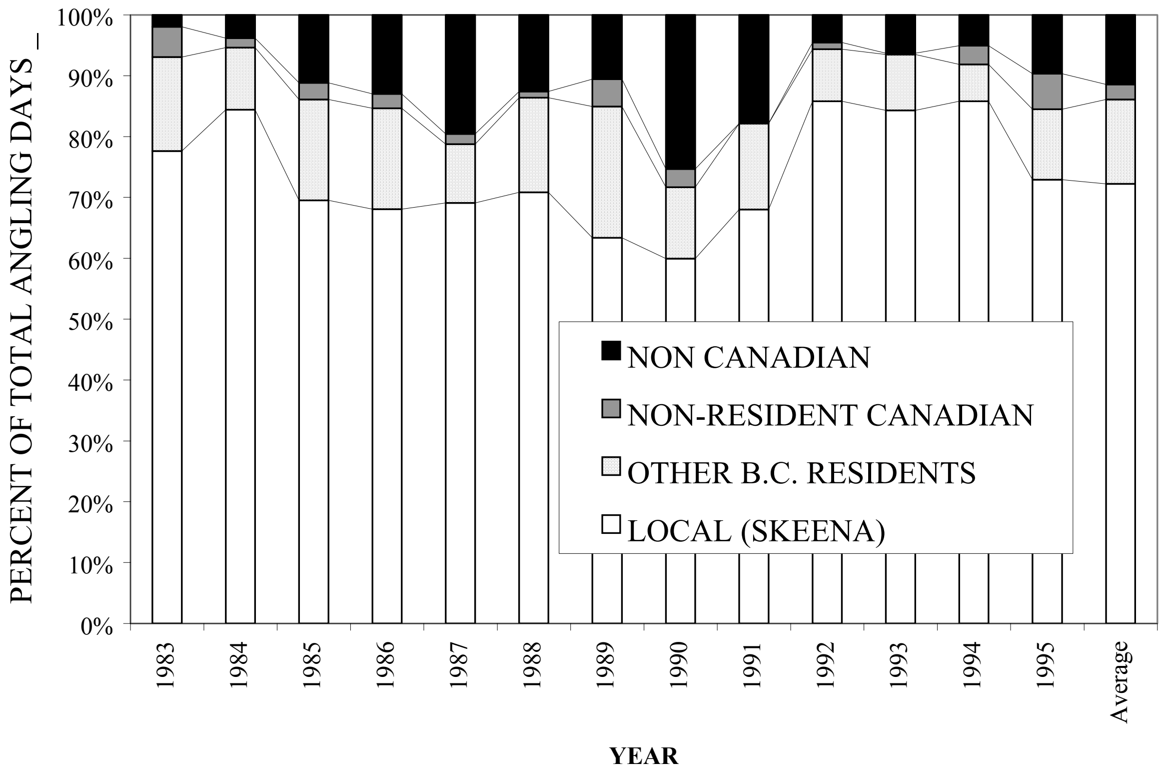


Figure 8. Summary of the residency status of anglers fishing the Zymoetz River from 1983 to 1995. Data compiled from the Steelhead Harvest Analysis database. Note there are no data for non-resident Canadians in 1991.

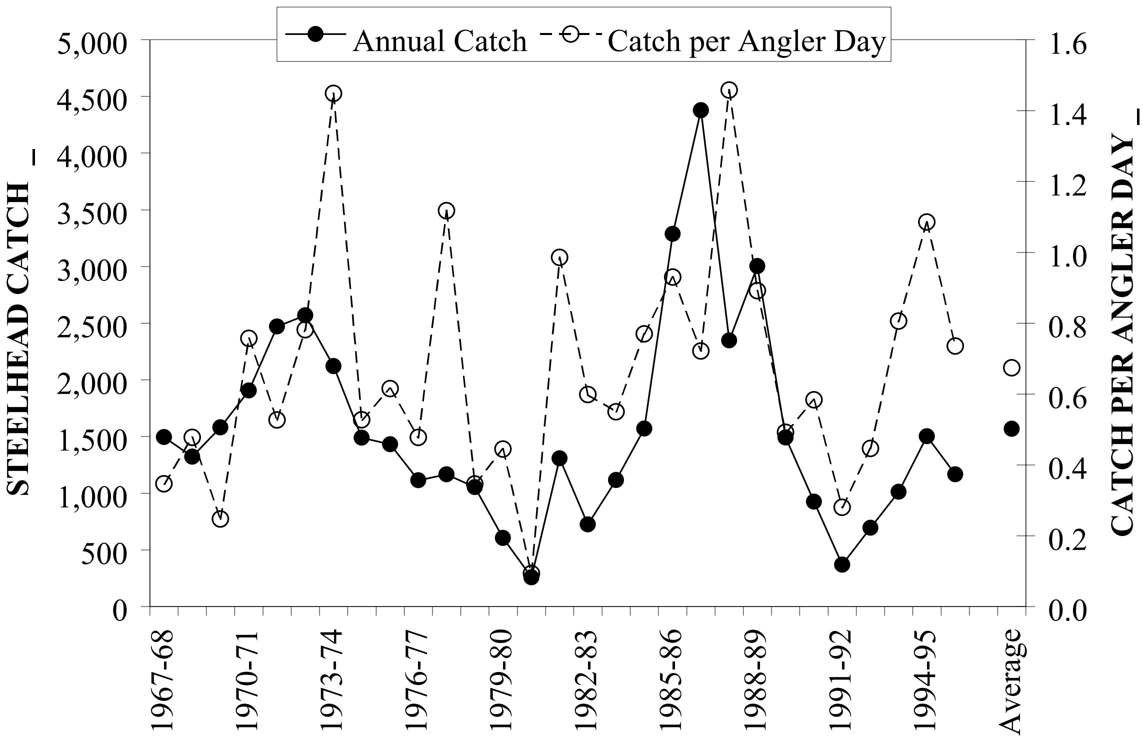


Figure 9. Steelhead catch and catch per angler day on the Zymoetz River, from 1967 to 1995.

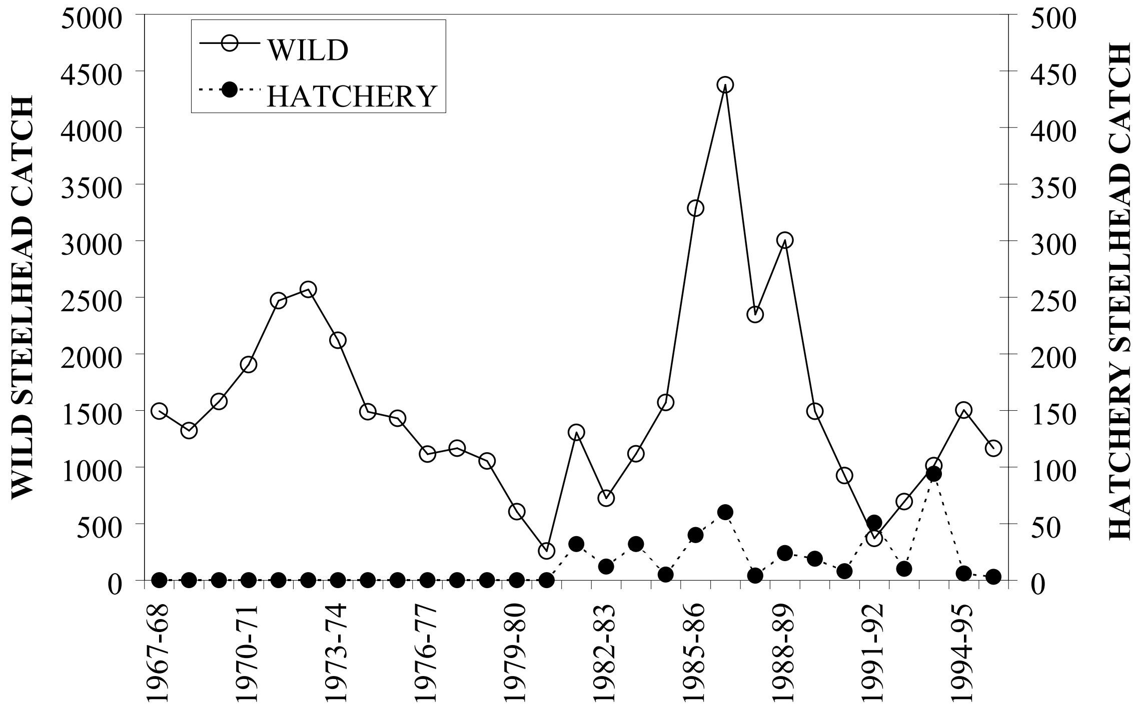


Figure 10. Estimated angler catch of wild and hatchery steelhead on the Zymoetz River from 1967 to 1995. Note the ten-fold larger scale for the wild steelhead catch.

8. ANGLING GUIDE ACTIVITY

Data on angling guide activity are available from a database maintained by MELP. Records were obtained for the years from 1990 to 1996. During these years and since that time, the Zymoetz River was considered a classified water from September 1 to October 31. Class I licensing applied upstream of Limonite Creek and Class II licensing applied downstream.

Guided angler days (effort) averaged 35 in the Class I section and 35 in the Class II section during the classified waters period over the period of record (Table 20). For the sections combined, guided angling days decreased from a high of 242 in 1990/91 to a minimum of 30 in 1993/94. The decline in guiding effort between 1990/1991 and 1991/1992 may be explained by poor steelhead returns, which in were greatly reduced in those years compared to the larger runs of the mid-1980s (Alexander *et al.* 1996). Water conditions also influence catch success and resultant angling effort and catch, however, large floods were not observed in 1991 or 1992 (Figure *2*). Guiding effort increased within Class II waters in the 1995/1996 (63 days) and the 1996/1997 (59 days) fiscal years. The guiding activity provides a socioeconomic benefit to Terrace.

Guiding effort within the classified waters period matched that over the whole season within the Class I section, averaging 35 and 36 days per year respectively (Table 21). In the Class II section guiding effort within the classified water period was 35 days, compared to 59 days over the whole season. The higher effort over the entire season within the Class II section reflects a fishery on the lower river during the fall and winter months, outside of the classified waters period.

Guiding effort was exercised by only 6 different guides over the period 1990- 1996. Two guides accounted for 72% of the guiding effort. Illegal guiding effort may be as large as recorded guiding effort by the licensed guides. Local contacts described illegal guiding as a substantial problem (B. Hill, and S. Nickolls, pers. comm., 1997).

Guided angler days requested exceeded those granted in most years in both the Class I and II sections of the Zymoetz River (Figure 11, Figure 12). For the last four years of the period of examination, the quota was 58 angler days in the Class I section, and 177 days in the Class II section. The number of anglers days used during the classified waters period tracked those used during the entire season quite closely within Class I waters, with an average of 45 days used within the classified waters period and 46 days used over the entire season. However, within Class II waters an average of 181 angler days were used over the entire season, whereas 120 days were used during the classified waters period.

Table 20. Guided angling effort on the Zymoetz River during the classified waters period, by classified waters section, from 1990 to 1996.

License Year	Angler Days Used		
	Class I Section	Class II Section	Sections Combined
90/91	195	47	242
91/92	8	10	18
92/93	0	1	24
93/94	3	27	30
94/95	8	35	43
95/96	12	63	75
96/97	16	59	75
Average	35	35	72

Table 21. Guided angling effort on the Zymoetz River during the classified waters period and over the whole season, by classified waters section, from 1990 to 1996.

License Year	Angler Days Used	
	Within Classified Waters Period	Over Whole Season
Class I Section		
90/91	195	197
91/92	8	8
92/93	0	0
93/94	3	6
94/95	8	8
95/96	12	12
96/97	16	18
Average	35	36
Class II Section		
90/91	47	65
91/92	10	14
92/93	1	24
93/94	27	48
94/95	35	46
95/96	63	119
96/97	59	94
Average	35	59

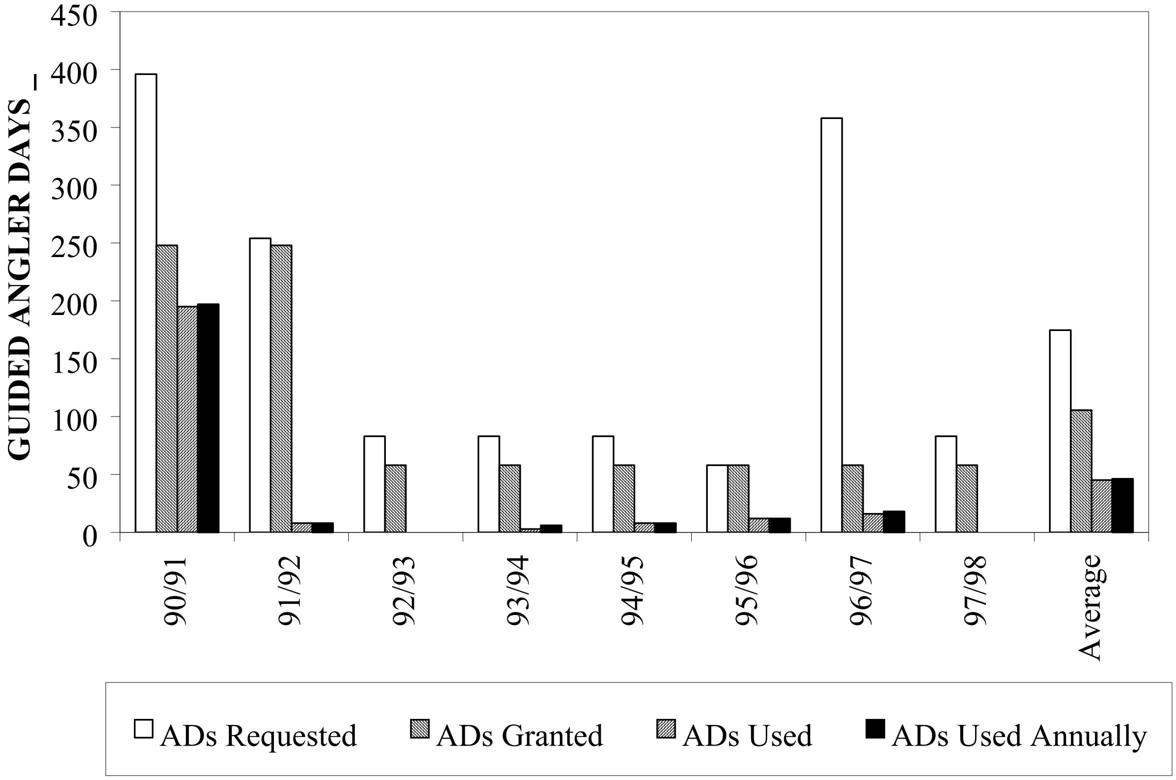


Figure 11. Summary of guided angler days (AD requested, granted, used and used annually (outside the classified waters period) by licensed angling guides on the Zymoetz River within the Class I section from 1990 to 1995.

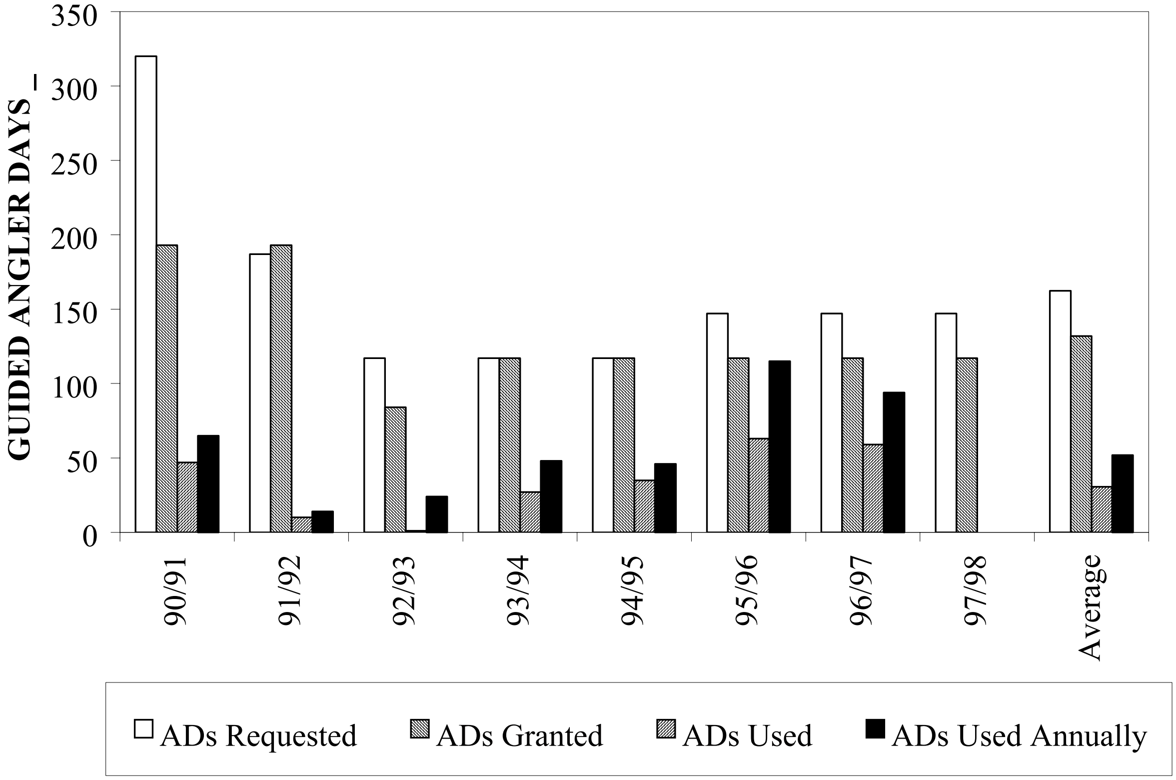


Figure 12. Summary of guided angler days (AD requested, granted, used and used annually (outside the classified waters period) by licensed angling guides on the Zymoetz River within the Class II section from 1990 to 1995.

9. CREEL SURVEY DATA

Creel census data were collected in five studies from 1974 to 1990 on the Zymoetz River. Taylor (1968) performed some incidental creel on the Zymoetz River coincident with biological studies in 1967, but surveyed only 80 hours of angling effort (over which there was a catch success of 0.1 steelhead per hour). He also reports results from the MELP road check in Cache Creek, B.C., at which primarily non-resident anglers were surveyed. Among these the catch success was 0.05 steelhead per hour (1966 and 1967 data combined).

In 1974, 51 anglers were interviewed between September 14 and October 7. Of these, B.C. residents comprised 78.5%, non-resident Canadians 7.8%, and non-residents 13.7% and combined they killed 48.3% of their catch, a total harvest of 143 steelhead (Anon. 1974). By the late 1970s the proportion of resident anglers had increased to the majority. Chudyk (1979) collected creel census data from September 1 to October 29, 1978 from dawn until dusk at Highway 16 and the Copper River Forest Service Road, with periodic interviews of anglers on the river. Anglers were 85.6 % B.C. residents, 9% non-resident Canadians and 5.4% non-residents, and the number of angler days spent by each residency category reflected the proportion of anglers. The proportion of residents was higher (92.2 %) on the Clore River than on the Zymoetz River. In 1979 Chudyk and Whately (1980) again found that residents dominated the fishery. Catch success in the Zymoetz River was 0.21 and 0.15 steelhead/day in 1978 and 1979 respectively, considerably lower than the 0.1 steelhead/hour reported by Taylor (1968) a decade earlier. On the Clore River catch success was 0.32 and 0.27 steelhead/day in 1978 and 1979 respectively. The higher success in the Clore River reflected the focus of local residents on this river.

Chudyk and Whately (1980) report 1979 creel data, but also integrate 1978 creel data and compare it with the SHA for that year. Based on this comparison, the SHA data appears to be an overestimate, however anglers were surveyed by creel census only from September 1 to October 29. This suggests a substantial negative bias in the creel census data, given that Lewynsky and Olmsted (1990) measured in 1989 that 16% of the total fall steelhead angling effort was expended during August. Moreover, the Zymoetz has historically provided a spring steelhead sport fishery, and the creel survey would exclude these data, whereas the SHA would include them. Accordingly, Table 22 cannot be considered to accurately reflect the magnitude of bias in the SHA.

Lewynsky and Olmsted (1990) surveyed Zymoetz anglers from August 15 to October 15, 1989, and recorded 749 days of effort. The greatest effort was recorded during the first half of September. Almost all (94%) of the anglers were non-guided: only 6% were guided. Anglers captured and released an estimated 279 steelhead trout of which 84% were attributed to non-guided and 16% to guided anglers. Catch success was greatest from September 15 to September 30, when river conditions were best for angling. CPUE ranged from 0.042 steelhead per angler hour from August 15 to August 31, to 0.111 steelhead per angler hour from October 1 to October 15. Daily fishing activity followed a normal distribution with a slight shift in peak activity in the early afternoon during August to late morning during September and October (Lewynsky and Olmsted 1990).

Table 22. Comparison of creel census and steelhead harvest analysis estimates of angler days, number of anglers, and angler catch for the Zymoetz and Clore river steelhead fisheries in 1978. Data taken from Chudyk and Whately (1980).

	Creel Census	Steelhead Harvest Analysis	% Difference
Zymoetz River			
Angler days	1,093	3,104	-65.0
Anglers	590	605	-2.5
Kills	117	378	-69.1
Releases	110	588	-81.3
Catch/day	0.21	0.33	-36.4
Clore River			
Angler days	117	231	-49.4
Anglers	60	24	150.0
Kills	17	15	13.3
Releases	20	73	-72.6
Catch/day	0.32	0.39	-18.0

10. REVIEW OF CURRENT ANGLING REGULATIONS

The Zymoetz River lies within Management Unit 6-9 of the Skeena Region (6). For the 1997/1998 angling season, angling regulations restrict steelhead fishing areas, times and methods in the Zymoetz River. Within Skeena Region the general regulations set an annual catch quota of ten steelhead, a monthly catch quota of two steelhead, and a daily catch quota of one. However, within the Skeena watershed only one steelhead may be retained per year. Steelhead are defined as rainbow trout exceeding 50 cm fork length when they occur in the same waters and resident rainbow trout. The Zymoetz River has no specific steelhead kill closure, however, for the past several years a kill ban has been instituted by public notice for the entire Skeena watershed to protect summer steelhead from harvest. Steelhead juveniles are protected from harvest by a minimum 30 cm fork length regulation. In the event of a kill fishery, impacts to steelhead are somewhat reduced by the requirement that when anglers have caught and retained their daily quota of steelhead from any water, they cease angling on those waters for the remainder of the day.

Within the Zymoetz River, angling is banned from McDonell Lake downstream 3 km to signs, between signs in Zymoetz Canyon, and above the signs at the transmission line crossing (below Zymoetz Canyon), between January 1 and June 15. These regulations protect overwintering and spawning adult steelhead from harassment by anglers. Gear restrictions ban the use of all baits and only allow the use of a single hook.

The 1997/1998 regulations improved the protection of steelhead in the Zymoetz River by restricting angling upstream of the transmission line crossing at 6 km, an area within which summer steelhead hold and which was previously open to angling year-round. The angling closure was implemented January 1, 1997.

The Zymoetz River is a “classified water” from September 1 to October 31. This classification requires that anglers purchase a license in addition to the basic angling license the steelhead stamp. There are 42 classified waters in British Columbia. These are denoted as such because they are highly productive streams. B.C. residents wishing to fish classified waters purchase an annual classified waters license, which covers all classified streams. Non-residents must purchase a daily classified waters license specific to the date and water of angling. The Zymoetz is a Class I water above Limonite Creek from September 1 to October 31, and a Class II water below Limonite Creek from September 1 to October 31. The different classes carried different restrictions and license fees.

11. RECREATIONAL FISHERIES

The Zymoetz River provides high quality angling and has recorded an annual steelhead catch in the top ten of B.C. rivers. The quality of the angling experience is distinct from that offered by other well-known rivers in the Skeena drainage because of the location in an area of rapid transition from the interior to coastal biogeoclimatic zones. Steep, rugged topography and the confined channel with attractive canyons distinguish the Zymoetz River from the Bulkley, Babine, Sustut, and Kispiox rivers. Proximity to a major population center in Terrace prompted the moniker 'everyman's river' (Pinsent and Chudyk 1973). A summary written in 1974 on file with the Ministry of Environment, Lands and Parks (Anon. 1974) concludes: "I am in agreement with Pinsent and Chudyk (1973) in their assessment of the Copper as an 'everyman's river'. Ranking in the top ten steelhead producing rivers of B.C. this river has averaged from 1968 to 1974;= .278 steelhead/angler/day. An estimated 1,000 anglers use this system annually, a very high percentage of whom are B.C. residents, a large portion being locals. All this points out the Copper River as a prime recreational resource for a wide range of individuals, and it should be maintained as such."

Angling effort is concentrated near the confluence of the Clore River to a point 10 km upstream. A steelhead resting hole at the fossil beds is the most upstream location accessible from the Copper River Main Forest Service Road, and upstream from this point angling pressure is reduced by the poor access. At the start of the season in August the sport fishery focuses on the lower river downstream of the canyon (Whelpley 1989). The upper Zymoetz River receives the greatest angling pressure later in the summer and early fall, after which angling pressure focuses again on the lower river. Anglers are found throughout the lower river but are concentrated along the lower 2 km. In the early 1990s, some anglers accessed the headwater region of the Zymoetz River by helicopter, and used a local guide during these trips (Lewynsky and Olmsted 1990). However, this is no longer the case (D. Atagi, pers. comm., 1997).

The fishery supports both gear and fly fishers. The percentage of fly anglers has increased since the bait ban was implemented, and at present they comprise the largest group of anglers using the river (Whelpley 1989). In the 1970s the Zymoetz River was considered of questionable value for fly-fishing because of velocity and turbidity, and designation of fly-fishing only areas was not recommended (Anon. 1974). In contrast, Whelpley (1989) concluded that the Zymoetz River was a "superb dry fly river" when water conditions and escapements allow.

Fishing opportunities have declined over the past 20 years. Changes in channel morphology in the Zymoetz River following the floods of 1974 and 1978 and in the Clore River in fall 1992 altered preferred angling locations (G. Llewellyn, pers. comm., 1997). Since 1929 the river has changed tremendously, and that all of the good holding water for steelhead has disappeared (G. Llewellyn, pers. comm., 1997). Angling in the Zymoetz and Clore rivers is highly dependent on turbidity, which is sometimes too great to permit angling. During April 1989 a bank failure on the Clore River prevented successful angling downstream (Whelpley 1989).

There is an extensive sports fishery in the lower Skeena River that may harvest steelhead migrating to the Zymoetz River. This fishery may incur a high rate of mortality on migrating steelhead, as shown in a radio telemetry study on the lower Skeena sport fishery, where 40% of steelhead were fatally hooked. In general, catch and release angling incurs a low rate of mortality, approximately 5% (Hooton 1987).

12. FIRST NATIONS USES/ HARVEST

Zymoetz River steelhead are harvested within First Nations fisheries in the Skeena River. Fixed gill nets are fished throughout the period of steelhead migration, along the margins of the Skeena River at numerous locations downstream of the Zymoetz River. Steelhead are also intercepted by Native food (net) fisheries at Hell's Gate Slough (Braun's Island) and opposite the Kalum River, and in beach seine fisheries for sockeye salmon on the Skeena River downstream of the Zymoetz River on the Skeena (B. Hill, pers. comm., 1997). The harvest of Zymoetz River steelhead within these fisheries has not been measured directly. However, the rate of harvest can be estimated by reference to overall harvest rates on Skeena River steelhead within the lower Skeena River. The majority of native food fisheries catch steelhead upstream of the Zymoetz in the mainstem Skeena (Lough 1988, Tetreau and Spence 1990, Beere 1991) and the harvest of Zymoetz River steelhead may be less than stocks further inland.

Alexander *et al.* (1996) radio-tagged steelhead and examined migration routes and rates as well as capture in First Nations fisheries. None of the tagged fish were recaptured in the Zymoetz River, however, the fish were captured in fishwheels at Kitselas, and Zymoetz River steelhead are unlikely to migrate up the Skeena to this point. As a result, Alexander *et al.* (1996) provides little information about the capture of Zymoetz River steelhead in native fisheries, although it provides excellent data for Skeena steelhead stocks spawning further inland.

No First Nations fisheries are active within the Zymoetz River (Beere 1995). Historically, members of the Kitsumkalum Band harvested fish in the lower river, however the harvest has been inactive for at least ten years (R. Bolton, pers. comm., 1997). The Zymoetz River is within the Kitselas fishing territory, the downstream boundary of which is found at the Skeena Hydro Crossing (M. Bevin, pers.comm., 1997). There was a food fishery (gillnet) opposite the mouth of the Copper over 10 years ago for chinook (May and June) and sockeye (July and August) by both the Kalum and Kitselas bands. Over 20 years ago the lower canyon of the Zymoetz River was fished by gillnet by Henry Bolton, now deceased.

Native harvest of Zymoetz River steelhead has not been quantified. However, the harvest rate on these stocks is probably small compared to steelhead stocks further up-river.

13. REVIEW OF MINIMUM ESCAPEMENT REQUIREMENTS

Minimum escapement estimates were calculated by (Tautz *et al.* 1992) using stream productivity models and inferring survival from empirical studies elsewhere in B.C.. This analysis predicted the number of spawners required at maximum sustained yield was 1,971, which represents 8.7 % of the total Skeena minimum escapement of 22,685. The MSY escapement would produce 3,789 adult recruits.

14. SUMMARY OF CURRENT STOCK STATUS

The escapement and catch of Zymoetz River steelhead has never been quantified accurately, hence a direct assessment of stock status is not possible. Fortunately we can assess stock status indirectly by examining indices of catch in the sport fishery and comparing them to other stocks, by examining basin-wide trends in stock status, and by comparing these trends to information on harvest and changes in habitat condition.

There are a number of assumptions that affect steelhead angler catch data that could influence the results of this analysis. Access to all rivers is not equal, so catch may be lower in remote rivers. Catchability may differ between rivers due to river size, clarity and temperature. Anglers may not disperse to equalize catch success, and these differences may change each year. To partly test these assumptions and provide some confidence in our assessment of stock status through steelhead catch, we compared steelhead success to independent variables likely to indicate steelhead stock size. Data on habitat productive capacity are available, and we expect these to be correlated to steelhead catch. Other factors, such as water temperature, nutrient levels, and interspecific interactions are also important, but we did not examine these. Furthermore, different steelhead stocks may have inherent differences in productivity because of differences in fecundity and growth rate. The assumptions made here demand caution in interpreting the following analysis.

The catch of Zymoetz River steelhead is >4% of the catch in Skeena Region (Table 23), based on data from the SHA for the fiscal years from 1986/87 to 1995/96 (the last ten years of the analysis). Among those steelhead streams with summer run stocks, which are for the most part located upstream of the Zymoetz River confluence, the Zymoetz River catch comprises 8.8% of the total steelhead catch. This catch fraction is 30% larger than the proportion of the basin occupied by the Zymoetz River (6.8%; 3,200 km^2 versus 47,200 km^2), suggesting that the Zymoetz River provides better steelhead habitat than is typically found throughout the basin.

Table 23. Annual angler steelhead catch and annual catch per day in the Skeena Region, Skeena River, and in the Zymoetz River. Data taken from the Steelhead Harvest Analysis.

	Steelhead Catch	CPUE (catch/angler day)
Skeena Region	36,583	0.94
Skeena River	19,122	0.67
Zymoetz / Clore	1,689	0.83
Zymoetz / Clore as:		
% of region	4.6%	
% of Skeena River	8.8%	

In a separate analysis of productive capacity in the Skeena drainage the Zymoetz River was found to provide 9.6% (1.10 million m^2) of the total usable steelhead fry rearing habitat in the Skeena basin (11.4 million m^2, Tautz *et al.* 1992). This comparison suggests that the Zymoetz under-produces by ~10% (9.6% of the fry habitat but only 8.8% of the adult catch).

Comparing the steelhead catch data to estimates of steelhead fry usable rearing habitat from Tautz *et al.* (1992) using linear regression yields a significant relationship (angler catch = 0.36*(Weighted Usable Area in 100 m^2) –561), $R_a^2 = 0.84$, F=44.0, d.f.=1,7, P<0.001), providing evidence for the hypothesis that steelhead parr rearing habitat drives adult production (Figure 13). The linear relationship suggests that 280 m^2 of rearing habitat are required to provide one angler caught steelhead. This figure demonstrates that the Zymoetz River, denoted by the solid symbol, follows the same general relationship as do the other Skeena tributaries plotted (the Babine, Bulkley, Kispiox, Kitseguecla, Kitwanga, Kluatantan, and Sustut rivers and Kleanza Creek). The Zymoetz stock appears slightly less productive than predicted by this relationship; this finding may be a result of measurement error, bias in the SHA, the physical conditions in the Zymoetz River, catch mortality, or a combination of these factors. Note that the productivity compared by this analysis includes habitat productivity and the inherent productivity of the steelhead stocks (e.g. fecundity or growth rate). The intercept of -561 suggests that small streams do not support steelhead, but probably results because anglers do not fish for steelhead in these smaller streams. Steelhead returning to these small streams tend to overwinter in larger rivers and do not migrate into their natal streams until spring, when angling is banned.

The Stream Information Summary System lists a mean escapement of 2,070 steelhead for the Zymoetz River and a maximum escapement of 4,353 over the period from 1963 to 1984, however these numbers merely reflect the average and maximum reported catches from the SHA. In fact, there are no accurate escapement data or population estimates for the Copper River steelhead (M. Beere, pers. comm., 1997). MELP agrees with the SISS escapement of 2,000 fish as a rough approximation, but notes that because all the tributaries have not been thoroughly investigated the spawning population may be larger.

Other indications of the size of the Zymoetz River steelhead population come from radio-telemetry studies. Based on the last known locations of ninety-five summer steelhead, radio-tagged upon entering the Skeena River in 1979, 3% entered the Zymoetz (Lough 1980).

Although no direct commercial fishery exists for Zymoetz steelhead, they are harvested in the Skeena River and approach waters during the sockeye fishery. From 1967 to 1995, the commercial fishery catch has averaged 26,000 steelhead (8,000 to 66,000) and the harvest rate has averaged 65% (31% to 85%) (data taken from Alexander *et al.* 1996). Harvest rates declined through the 1990s with the implementation of management strategies that included reduced fishery durations, altered fishery timings, and the catch and release of gillnet-caught steelhead. These methods were not very effective: for example, in a radio telemetry study 48% of steelhead captured in the gillnet test fishery were dead or died soon after landing (Beere 1991).

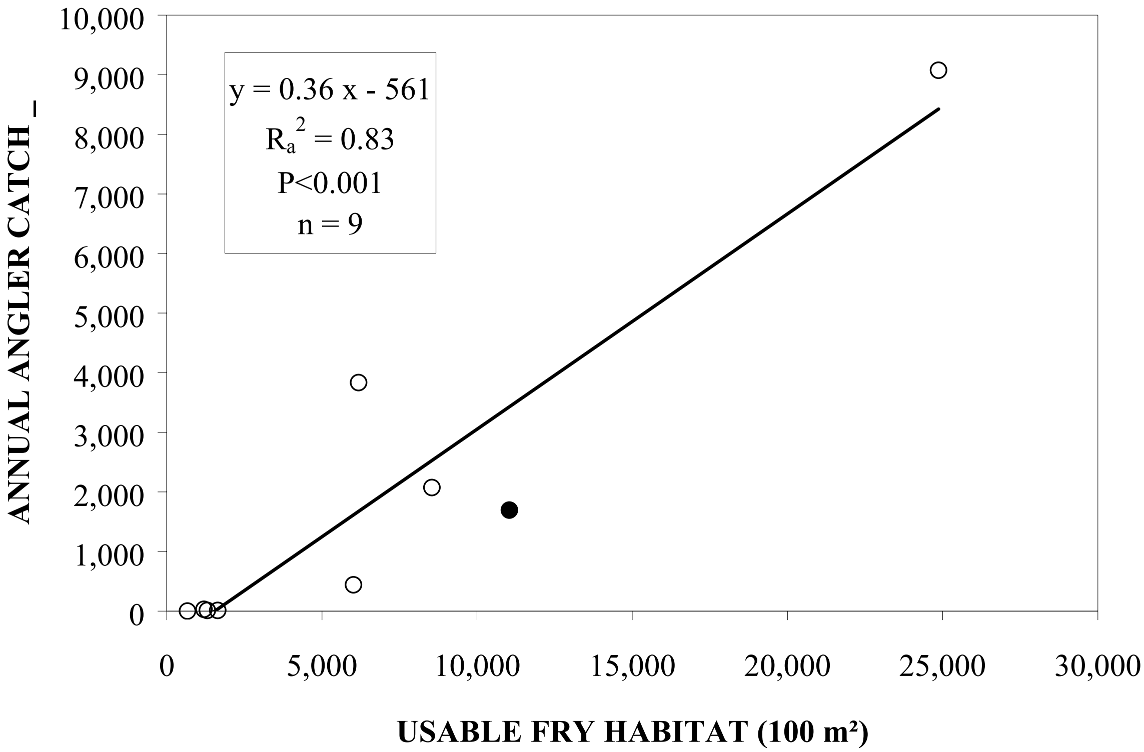


Figure 13. Mean annual steelhead angler catch from the Steelhead Harvest Analysis (from 1986/87 to 1995/96) as a function of usable steelhead fry habitat for the Babine, Bulkley, Kispiox, Kitseguecla, Kitwanga, Kluatantan, Sustut and Zymoetz rivers and Kleanza Creek. The closed symbol represents the Zymoetz River.

Commercial harvest remains the major source of adult mortality. From 1994 to 1996, average summer steelhead harvest rate was 35%, and for early run summer steelhead the harvest rate was 42% (Cox-Rogers 1997). Habitat capacity and survival modelling suggest that Zymoetz River steelhead can withstand an estimated exploitation rate of 48% at maximum sustained yield (Tautz *et al.* 1992). Zymoetz steelhead arrive to the Skeena approach waters earlier than the Skeena summer steelhead aggregate and more closely overlap with sockeye run timing and so may experience greater harvest rates. Cox-Rogers (1994) calculated through simulation modelling that Zymoetz River steelhead experience a harvest rate of 42% in Area 4 (Skeena River mouth and approach waters) while the Skeena summer steelhead aggregate experienced a harvest of only 36%. In addition to these, harvest rates in Alaskan waters may range from 20 to 25% (D. Atagi, pers.comm. 1998), thus exploitation rates may exceed the maximum sustainable estimated by Tautz *et al.* (1992). The early portion of the Zymoetz stock, which is the most valuable for angling, may experience higher harvest rates than the Zymoetz stock as a whole. Commercial interceptions also include emigrating kelts, as demonstrated by radio telemetry. Repeat spawning declined in the Zymoetz River steelhead population between the 1970s and 1980s

(Table 6). The interception of kelts in the commercial fishery partly explain the decline, as may changes in marine productivity or spawning conditions.

Another way to assess the status of the Zymoetz River steelhead stock is to compare trends in angler catch with other Skeena River tributaries. Such comparisons will be affected by changes in catchability associated with poor water conditions and from improved angling technology, methods and access, by changes in harvest rate in commercial and native fisheries, and by angling regulations that restrict the area, time, method, and catch quota for angling. A statistical technique has been used successfully with Pacific salmon to block these influences by contrasting a study river to a factor extracted from a set of other rivers. Bradford (1994) used this technique to identify irregularities in chinook salmon escapement to the Nechako River by standardizing escapement to a mean of zero and a standard deviation of 1, and extracting a factor from a set of nearby chinook salmon populations using principal components analysis. We applied this technique to the Skeena steelhead data, extracting a factor from the catch per unit effort data in the SHA for the Kispiox, Babine, Bulkley, Morice, and Skeena mainstem (the upper Skeena index or USI).

The Skeena summer steelhead stocks display similar time trends in angler catch. In fact, all seven of the rivers with major fisheries, those fisheries that catch 200 steelhead or more annually (the Skeena, Zymoetz, Bulkley, Morice, Kispiox, Babine, and Sustut rivers), were significantly correlated (Table 24). Pearson correlation coefficients ranged from 0.29 to 0.93 over a sample size of 29 years.

Table 24. Correlation matrix of summer steelhead angler catch for seven major Skeena watershed rivers. (n=29, from 1967/68 to 1995/96). Data taken from the Steelhead Harvest Analysis.

	Babine	Bulkley	Kispiox	Morice	Skeena	Sustut	Zymoetz
Zymoetz	0.74	0.86	0.82	0.84	0.76	0.47	
	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	P<0.001	
Sustut	0.40	0.47	0.34	0.47	0.29		
	P<0.001	P<0.001	P<0.001	P<0.001	P=0.027		
Skeena	0.64	0.73	0.84	0.65			
	P<0.001	P<0.001	P<0.001	P<0.001			
Morice	0.71	0.93	0.81				
	P<0.001	P<0.001	P<0.001				
Kispiox	0.82	0.85					
	P<0.001	P<0.001					
Bulkley	0.69						
	P<0.001						

These significant correlations supported the extraction of a factor using a principal components model, in which variables are assumed to be exact linear combinations of factors (SPSS 1995). A single factor was extracted by minimizing the discrepancies between true and estimated factors over each observation. The extracted factor has a mean of 0 and variance equal to the squared multiple correlation between the estimated factor scores and the true factor values.

The extracted factor (the USI) was significantly correlated with Zymoetz River angler catch ($R=0.63$, $n=29$, $P<0.001$). The USI showed a trend to increased angler catch over time, albeit with a major increase in the 1980s followed by a major decrease in the early 1990s (Figure 14). The long-term increasing trend likely results from increased steelhead catchability due to improvements in angling methods, access and technology, increasing angler effort, and increased fish abundance resulting from the catch and release regulation imposed over the past decade. Increased steelhead catchability by anglers masks the effects of commercial and native fishing, and of changes in marine survival.

The correlation of steelhead catch between the Zymoetz River and USI may reflect similarities in factors affecting steelhead survival in freshwater. All stocks have a similar life history, dependent largely on freshwater conditions. A major departure by the Zymoetz data from USI trend could indicate important survival effects. Zymoetz River catch declined to a low in 1980/1981, while the USI increased. The relative decrease in Zymoetz CPUE may reflect the impacts of the October 15, 1974 flood and resultant instream works. The timing of the apparent decline in survival reflects impacts to the 1974 brood, which were 0+ fry at the time of the flood and seven year old fish at the time of the 1980/1981 run. The claims by anglers of impacts to steelhead habitat and survival from the 1974 flood (J. Culp, G. Llewellyn, pers. comm., 1997) are supported by our analysis of the angler catch data.

The consensus among anglers is that the quality of fishing and the escapement of steelhead to the Zymoetz River have declined in the last 25 years (J. Culp, G. Llewellyn, pers. comm., 1997). A quantitative assessment of how much the steelhead populations (summer and winter run) have declined, if at all, cannot be made. However, Figure 14 shows that prior in the 1970s the standardized Zymoetz angler catch was greater than zero (and thus above the long-term average) while the angler catch described in the USI was below zero. Twenty-years later the standardized Zymoetz angler catch is below zero, while angler catch in the USI is above zero. This change in status may reflect increased catches in the other six rivers from increased angling effort, as access to remote rivers like the Sustut has improved. The trend could also reflect a higher harvest rate in commercial fisheries. Regardless, the trend agrees with the angler's consensus of a decline in Zymoetz River steelhead abundance.

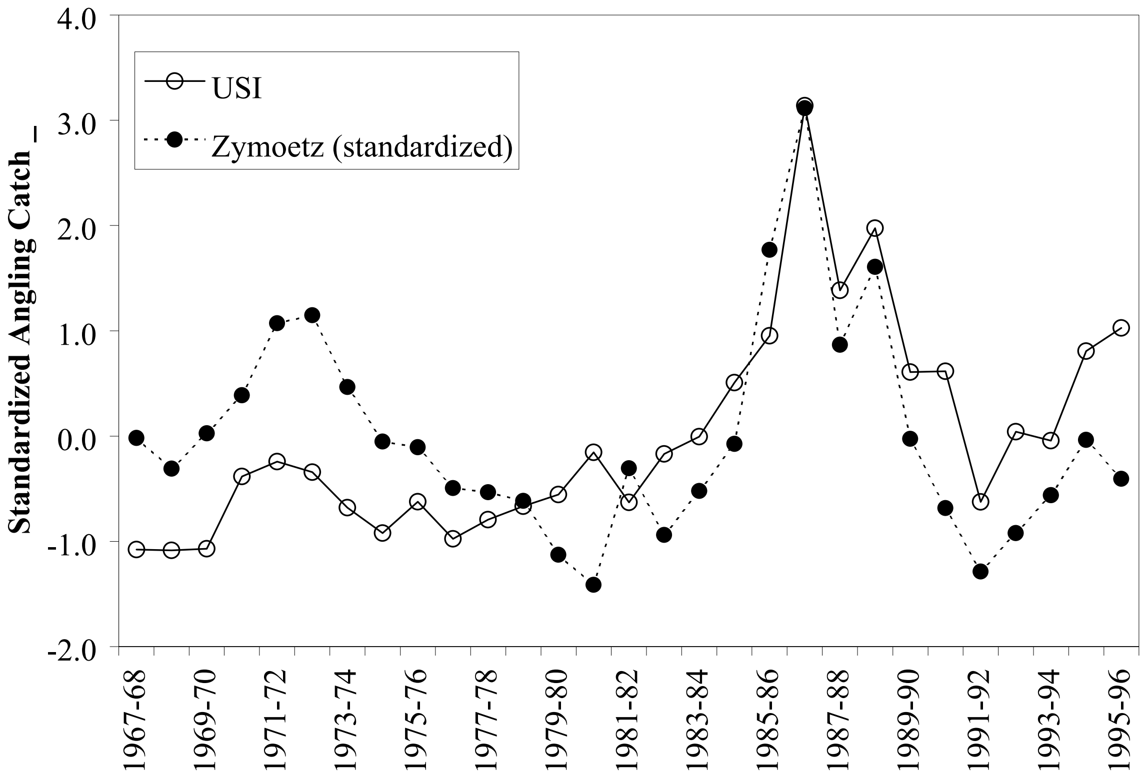


Figure 14. Time trends in steelhead angling catch for the Zymoetz River and five upper Skeena stocks (USI). The data have been standardized to a mean of 0 and standard deviation of 1.

Another source of information against which to compare Zymoetz stock status (as reflected by angler catch) is the test fishing index at Tyee on the lower Skeena River. Gillnets have been set here at specific times in a constant method since 1956, and the number of steelhead and other species of salmon has been recorded with each net set (Anon. 1997). The catch per set over an entire season gives an indication of how many steelhead swim past Tyee, which is upstream of the commercial fishing area and downstream of the sport and aboriginal fisheries on the Skeena River. The catch per set over the entire season is summed, and this total is multiplied by 245, to yield a rough estimate of steelhead escapement. The expansion factor is crucial to this calculation, and has not been verified independently, but does provide an index.

Angler catch of Zymoetz River steelhead was significantly correlated with the Tyee steelhead index from 1967 to 1995 (Pearson R=0.47, n=29, P(1-tail)=0.005). This is further evidence that angler catch provides an index of steelhead abundance in the Zymoetz River. Over the last ten years of available data (from 1986 to 1995) this correlation was higher (Pearson R=0.88, n=10, P(1-tail)<0.001).

Accurate monitoring of fish populations requires an adequate understanding of the timing and spatial distribution of each life history phase. For the Zymoetz River steelhead population this understanding has come only recently, for example the existence of a winter run was known by anglers but not confirmed until Whelpley (1989). Although the evidence presented in this report shows that habitat has been impacted by floods, gas pipeline construction, and forest road construction, it cannot be proven if these impacts have been sufficient to affect steelhead populations. Anglers commented that the variability in steelhead runs had increased in recent years. However, the variation in angler catch and CPUE in the Zymoetz River does not differ much that from other Skeena tributaries (Table 25).

Table 25. Variation in steelhead angler catch and CPUE in Skeena River tributaries from 1986 to 1995. Data taken from the Steelhead Harvest Analysis.

	Coefficient of variation	
	CPUE	Catch
Babine River	0.22	0.29
Bulkley River	0.17	0.42
Kispiox River	0.25	0.48
Morice River	0.23	0.41
Skeena River	0.35	0.97
Sustut River	0.26	0.31
Zymoetz River	**0.20**	**0.73**
Average	0.24	0.52
S.E.	0.01	0.06

Fish habitat quality in the Zymoetz River has declined since at least 1974. A Level 1 Riparian Assessment by RJA Forestry in 1995 concluded that riparian habitat has been substantially reduced in the Zymoetz watershed (Pollard *et al.* 1996). Fire was the largest impact on mature and over mature forests in the watershed, but the authors concluded that forestry activities had a notable destructive impact. Several kilometers of both the lower Zymoetz and the Clore rivers lacked any riparian habitat, and in total only 20% of the original riparian forest existed on the first five reaches of the Zymoetz River and the first three reaches of the Clore River. This suggests that areas of functional large organic debris and associated fish habitat will decline in the future. Other important impacts were the loss of 25 to 30% of the off-channel habitat from road construction, either by isolation from the mainstem or by alienation (Pollard *et al.* 1996).

Apparent damage to fish habitat from high discharge, turbidity and erosion pre-dates forest harvesting activities in the watershed. Extreme floods were noted in the late 1940s, and DFO records high turbidity at this time (Pollard *et al.* 1996). Natural slope failures from 7-8 km on the Clore River and at Red Canyon Creek (a tributary to the Zymoetz River in Reach 7), unstable clay deposits/soils, and glacial silt from Serb Creek and other tributaries combine to increase turbidity. Changes in channel morphology have been accelerated by the harvesting of floodplain forests, road building, rip-rapping and stream channelization (I. Weiland, pers. comm. cited in Pollard *et al.* 1996).

15. MANAGEMENT RECOMMENDATIONS

Our review of stock status has identified commercial fishery harvest as the primary factor influencing Zymoetz River steelhead. Native fisheries operate primarily upstream of the Zymoetz and so do not have an important effect, and sport fisheries operate only during the summer and fall, and are restricted to catch and release. Habitat degradation is apparent, and although catch trends in the Zymoetz follow those in other Skeena tributaries, there was evidence of a general decline, suggesting that the freshwater environment may have degraded or that commercial harvest is greater on Zymoetz River stocks, or both. Simulation models estimate that commercial fishers harvested 42% of adult Zymoetz River steelhead in Area 4 and that total exploitation was 57% (Cox-Rogers 1994). Fishing plans have reduced commercial harvests in Skeena approach waters, however they may remain as high as 32.5% (Cox-Rogers 1997). Given this, our primary management recommendation is to eliminate the commercial harvest of steelhead. This action would increase present steelhead escapements by 48% (based on a 32.5% harvest rate) and allow the full seeding of upstream habitat. Furthermore, the early run component of this stock, that is most valuable to sport anglers, would be protected, since it now migrates concurrent with the sockeye run, which is heavily harvested. Protection from the commercial fishery will enhance the benefits of habitat improvement, since the additional adults produced by these improvements would be partly harvested in the commercial fishery. MELP has been working with DFO for several decades to reduce the commercial harvest of steelhead. The Skeena Watershed Committee is a multi-stakeholder group that prepares fishing plans that can reduce steelhead harvest, while still allowing for commercial fishing. Alternate harvest techniques may allow for selective fishing and the release of steelhead.

Sport fisheries in the Zymoetz River have been regulated to the point that fishing mortality is minimal. The latent mortality from catch and release angling is estimated to be 5% (Hooton 1987), and may be lower in cold water conditions late in the fall when most of the steelhead catch is made. Radio telemetry studies in the Zymoetz River demonstrate that adult steelhead survive angling, handling, and radio-tagging (Beere 1995). A bait ban reduces the chance of mortality by angling (Taylor and White 1992). Summer run steelhead are presently protected from sport fishing during the winter by a closure upstream of 6 km.

Future land use will strongly affect the quality of fish habitat in the Zymoetz watershed. The Bulkley Land and Resource Management Plan has been accepted by the Provincial cabinet and includes special management zones for the Zymoetz River watershed (Anon. 1996). Although a portion of the watershed lies outside of this planning area within the Kalum Forest District (where there is as of yet no similar plan), four management units in the upper Zymoetz River have special status that confers more rigorous environmental protection. These include the Mullwain and Red Canyon watersheds, the Zymoetz mainstem from Mullwain Creek upstream to Aldrich Lake, Silvern Lakes, and the Serb Creek watershed. The mainstem Zymoetz has been designated as Special Management Zone 2 with objectives to maintain fisheries values and riparian ecosystems within a Forest Ecosystem Network. Access will be developed through management plan which will attempt to maintain the quality wilderness angling to meet MELP objectives for classified waters. New permanent roads will be located at least 1 km from the river and new temporary roads within 1 km will be deactivated. Landscapes visible from the river will be considered when preparing development plans. Watershed assessments for areas between McDonell and Dennis Lake, and on Passby Creek have been given priority. Fish habitat will be inventoried and critical spawning areas will be identified. Developments adjacent to critical habitat, such as identified spawning streams and staging areas, will consider fisheries windows. For steelhead these are July 15 – June 15 for adults and from June to September 1 for incubating eggs. The mainstem Zymoetz River from Serb Creek up to Aldrich Lake and Coal, Willow, Sandstone and Passby creeks are recognized as a regionally significant spawning areas for steelhead and sockeye. A survey has been recommended to identify sediment sources that may be impacting these spawning areas.

A Level 1 Riparian Assessment by RJA Forestry in 1995 identified potential sites for habitat restoration (Pollard *et al.* 1996). The west Zymoetz area, located between 8 and 34 km upstream of the Skeena confluence, had the greatest number of forestry-related impacts and the highest priority for restoration (Table 26). The Clore and Kitnayakwa watersheds also had high numbers of impacts. Level II assessments were recommended for Cole Creek, Elf Creek, and the Copper Forest Service Road to evaluate the effects of channelization, riparian vegetation loss, and habitat isolation.

Table 26. Sub-watersheds of the Zymoetz basin with priorities for restoration.

Sub watershed	Number of impacts	Priority
Lower Zymoetz	2	#2
West Zymoetz	23	#1
Clore	7	#4
Kitnayakwa	10	#3
Mattock Creek	1	#7
Limonite	2	#5
Nogold	2	#6

Data taken from Pollard *et al.* 1996

Implementation of the Bulkley Land and Resource Management Plan and watershed restoration actions will protect and improve habitat in the Zymoetz basin. These actions will supplement enhance the effects of other potential management actions such as reduced commercial fishery interception.

Although no data were obtained on the illegal capture of steelhead (poaching) when preparing this report, some poaching of Zymoetz River steelhead is likely. Increased enforcement would reduce the incidence of poaching.

16. FUTURE STUDY RECOMMENDATIONS

Our knowledge of the life history and habitat use of the Zymoetz River steelhead, and the fishery for them, has increased since the late 1970s to the point that the MELP can prepare effective policies to manage the habitat and fishery. Additional information on spawning and rearing areas would assist management if the data were sufficiently quantitative to describe the relative importance of each habitat. Land use practices in each sub-basin of the Zymoetz River could then be tailored to reflect habitat importance. These data will be partly collected during stream inventories under the Forest Practices Code. An ongoing system of capturing and integrating data from forest inventories with the existing data would assist MELP in further defining the relative importance of habitats within the basin, and implementing protective measures.

Radio telemetry has shown that population estimates conducted solely at the McDonell Lake outlet area do not reflect Zymoetz River summer run steelhead escapement. Annual estimates of stock abundance would allow the calibration of the SHA data to create an angling-based index of abundance. Abundance could be estimated by mark-recapture studies using angling to collect fish for tagging, and by snorkel surveys to define recaptures in the spring, prior to the onset of freshet. A portion of the marked fish could be radio-tagged to help focus tag recovery effort.

Rearing habitat in the Zymoetz River has not been completely described. Density data are lacking on major tributaries such as Mullwain and Red Canyon creeks, the Clore and Burnie rivers upstream of their confluence, and on the Zymoetz River and tributaries upstream of McDonell Lake. Density estimates should be made in these reaches to estimate productive capacity.

The Zymoetz River has numerous tributaries with habitat inaccessible to adult steelhead. In the future, if escapements increase, accessible habitats may become fully-seeded. At that time inaccessible habitats could provide additional habitat, potentially increasing steelhead production. The removal of barriers to upstream migration is technically difficult and likely not cost-effective. However, the transport of ripe adult steelhead upstream of the barriers may provide an alternative method of colonizing habitat. This approach to steelhead enhancement is not provincial policy at present (M. Beere, pers. comm., 1997). However, if waters upstream of barriers were barren of all fish, impacts to resident populations through the introduction of steelhead would be avoided. Local anglers may provide the volunteer effort to collect stock for transport. Volunteer effort could be attracted by the offer of angling in the upper Zymoetz River during the late winter, which is presently closed to angling. The fish captured during this program should be radio-tagged to determine if they spawn in target streams. Candidate areas for the transport of adults include Trapline Creek. Should research determine that the Clore and Burnie rivers upstream of their confluence have barren habitat, this too could be used.

17. REFERENCES

Alexander, R.F., K.K. English, and W.R. Koski. 1996. Distribution, timing, and numbers of steelhead returning to the Skeena watershed in 1995. Fisheries Branch, B.C. Ministry of Environment, Lands and Parks.

Anon. 1969. Fish and Game Branch Memorandum: 5 June, 1969. File No 42.02.7.

Anon. 1974. Summary of steelhead angler interviews and list of tagged fish. Ministry of Recreation and Conservation. 42 – 02.

Anon. 1981. Memorandum to File 0524 Zymoetz. Ministry of Environment, Fish and Wildlife Branch, Smithers, B.C..

Anon. 1996. Bulkley Land and Resource Management Plan. Volume: 1, Consensus management direction. Bulkley Valley Community Resources Board and the Bulkley Inter-Agency Planning Team.

Anon. 1997. Tyee test fishery steelhead index summary 1956-1997. M.S. Ministry of Environment, Lands and Parks, Fisheries Branch, Smithers, B.C. December 15, 1997.

Beere, M.C. 1991. Survey of native food fisheries for steelhead in the Skeena River system. B.C. Environment, Skeena Fisheries Report #SK-72.

Beere, M.C. 1993. Juvenile Steelhead surveys in the Kitwanga, Morice and Zymoetz Rivers, 1993. B.C. Environment Skeena Fisheries Report #SK-90.

Beere, M.C. 1995. Movements of Summer Run Steelhead Trout tagged with Radio Transmitters in the Zymoetz River during Spring, 1994. B.C. Environment, Skeena Fisheries Report #SK-93.

Bradford, M.J. 1994. Trends in the abundance of Chinook salmon (*Oncorhynchus tshawytscha*) of the Nechako River, British Columbia. Can. J. Fish. Aquat. Sci. 51:965-972.

Bustard, D. 1992. Juvenile Steelhead Surveys in the Kitwanga, Morice, Sustut and Zymoetz Rivers 1991. Prepared by David Bustard and Associates for B.C. Ministry of Environment, Lands, and Parks, Smithers, B.C..

Bustard, D. 1993. Juvenile Steelhead Surveys in the Kitwanga, Morice, Sustut and Zymoetz Rivers 1992. Prepared by David Bustard and Associates for B.C. Ministry of Environment, Lands, and Parks, Smithers, B.C..

Bustard, D. 1994. Fisheries Assessment of the Upper Kitnayakwa River. Prepared by David Bustard and Associates for Skeena Cellulose Inc. Terrace, B.C..

Bustard, D. 1995. Stream Classification of the Zymoetz River and Tributaries from Treasure to Red Canyon Creek. Prepared by David Bustard and Associates for Skeena Cellulose Inc., Terrace, B.C..

Bustard, D. 1996. Overview Fisheries Assessment of the Lower Clore River and Tributaries. Prepared by David Bustard and Associates for: Skeena Cellulose Inc., Terrace, B.C..

Chudyk, W.E. 1979. Zymoetz River steelhead trout: A preliminary report on the 1978 sport fishery and some aspects of their life history. B.C. Environment, Skeena Fisheries Report #SK-22.

Chudyk, W.E. 1980. Zymoetz River steelhead trout: a progress report on the Zymoetz River enhancement program; specifically the diversion of Serb Creek. B.C. Environment, Skeena Fisheries Report #SK-26.

Chudyk, W.E. and M.R. Whately. 1980. Zymoetz and Clore River steelhead trout: a report on the 1978 and 1979 sport fishery and some aspects of their life history. B.C. Environment, Skeena Fisheries Report #SK-27.

Cox-Rogers, S.F. 1981. Racial analysis of Skeena river steelhead trout (*Salmo gairdneri*) by scale pattern features. M. Sc. Thesis, University of British Columbia, Vancouver, B.C..

Cox-Rogers, S. 1984. Description of a daily simulation model for the Area 4 (Skeena) commercial gillnet fishery. Can. Man. Rep. Fish. Aquat. Sci. 2256. 46 p.

Cox-Rogers, S. 1997. Post-season review of 1997 Area 3/4/5 Skeena sockeye, coho, and steelhead harvest rates. Memorandum, DFO, Stock Assessment Division, Prince Rupert, B.C..

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Bd. Can., Bulletin 180, 740 p.

Hooton, R.S. 1997. Catch and release as a management strategy for steelhead in British Columbia. p. 143-156. In: R.A. Barnhardt and T.D. Roelofs (Ed.). Catch and release fishing, a decade of experience. California Cooperative Fishery Research Unit, Humboldt State University. Arcata, CA.

Humphries, D.H. and C. Morley. 1978. A fisheries survey of the upper Zymoetz River system (headwaters to Red Canyon Creek) with particular reference to steelhead and cutthroat trout habitat and enhancement opportunities. B.C. Environment, Skeena Fisheries Report #SK-21.

Jensen, A.J. and B.O. Johnsen. 1982. Difficulties in aging Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) from cold rivers due to lack of scales as yearlings. Can. J. Fish. Aquat. Sci. 39(2): 321-325.

Koo, T.S.Y. 1962. Age designation in salmon, p. 41-48. In: T.S.Y. Koo (Ed.). Studies of Alaska red salmon. Univ. Wash. Publ. Fish. New Ser.1

Lewynsky, V.A. and W. R. Olmsted. 1990. Angler Use and Catch Surveys of the Lower Skeena, Zymoetz (Copper), Kispiox and Bulkley River Steelhead Fisheries, 1989 (Draft). Prepared for ESL Environmental Sciences Ltd., Vancouver, B.C..

Lough, M.J. 1979. Radio telemetry studies of summer run steelhead trout in the Skeena River, 1978, with particular reference to equipment and capture methods. B.C. Environment, Skeena Fisheries Report #SK-24.

Lough, M.J. 1980. Radio telemetry studies of summer run steelhead trout in the Skeena River drainage, 1979, with particular reference to Morice, Suskwa, Kispiox and Zymoetz River stocks. B.C. Environment, Skeena Fisheries Report #SK-29.

Lough, M.J. 1981. Commercial interceptions of steelhead trout in the Skeena River - radio telemetry studies of stock identification and rates of migration. B.C. Environment, Skeena Fisheries Report #SK-32.

Lough, M.J. 1983. Radio telemetry studies of summer steelhead trout in the Cranberry, Kispiox, Kitwanga and Zymoetz Rivers and Toboggan Creek, 1980. B.C. Environment, Skeena Fisheries Report #SK-33.

Lough, M.J. 1988. M.S. Skeena net survey – preliminary report of Native food fishing effort on the Skeena River in 1987. B.C. Min. Envir., Fish and Wildl. Br., Skeena Fisheries Report #SK-61.

Maher, F.P. 1961. Memorandum on file, Game Department. MELP, Smithers, B.C. Cited in Bustard 1995.

Narver, D.W. 1969. Age and size of steelhead trout in the Babine River, B.C.. J. Fish. Res. Bd. Can. 26: 2751-2760.

Narver, D.W. and F.C. Withler. 1971. Age and size of steelhead trout (S*almo gairdneri*) in angler's catches from Vancouver Island B.C. streams. Pacific Biol. Stn. Circ. 91.

Parker, R.R. and P.A. Larkin. 1959. A concept of growth in fishes. J. Fish. Res. Bd. Can. 16: 721-745.

Parkinson, E.A. 1984. Genetic variation in populations of steelhead trout (*Salmo gairdneri*) in British Columbia. Can. J. Fish. Aquat. Sci. 41: 1412-1420.

Pinsent, M.E. and W.E. Chudyk. 1973. An outline of the steelhead of the Skeena River system. Unpubl. M.S. Fish and Wildlife Branch, Prince George, B.C. 26 p. and appendices.

Pollard, B.T., J. Quigley, and S. Campagna. 1996. Level 1 Fisheries Assessment for the Zymoetz River. Prepared for: The Copper River Watershed Partnership Group, Terrace, B.C..

Ptolemy, R.A. 1979. Some Biological Consideration for the Proposed Serb Creek (Upper Zymoetz River Tributary) Diversion Project. Fish Habitat Improvement Unit, Fish and Wildlife Branch, Ministry of Environment, Lands, and Parks, Victoria, B.C..

Schultze, G.C. and M.J. Lough. 1987. Survival rates of fry released in the headwaters of Suskwa and Zymoetz Rivers. A Preliminary Assessment. B.C. Environment, Skeena Fisheries Report #SK-63.

Seredick, R.W. 1969. Research – Fish – Steelhead – Copper River. Fish and Wildlife Branch Memorandum 42.02.7, June 5, 1969.

Shapovalov, L., and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*). California Dept. Fish and Game, Fish Bull. No. 98: 379 p.

Silverman, B.W. 1986. Density estimation for statistics and data analysis. Chapman and Hall, New York. 175 p.

Spence, C.R. 1989. Movement of Skeena River steelhead trout through salt water and inland fisheries, 1988. B.C. Environment, Skeena Fisheries Report #SK-62.

SPSS Inc. 1995. SPSS for Windows. Statistical software manual V. 6.1.3.

Tautz, A.F., B.R. Ward, and R.A. Ptolemy. 1992. Steelhead trout productivity and stream carrying capacity for rivers of the Skeena drainage. Pacific Stock Assessment Review Committee, Working Paper S92-6 and 8.

Taylor, G.D. 1968. Report on preliminary survey of steelhead of Skeena River drainage streams. Manuscript prepared by Regional Fisheries Biologist, Fish and Wildlife Branch, Prince George, B.C.. 41 p.

Taylor, M.J. and K.R. White. 1992. A meta-analysis of hooking mortality of non-anadromous trout. North American Journal of Fisheries Management 12:760-767.

Tetreau, R. and C. Spence. 1990. Survey of Native Food Fisheries for Steelhead in the Skeena River system, 1989. B.C. Environment, Skeena Fisheries Report #SK-68.

Tredger, C.D. 1984. Zymoetz River fry stocking assessment. Unpubl. Reconnaissance Report, B.C. Fish and Wildlife Branch, Victoria, B.C.. 49 p.

Triton Environmental Consultants Ltd. 1998. Bulkley Forest District Stream Inventory, Working Unit 11, Zymoetz River watershed: Prepared for Pacific Inland Resources Ltd., Smithers, B.C..

Wadley, G. 1981. Zymoetz River Steelhead Trout: A report on future sites for steelhead fry colonization between Aldrich, Dennis and McDonell Lakes. Skeena Fisheries File Report. B.C. Fish and Wildlife Branch, Smithers, B.C..

Ward, B.R., A.F. Tautz, S. Cox-Rogers, and R.S. Hooton. 1993. Migration timing and harvest rates of steelhead trout populations of the Skeena River system. PSARC Working Paper S93-06.

Whately, M.R. 1977. Kispiox River steelhead trout: the 1975 Sport Fishery and Life History Characteristics from Angler's Catches. B.C. Fisheries Technical Circular No. 36.

Whately, M.R. 1979. Steelhead production targets. Ministry of Environment letter to the Fisheries and Oceans, File 1621/XR1020/XR0542, 2p.

Whelpley, M. 1989. Copper (Zymoetz) River Steelhead Radio Telemetry, November 1988 to June 1989. Northwest Chapter of the Steelhead Society of British Columbia, Terrace, B.C..

Withler, I.L. 1966. Variability in life history characteristics of steelhead trout *(Salmo gairdneri*) along the Pacific Coast of North America. J. Fish. Re. Bd. Canada. 23: 365-393.

18. LIST OF PERSONAL COMMUNICATIONS

Atagi, Dana. Senior Fisheries Biologist, Fisheries Branch, Ministry of Environment, Lands and Parks, Smithers, B.C., pers. comm., 1997.

Beere, Mark. Fisheries Biologist, Fisheries Branch, Ministry of Environment, Lands and Parks, Smithers, B.C., pers. comm., 1997.

Bevin, Mel. Chief Councilor, Kitselas Band, Terrace, B.C., pers. comm., 1997.

Bolton, Russell. Senior Fisheries Technician, Kitsumkalum Band, Terrace, B.C., pers. comm., 1997.

Culp, Jim. Hatchery Manager, Deep Creek Hatchery, Terrace, B.C., pers. comm., 1997

Gordon, Dave. Manager, Northern Operations, Triton Environmental Consultants Ltd., Terrace, B.C., pers. comm., 1998.

Hebden, Bryan. Environmental Biologist, Power Supply, B.C. Hydro, Kamloops, B.C., pers. comm., 1997.

Hill, Bruce. Past President, Steelhead Society of British Columbia, Terrace, B.C., pers. comm., 1997.

Llewellyn, Gene. Angler, Terrace, B.C., pers. comm., 1997.

Nickolls, Steve. Angling Guides Association, Terrace, B.C., pers. comm., 1997.

Tetreau, Ron. Fisheries Technician, Fisheries Branch, Ministry of Environment, Lands and Parks, Smithers, B.C., pers. comm., 1997.

Weiland, I. pers. comm., cited in Pollard *et al.* 1996.

APPENDICES

APPENDIX 1. Scale and fork length data for Zymoetz River steelhead.

APPENDIX 2. Hatchery fry stocking record For Zymoetz River steelhead.

APPENDIX 3. Tagging data summary for Zymoetz River steelhead.

APPENDIX 3. TAGGING DATA SUMMARY FOR ZYMOETZ RIVER STEELHEAD.
Note: R1 = First recapture, R2 = Second recapture, ID. = Identification, LOC. = Location.
Data include fish marked with spaghetti, anchor, floy, and/or radio tags.

TAG #	SEX	LENGTH	TAG DATE	TAG LOC.	TAG LOC. DETAILS	TAG GEAR	TAGGER ID.	R1 DATE	R1 LOC.	R1 LOC. DETAILS	R1 FATE	R1 ID.	R1 GEAR	R2 DATE	R2 LOC.	R2 LOC. DETAILS
74	M		31-Oct-79	ZY	Clore River			24-Nov-79	ZY	Clore, 16km	R					
01974 / 01975	F		31-Oct-79	ZY	Clore, 8-10 km			22-Nov-79	ZY	Clore, 8.5km	R					
19	F		31-Oct-79	ZY	Clore River				SK	mouth of Telegraph skeena pass	K		AN			
69	M		31-Oct-79	ZY	Zymoetz River			10-Feb-80	ZY	Zymoetz 24km	K					
333	F		30-Apr-81	ZY	Upper Zymoetz			09-Aug-82	SK	Dundas Island	K					
784	F	762	30-Apr-83	ZY	Upper Zymoetz			16-Jul-84	SK	Commercial Gillnet.	K					
756	M	826	30-Apr-83	ZY	Upper Zymoetz			08-Aug-84		Ocean, Area 16-20, Commerical Seine	K					
748	M	610	30-Apr-83	ZY	Upper Zymoetz			02-Aug-84	SK	Skeena	K	Commercial				
769	F	762	30-Apr-83	ZY	Upper Zymoetz			16-Jun-83	SK	Skeena, (Inverness Pass)	K	Commercial				
752	F	762	30-Apr-83	ZY	Upper Zymoetz				SK	Skeena, Gillnet.	K					
771	F	737	30-Apr-83	ZY	Upper Zymoetz			23-Aug-83	SK	Skeena, Test fishery	K					
731	F	762	30-Apr-83	ZY	Upper Zymoetz			12-Aug-83	SK	Skeena, Test fishery	K					
719	F	787	30-Apr-83	ZY	Upper Zymoetz			30-Sep-84	ZY	Zymoetz	R					
265	M	32	30-Apr-87	ZY	Zymoetz, Judges			01-May-87	unknown	unknown	unknown	unknown				
196	F	838	30-Apr-87	ZY	Zymoetz, Judges			29-May-87	ZY	Zymoetz Judges						
02782	F	87	08-Aug-89	SK	Esker Bar		R BROWN	10-Sep-89	ZY	Lower End	K	Werner Pielenz				
02150	M	76	27-Jul-90	SK	Old Remo		A ZAGLAUER	19-Nov-90	ZY	~4km d/s Red Canyon Creek	R	MARK BEERE				
05002	F	73	19-Nov-90	ZY	~4km d/s Red Canyon Creek		F&W									
05003	F	73	19-Nov-90	ZY	u/s TREASURE CR.		F&W									
01985	M	83	11-Apr-91	ZY	Kitnayakwa Creek Confluence		M BEERE									
01979	F	76	11-Apr-91	ZY	Kitnayakwa Creek Confluence		M BEERE									
01987	F	88	11-Apr-91	ZY	Kitnayakwa Creek Confluence		M BEERE									
01989	F	74	11-Apr-91	ZY	Kitnayakwa Creek Confluence		M BEERE									
01990	M	75	11-Apr-91	ZY	Kitnayakwa Creek Confluence		M BEERE									
02975	F	74	23-May-91	ZY	McDonell Lake Outlet		F&W									
02976	M	93	23-May-91	ZY	McDonell Lake Outlet		F&W									
02977	F	78	23-May-91	ZY	McDonell Lake Outlet		F&W									
02978	F	77	23-May-91	ZY	McDonell Lake Outlet		F&W									
01681	M	76	23-May-91	ZY	McDonell Lake Outlet		F&W									
02090	M	93	23-May-91	ZY	McDonell Lake Outlet		F&W									
02089	M	76	23-May-91	ZY	McDonell Lake Outlet		F&W									
02024	M	86	23-May-91	ZY	McDonell Lake Outlet		F&W									
02023	F	77	23-May-91	ZY	McDonell Lake Outlet		F&W									
01682	M	59	23-May-91	ZY	McDonell Lake Outlet		F&W									
01683	F	70	23-May-91	ZY	McDonell Lake Outlet		F&W									
02086	M	83	23-May-91	ZY	STEELHEAD HOLE		F&W									
02000	M	84	23-May-91	ZY	STEELHEAD HOLE		F&W									
02018	M	84	23-May-91	ZY	STEELHEAD HOLE		F&W									
02087	M	69	23-May-91	ZY	STEELHEAD HOLE		F&W									
02022	F	76	23-May-91	ZY	STEELHEAD HOLE		F&W									
02021	M	78	23-May-91	ZY	STEELHEAD HOLE		F&W									
02020	F	84	23-May-91	ZY	STEELHEAD HOLE		F&W									
02019	F	76	23-May-91	ZY	STEELHEAD HOLE		F&W									
02088	F	71	23-May-91	ZY	STEELHEAD HOLE		F&W									
01999	F	79	23-May-91	ZY	u/s JUDGES HOLE		F&W									
01998	M	75	11-Apr-91	ZY	u/s Kitnayakwa Creek		M BEERE									

ZY	u/s Kitnayakwa Creek		M BEERE									
ZY	u/s Kitnayakwa Creek		M BEERE									
ZY	u/s Kitnayakwa Creek		M BEERE									
ZY	u/s Kitnayakwa Creek		M BEERE									
ZY	u/s Kitnayakwa Creek		M BEERE									
3-?	Hogan Island	TS	920805160031	28-Feb-93	ZY	Copper River,Mile 37	R	Kent Lowe	AN			
3-01	Dundas Island, Goose Bay	TS	930301101812	25-Aug-92	ZY	Lower Copper	R	Glen Bannister	AN			
4-07	1/2 mile N. of Slippery Rock	TG	920813093325	01-Aug-92	ZY	Gravy Hole,Rawlins Run	R	Robert Brown	AN			
4-12	Smith Island	TG	920828085933	08-Mar-96	ZY	11 Mile,Copper river	R	Larry Zelinski	AN	92/03/23	ZY	confluence Copper/Skeena
4-12	Smith Island	UO	920908151629	14-Feb-93	ZY	2 mi u/s Copper bridge	R	Dave Marek	AN			
4-12	Kitson Island	TG	920908145336	92/??/??	SK	China bar	R	Don Eliuk	AN	93/03/17	ZY	copper River
4-12	Smith Island	TG	920908151629	19-Feb-93	ZY	Copper River	R	Keith Williams	AN			
BU	1.5 Mile u/s Suskwa Bridge	AN	920911162433	19-Sep-93	ZY	km 79, upper copper	R	keith Douglas	AN			
SW		UO	930114112658	13-Feb-93	ZY	Copper River	R	Lloyd Franks	AN			
3-04	Birnie Island , south end	TS	920824152054	28-Dec-93	ZY	kitnayakwa	R	Arnie Parent	AN			
4-15	Claxton	TG	920710110940	26-Dec-93	ZY	Clore Confluence	R	Arnie Parent	AN			
4-15	Claxton	TG	920710110940	20-Oct-93	ZY	u/s 2nd Canyon,Madson Creek	R	Mike Whelpley	AN			
SK	Old Remo	AN	920807131336	22-Sep-93	ZY	45 km. end of road	R	Werner Pieleuz	AN			
ZY	d/s Kitnayakwa Creek	AN	R TETREAU									
ZY	d/s Kitnayakwa Creek	AN	R TETREAU									
ZY	d/s Kitnayakwa Creek	AN	R TETREAU									
ZY	d/s Kitnayakwa Creek	AN	M BEERE									
ZY	Fossil Beds	AN	R TETREAU									
ZY	Fossil Beds	AN	R TETREAU									
ZY	Fossil Beds	AN	R TETREAU									
ZY	Fossil Beds	AN	R TETREAU									
ZY	Fossil Beds	AN	R TETREAU									
ZY	Leaning Cedar Tree	AN	R TETREAU									
ZY	Rum Hole	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s Kitnayakwa Creek	AN	M BEERE									
ZY	u/s NoGold Creek	AN	R TETREAU									
ZY	u/s Treasure Creek	AN	M BEERE									
ZY	u/s Treasure Creek	AN	M BEERE									
ZY	u/s Treasure Creek	AN	R TETREAU									
ZY	Fossil Beds	AN	R TETREAU	11-Dec-93	ZY	36 km. on Copper Rd.	R	Dan Giallonardo	AN			
ZY	Fossil Beds	AN	R TETREAU	11-Dec-93	ZY	36 km. on Copper Rd.	R	Dan Giallonardo	AN			
ZY	u/s Treasure Creek	AN	M BEERE	11-Dec-93	ZY	36 KM. on Copper Rd.	R	Dan Giallonardo	AN			
ZY	u/s Treasure Creek	AN	M BEERE	11-Dec-93	ZY	36 KM. on Copper Rd.	R	Dan Giallonardo	AN			
ZY	u/s Kitnayakwa Creek	AN	M BEERE	16-Dec-93	ZY	u/s Clore Confluence	R	Noel Gyger	AN			
ZY	u/s Kitnayakwa Creek	AN	M BEERE	16-Dec-93	ZY	u/s Clore Confluence	R	Noel Gyger	AN			
ZY	u/s Treasure Creek	AN	R TETREAU	19-Dec-93	ZY	u/s Clore Confluence	R	Noel Gyger	AN			
ZY	u/s Treasure Creek	AN	R TETREAU	19-Dec-93	ZY	u/s Clore Confluence	R	Noel Gyger	AN			
ZY	Fossil Beds	AN	R TETREAU	27-Dec-93	ZY	u/s Clore River	R	Clayton Harker	AN			
ZY	Fossil Beds	AN	R TETREAU	27-Dec-93	ZY	u/s Clore River	R	Clayton Harker	AN			
4-01	Jackel Point			20-Feb-95	ZY	Zymoetz River						
4-12	W Smith Island			22-Feb-95	ZY	1 km d/s Clore						
4-12	Smith Island			23-Aug-94	ZY	Lower Zymoetz						
4-13	Simpson Rock, Brown Pass.			03-Sep-95	ZY	Clore Confluence						
ZY	u/s Kitnayakwa Creek 1 km			01-May-96		41 km						
3-03	Dundas/ Hogan Pt.			02-Dec-95		lower river						
SW				28-Mar-96		36 KM.						
ZY	d/s Kitnayakwa Creek			27-Mar-96		30 km (Clore River)						
ZY	d/s Kitnayakwa Creek			29-Mar-96		Road run u/s Clore						
ZY	d/s Kitnayakwa Creek			18-Mar-95		upstream clore						
ZY	d/s Kitnayakwa Creek			18-Mar-95		upstream Clore						
				31-Mar-93	ZY	Copper river	R	Walt Bibby	AN			

APPENDIX 4. Steelhead Harvest Analysis for the Zymoetz and Clore rivers.

APPENDIX 4. STEELHEAD HARVEST ANALYSIS FOR ZYMOETZ AND CLORE RIVERS.

STREAM NAME	FISCAL YEAR	RESIDENT AREA NO.	RESIDENT AREA NAME	NO. ANGLERS	DAYS FISHED	WILD KEPT	WILD RELEASED	HATCHERY KEPT	HATCHERY RELEASED	TOTAL KEPT	TOTAL RELEASED	TOTAL CATCH	CPUE
ZYMOETZ RIVER	1967-68	A	All Resident areas	965	4312	1495	0	0	0	1495	0	1495	0.35
ZYMOETZ RIVER	1968-69	A	All Resident areas	984	4017	1236	0	0	0	1236	0	1236	0.31
ZYMOETZ RIVER	1969-70	A	All Resident areas	1316	5558	1534	0	0	0	1534	0	1534	0.28
ZYMOETZ RIVER	1970-71	A	All Resident areas	1223	4865	1020	834	0	0	1020	834	1854	0.38
ZYMOETZ RIVER	1971-72	A	All Resident areas	977	4158	1340	1119	0	0	1340	1119	2459	0.59
ZYMOETZ RIVER	1972-73	A	All Resident areas	1142	4927	1432	1095	0	0	1432	1095	2527	0.51
ZYMOETZ RIVER	1973-74	A	All Resident areas	1080	4427	1162	762	0	0	1162	762	1924	0.43
ZYMOETZ RIVER	1974-75	A	All Resident areas	1000	4926	813	651	0	0	813	651	1464	0.30
ZYMOETZ RIVER	1975-76	A	All Resident areas	888	3651	786	630	0	0	786	630	1416	0.39
ZYMOETZ RIVER	1976-77	A	All Resident areas	810	3100	655	418	0	0	655	418	1073	0.35
ZYMOETZ RIVER	1977-78	A	All Resident areas	686	3349	625	413	0	0	625	413	1038	0.31
ZYMOETZ RIVER	1978-79	A	All Resident areas	605	3104	378	588	0	0	378	588	966	0.31
ZYMOETZ RIVER	1979-80	A	All Resident areas	511	2302	262	250	0	0	262	250	512	0.22
ZYMOETZ RIVER	1980-81	A	All Resident areas	248	1382	117	141	0	0	117	141	258	0.19
ZYMOETZ RIVER	1981-82	A	All Resident areas	240	1816	184	1024	9	23	193	1047	1240	0.68
ZYMOETZ RIVER	1982-83	A	All Resident areas	324	1531	260	406	5	7	265	413	678	0.44
ZYMOETZ RIVER	1983-84	0	NON CANADIAN	6	33	15	15	0	0	15	15	30	0.91
ZYMOETZ RIVER	1983-84	1	VANCOUVER ISLAND	9	17	0	4	0	0	0	4	4	0.24
ZYMOETZ RIVER	1983-84	2	LOWER MAINLAND	35	118	28	47	0	0	28	47	75	0.64
ZYMOETZ RIVER	1983-84	6	SKEENA	241	1175	208	514	4	12	212	526	738	0.63
ZYMOETZ RIVER	1983-84	7	OMINECA-PEACE	41	114	31	97	0	0	31	97	128	1.12
ZYMOETZ RIVER	1983-84	8	OKANAGAN	3	3	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1983-84	9	NON-RESIDENT CANADIAN	42	78	33	24	0	16	33	40	73	0.94
ZYMOETZ RIVER	1984-85	0	NON CANADIAN	26	87	17	50	0	2	17	52	69	0.79
ZYMOETZ RIVER	1984-85	1	VANCOUVER ISLAND	10	14	0	3	0	0	0	3	3	0.21
ZYMOETZ RIVER	1984-85	2	LOWER MAINLAND	42	96	6	29	0	0	6	29	35	0.36
ZYMOETZ RIVER	1984-85	4	KOOTENAYS	3	11	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1984-85	5	CARIBOO-CHILCOTIN	3	7	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1984-85	6	SKEENA	285	2012	221	1050	0	3	221	1053	1274	0.63
ZYMOETZ RIVER	1984-85	7	OMINECA-PEACE	32	82	9	44	0	0	9	44	53	0.65
ZYMOETZ RIVER	1984-85	8	OKANAGAN	5	38	5	0	0	0	5	0	5	0.13
ZYMOETZ RIVER	1984-85	9	NON-RESIDENT CANADIAN	24	37	2	4	0	0	2	4	6	0.16
ZYMOETZ RIVER	1985-86	0	NON CANADIAN	71	448	11	343	0	23	11	366	377	0.84
ZYMOETZ RIVER	1985-86	1	VANCOUVER ISLAND	28	170	4	290	0	0	4	290	294	1.73
ZYMOETZ RIVER	1985-86	2	LOWER MAINLAND	45	174	39	174	0	0	39	174	213	1.22
ZYMOETZ RIVER	1985-86	3	THOMPSON-NICOLA	15	61	9	26	0	0	9	26	35	0.57
ZYMOETZ RIVER	1985-86	4	KOOTENAYS	6	43	28	28	0	0	28	28	56	1.30
ZYMOETZ RIVER	1985-86	5	CARIBOO-CHILCOTIN	6	19	6	0	0	0	6	0	6	0.32
ZYMOETZ RIVER	1985-86	6	SKEENA	351	2715	279	1595	4	0	283	1595	1878	0.69
ZYMOETZ RIVER	1985-86	7	OMINECA-PEACE	53	144	13	103	0	0	13	103	116	0.81
ZYMOETZ RIVER	1985-86	8	OKANAGAN	8	14	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1985-86	9	NON-RESIDENT CANADIAN	45	111	18	71	0	13	18	84	102	0.92
ZYMOETZ RIVER	1986-87	0	NON CANADIAN	104	715	19	717	0	6	19	723	742	1.04
ZYMOETZ RIVER	1986-87	1	VANCOUVER ISLAND	20	351	8	251	0	8	8	259	267	0.76
ZYMOETZ RIVER	1986-87	2	LOWER MAINLAND	74	263	46	277	0	23	46	300	346	1.32
ZYMOETZ RIVER	1986-87	3	THOMPSON-NICOLA	9	54	9	16	0	0	9	16	25	0.46
ZYMOETZ RIVER	1986-87	5	CARIBOO-CHILCOTIN	10	21	3	0	0	0	3	0	3	0.14
ZYMOETZ RIVER	1986-87	6	SKEENA	524	3853	439	2091	4	17	443	2108	2551	0.66
ZYMOETZ RIVER	1986-87	7	OMINECA-PEACE	62	170	13	252	0	0	13	252	265	1.56
ZYMOETZ RIVER	1986-87	9	NON-RESIDENT CANADIAN	48	135	15	55	0	0	15	55	70	0.52
ZYMOETZ RIVER	1987-88	0	NON CANADIAN	69	587	4	287	0	4	4	291	295	0.50
ZYMOETZ RIVER	1987-88	2	LOWER MAINLAND	32	65	12	101	0	0	12	101	113	1.74
ZYMOETZ RIVER	1987-88	3	THOMPSON-NICOLA	9	30	6	15	0	0	6	15	21	0.70
ZYMOETZ RIVER	1987-88	4	KOOTENAYS	9	36	3	0	0	0	3	0	3	0.08
ZYMOETZ RIVER	1987-88	6	SKEENA	393	2080	187	1526	0	0	187	1526	1713	0.82
ZYMOETZ RIVER	1987-88	7	OMINECA-PEACE	65	145	10	69	0	0	10	69	79	0.54
ZYMOETZ RIVER	1987-88	8	OKANAGAN	3	6	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1987-88	9	NON-RESIDENT CANADIAN	22	51	12	43	0	0	12	43	55	1.08
ZYMOETZ RIVER	1988-89	0	NON CANADIAN	97	402	27	456	6	14	33	470	503	1.25
ZYMOETZ RIVER	1988-89	1	VANCOUVER ISLAND	10	20	0	30	0	0	0	30	30	1.50
ZYMOETZ RIVER	1988-89	2	LOWER MAINLAND	94	278	27	349	0	0	27	349	376	1.35
ZYMOETZ RIVER	1988-89	3	THOMPSON-NICOLA	7	11	0	0	0	0	0	0	0	0.00
ZYMOETZ RIVER	1988-89	4	KOOTENAYS	7	29	7	0	0	0	7	0	7	0.24
ZYMOETZ RIVER	1988-89	5	CARIBOO-CHILCOTIN	14	27	0	7	0	0	0	7	7	0.26
ZYMOETZ RIVER	1988-89	6	SKEENA	399	2213	126	1798	0	0	126	1798	1924	0.87
ZYMOETZ RIVER	1988-89	7	OMINECA-PEACE	46	127	8	61	4	0	12	61	73	0.57
ZYMOETZ RIVER	1988-89	8	OKANAGAN	11	11	4	0	0	0	4	0	4	0.36
ZYMOETZ RIVER	1988-89	9	NON-RESIDENT CANADIAN	32	34	3	8	0	0	3	8	11	0.32
ZYMOETZ RIVER	1989-90	0	NON CANADIAN	50	191	0	111	0	0	0	111	111	0.58
ZYMOETZ RIVER	1989-90	1	VANCOUVER ISLAND	24	76	0	208	0	0	0	208	208	2.74
ZYMOETZ RIVER	1989-90	2	LOWER MAINLAND	80	192	0	88	0	0	0	88	88	0.46
ZYMOETZ RIVER	1989-90	3	THOMPSON-NICOLA	10	48	0	31	0	0	0	31	31	0.65

RESIDENT AREA NAME	NO. ANGLERS	DAYS FISHED	WILD KEPT	WILD RELEASED	HATCHERY KEPT	HATCHERY RELEASED	TOTAL KEPT	TOTAL RELEASED	TOTAL CATCH	CPUE
KOOTENAYS	5	24	0	5	0	0	0	5	5	0.21
CARIBOO-CHILCOTIN	10	14	3	0	0	0	3	0	3	0.21
SKEENA	209	1118	43	921	4	0	47	921	968	0.87
OMINECA-PEACE	14	32	0	7	0	0	0	7	7	0.22
OKANAGAN	4	4	0	4	0	0	0	4	4	1.00
NON-RESIDENT CANADIAN	27	81	2	46	0	15	2	61	63	0.78
NON CANADIAN	73	338	7	216	0	0	7	216	223	0.66
VANCOUVER ISLAND	8	19	0	23	0	0	0	23	23	1.21
LOWER MAINLAND	41	81	0	49	0	0	0	49	49	0.60
SKEENA	206	795	15	506	0	8	15	514	529	0.67
OMINECA-PEACE	26	40	0	0	0	0	0	0	0	0.00
OKANAGAN	10	17	0	31	0	0	0	31	31	1.82
NON-RESIDENT CANADIAN	21	41	0	51	0	0	0	51	51	1.24
NON CANADIAN	39	116	0	33	0	0	0	33	33	0.28
VANCOUVER ISLAND	4	8	0	0	0	0	0	0	0	0.00
LOWER MAINLAND	34	38	0	14	0	0	0	14	14	0.37
CARIBOO-CHILCOTIN	3	25	0	16	0	0	0	16	16	0.64
SKEENA	119	450	4	242	0	51	4	293	297	0.66
OMINECA-PEACE	10	24	0	10	0	0	0	10	10	0.42
NON CANADIAN	17	37	0	4	0	2	0	6	6	0.16
VANCOUVER ISLAND	4	19	0	11	0	0	0	11	11	0.58
LOWER MAINLAND	16	41	0	12	0	0	0	12	12	0.29
SKEENA	134	663	0	644	0	8	0	652	652	0.98
OMINECA-PEACE	4	7	0	0	0	0	0	0	0	0.00
OKANAGAN	3	3	0	3	0	0	0	3	3	1.00
NON-RESIDENT CANADIAN	4	9	0	11	0	0	0	11	11	1.22
NON CANADIAN	28	79	0	85	0	0	0	85	85	1.08
VANCOUVER ISLAND	15	41	0	25	0	0	0	25	25	0.61
LOWER MAINLAND	22	49	0	27	0	0	0	27	27	0.55
KOOTENAYS	6	6	0	6	0	0	0	6	6	1.00
CARIBOO-CHILCOTIN	9	9	0	14	0	0	0	14	14	1.56
SKEENA	157	1060	10	747	0	89	10	836	846	0.80
OMINECA-PEACE	5	10	0	5	0	5	0	10	10	1.00
NON-RESIDENT CANADIAN	3	3	0	0	0	0	0	0	0	0.00
NON CANADIAN	28	65	0	42	0	0	0	42	42	0.65
VANCOUVER ISLAND	3	3	0	3	0	0	0	3	3	1.00
LOWER MAINLAND	32	67	0	29	0	0	0	29	29	0.43
THOMPSON-NICOLA	3	3	0	0	0	0	0	0	0	0.00
SKEENA	188	1080	3	1382	0	6	3	1388	1391	1.29
OMINECA-PEACE	5	5	0	0	0	0	0	0	0	0.00
NON-RESIDENT CANADIAN	13	40	0	13	0	0	0	13	13	0.33
NON CANADIAN	47	125	0	62	0	0	0	62	62	0.50
VANCOUVER ISLAND	14	34	0	24	0	0	0	24	24	0.71
LOWER MAINLAND	42	104	3	123	0	0	3	123	126	1.21
SKEENA	218	937	21	816	0	3	21	819	840	0.90
OMINECA-PEACE	6	6	0	0	0	0	0	0	0	0.00
OKANAGAN	5	5	0	11	0	0	0	11	11	2.20
NON-RESIDENT CANADIAN	20	77	3	85	0	0	3	85	88	1.14
All Resident areas	41	133	86	0	0	0	86	0	86	0.65
All Resident areas	51	211	46	0	0	0	46	0	46	0.22
All Resident areas	29	45	13	38	0	0	13	38	51	1.13
All Resident areas	23	26	12	0	0	0	12	0	12	0.46
All Resident areas	11	40	23	19	0	0	23	19	42	1.05
All Resident areas	29	80	103	94	0	0	103	94	197	2.46
All Resident areas	15	33	15	10	0	0	15	10	25	0.76
All Resident areas	12	19	6	10	0	0	6	10	16	0.84
All Resident areas	29	69	20	22	0	0	20	22	42	0.61
All Resident areas	22	67	16	113	0	0	16	113	129	1.93
All Resident areas	24	231	15	73	0	0	15	73	88	0.38
All Resident areas	61	141	32	62	0	0	32	62	94	0.67
All Resident areas	3	3	0	0	0	0	0	0	0	0.00
All Resident areas	25	52	6	61	0	0	6	61	67	1.29
All Resident areas	28	61	19	27	0	0	19	27	46	0.75
LOWER MAINLAND	8	8	4	0	0	0	4	0	4	0.50
SKEENA	24	147	24	41	0	0	24	41	65	0.44
OMINECA-PEACE	3	3	0	0	0	0	0	0	0	0.00
NON-RESIDENT CANADIAN	7	7	0	0	0	0	0	0	0	0.00
NON CANADIAN	6	9	3	6	0	0	3	6	9	1.00
VANCOUVER ISLAND	3	3	0	7	0	0	0	7	7	2.33
SKEENA	23	114	23	67	0	0	23	67	90	0.79
OMINECA-PEACE	3	6	6	13	0	0	6	13	19	3.17
NON-RESIDENT CANADIAN	2	2	0	0	0	0	0	0	0	0.00
NON CANADIAN	5	9	0	28	0	0	0	28	28	3.11
VANCOUVER ISLAND	4	49	0	35	0	0	0	35	35	0.71

RESIDENT AREA NAME	NO. ANGLERS	DAYS FISHED	WILD KEPT	WILD RELEASED	HATCHERY KEPT	HATCHERY RELEASED	TOTAL KEPT	TOTAL RELEASED	TOTAL CATCH	CPUE
SKEENA	36	132	29	118	0	0	29	118	147	1.11
OMINECA-PEACE	3	6	0	0	0	0	0	0	0	0.00
NON CANADIAN	13	28	2	26	0	2	2	28	30	1.07
VANCOUVER ISLAND	4	84	0	48	0	0	0	48	48	0.57
LOWER MAINLAND	5	5	0	9	0	0	0	9	9	1.80
SKEENA	17	43	4	17	0	0	4	17	21	0.49
NON CANADIAN	2	6	0	8	0	0	0	8	8	1.33
LOWER MAINLAND	8	8	0	16	0	0	0	16	16	2.00
SKEENA	15	15	4	38	0	0	4	38	42	2.80
OMINECA-PEACE	3	3	0	3	0	0	0	3	3	1.00
NON CANADIAN	4	4	0	0	0	0	0	0	0	0.00
SKEENA	12	77	4	65	0	0	4	65	69	0.90
SKEENA	12	27	0	4	0	0	0	4	4	0.15
NON CANADIAN	7	9	0	0	0	0	0	0	0	0.00
LOWER MAINLAND	4	4	0	0	0	0	0	0	0	0.00
SKEENA	11	26	0	19	0	0	0	19	19	0.73
NON CANADIAN	2	4	0	0	0	0	0	0	0	0.00
SKEENA	8	8	0	0	0	0	0	0	0	0.00
SKEENA	15	38	0	0	0	0	0	0	0	0.00
SKEENA	13	25	0	25	0	0	0	25	25	1.00
NON CANADIAN	2	2	0	0	0	0	0	0	0	0.00
SKEENA	12	21	0	12	0	0	0	12	12	0.57
OKANAGAN	3	3	0	3	0	0	0	3	3	1.00