2000 Northern Pike Investigations in Milltown Reservoir

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Summary

Spawning times

Beginning March 8, 2000 I netted Milltown reservoir using between 1 and 3 experimental gill nets with 5- 7 m panels ranging in bar size from 20 cm to 50 cm to determine spawning times of northern pike (*Esox lucius*). Gill nets were set and checked on approximately one-hour intervals and all pike and other fish were removed. I collected sex, ripeness and length (TL, mm) information from all fish and scales from a subset. Most fish were killed; however, I did release 20 northern pike that were tagged with colored numeric Floy™ FD-67 anchor tags. While Floy tagged northern pike have been shown to grow significantly less than non-tagged northern pike, the length data on recaptured northern pike can be used as a minimum growth rate. Overall, I captured 118 northern pike, 6 largescale suckers (*Catostomus macrocheilus*) and 1 yellow perch (*Perca flavescens*), netting about 3 times per week until March 26. The spawning period began around March 24, based on ripeness of females and activity of fish. Most of the spawning pike were age 3 and 4, between 500 and 650 mm TL, based on scales from 24 northern pike. These ranges are similar to the standard length for age values for northern pike elsewhere. In the future, comparing lengths to the known growth curves can determine ages. Of 12 recaptured fish from last August, growth averaged 48 mm, and similarly corresponds to growth curves, even with Floy tags. Based on the 12 recaptures I was able to get an estimate, although violating some assumptions. Notwithstanding, the estimate was approximately 2,500 fish. This is similar to the estimates I performed last summer (between 1,800 and 3,600).

Food Habits

In order to determine food habits of northern pike in Milltown Reservoir, and seasonal shifts in diets, I captured northern pike in 3 out of the 4 seasons in 2000, representing early spring (pre-spawn), late spring (high water) and fall/ onset of winter. I removed stomachs of the northern pike and determined frequency of occurrence of each prey species in each northern pike. Generally, northern pike were captured during the day in experimental gill nets; I tried to get a minimum of 50 pike stomachs per season and prey was identified to species and subspecies if possible. Between March 8 and March 24, I analyzed the contents of 57 northern pike stomachs. Largescale sucker, northern pikeminnow (*Ptychocheilus oregonensis*) and mountain whitefish (*Prosopium williamsoni*) were the most abundant species in the stomachs. To determine food habits during high water and to determine if northern pike in Milltown Reservoir were eating out migrating juvenile bull trout (*Salvelinus confluentus*) or westslope cutthroat trout (*Oncorhynchus clarki lewisi*), I collected northern pike on 8 days from Milltown reservoir from May 3- May 17,2000. Fish were collected from 2 experimental gill nets that were set between 1.5 and 3 hours. In all, I collected 56 northern pike, 32 of which had empty stomachs. In the remaining 24 stomachs, nine bull trout (mean length 200 mm) were collected from nine stomachs. Additionally, seven westslope cutthroat trout or rainbow trout (*O. mykiss*) were collected from seven stomachs. The remaining eight stomachs contained sculpins (*Cottus* spp.), dragonfly nymphs, largescale suckers, yellow perch, and a pumpkinseed (*Lepomis gibbosus*). Bull trout were the single most abundant species collected in this time series. No bull trout were sampled from stomachs on May 3 or May 17 and this appears to represent a relatively short window under which predation on out-migrating bull trout is high. I captured 84 northern pike during fall sampling from October 17-Novemer 6. Northern pike lengths averaged 520 mm (SD 148, range 235-850). Largescale suckers and mountain whitefish were the most abundant

species found in pike stomachs during this time. In addition to the northern pike captured in this gill netting series I captured 4 adult bull trout (mean length 520 mm), and they were the most abundant trout species in Milltown Reservoir.

Introduction

Exotic species are responsible for declines of native species and the homogeneity of the earth's regional distinctiveness (Li and Moyle 1981; Vitousek 1990). However, in recreational fisheries, introduction and the management of non-native fish species is common though there is a precarious balance between managing exotic fishes and maintaining native fish stocks (Li and Moyle 1981; Moyle et al. 1986). Like elsewhere in the northwest, illegal introductions of a top predator have created a fishery where one previously did not exist (McMahon and Bennet 1996). However, introducing and managing for a top predator can have significant, deleterious community level effects (Colby et al. 1987)

Northern pike (*Esox lucius*) were illegally introduced into the Clearwater chain of lakes in western Montana and have spread downstream to the Blackfoot and Clark Fork rivers. This spread throughout the Blackfoot watershed is now threatening native game and non-game fishes. Northern pike have extirpated local populations of native or naturalized fishes following illegal introductions (McMahon and Bennett 1996) and have shown to compete heavily with other fishes for food (Hunt and Carbine 1950). Concern for native and non-native salmonids and two species of special concern, the westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and bull trout (*Salvelinus confluentus*) has prompted management action such as an extended angler harvest.

The lakes in the Clearwater drainage are following a rapid increase in pike densities and growth rates, followed declines in densities and condition factors and finally dispersal(R. Berg, Montana Fish, Wildlife and Parks [MFWP], Pers. Comm.). Milltown Reservoir now serves as a satellite source of pike to the Blackfoot and Clark Fork rivers. Abundant spawning habitat in Milltown Reservoir provides a source of northern pike recruitment to downstream and upstream areas. It appears that significant numbers of pike have moved downstream in the Clearwater and Blackfoot Rivers and over 100 km to Milltown Reservoir and the Clark Fork River. This movement and expansion is now threatening native game and non-game fishes in the Milltown reservoir and in the Blackfoot and Clark Fork rivers.

While removal and suppression of pike is being considered, angler education will be vital to the future of this endeavor. One of the consequences of the pike expansion in the Clearwater drainage has been increased awareness of native species management and conflicts between recreational fisheries and sustainable resources. The areas where pike have become naturalized are receiving greater fishing pressure, though angler satisfaction is waning as pike numbers and condition factors have declined (R. Berg, MFWP, Pers. Comm.).

The objectives of this project were to 1) monitor pike populations in Milltown Reservoir; 2) determine spawning times; 3) monitor movement through angler tag returns and 4) determine seasonal food habits of northern pike in Milltown Reservoir. Results from this investigation will help to determine management activities aimed at protecting and enhancing trout populations and explore opportunities for pike removal or suppression.

Background

Milltown reservoir northern pike investigations (Schmetterling 2000)

I conducted northern pike sampling in Milltown Reservoir from August 23-27, 1999. The goal of this project was to estimate abundance of northern pike in Milltown Reservoir, establish long-term gill net sets and compare species composition to previous data. I used three experimental gill nets with 5- 7 m panels ranging in bar size from 20 mm - 50mm. Marking runs consisted of setting gill nets and checking them on one-hour intervals and removing all fish, marking them with colored, numeric anchor tags and releasing them. Subsequent recaptures were made by setting nets for the duration of the marking sessions. I attempted to determine population estimates using a modified mark recapture estimate and a multiple mark, multiple recapture estimator. I captured 222 pike, which averaged 528 mm TL, 1.3 kg (range 210-695 mm, 0.2-3.0 kg). These were significantly larger than pike captured downstream in the Milltown section (See below). However, I only recaptured 3 pike, making the estimate equivocal. Since the time of the netting, three tags have been returned, 2 of which demonstrated movement to the weir at the Stimson Mill on the Blackfoot River. The species composition of the reservoir is dominated (60%) by northern pike. In the past the dominant fish, northern pikeminnow (historically 85% of the catch), now only contribute to 15% of the population.

Milltown section fish population estimates

In the spring 1999, I performed fish population estimates in the Milltown Section of the Clark Fork River immediately downstream of Milltown Dam. We estimated populations of bull trout, westslope cutthroat trout, rainbow trout, brown trout and northern pike. Perhaps more notable, I captured 41 northern pike (average length 604 mm, weight 2050 g) and tagged them with numeric Floy™ anchor tags. In 1996, we did not capture any northern pike in this river reach. Of those 41 tagged fish, 16 tags have been returned by anglers. Stomach contents of 30 pike revealed mountain whitefish (*Prosopium williamsoni*), rainbow trout (*O. mykiss*), northern pikeminnow (*Ptychocheilus oregonensis*) and largescale suckers (*Catostomus macrocheilus*). The northern pike estimate in Milltown section is about 10% of the estimated trout abundance.

Methods

Study area

Milltown Dam is a 3.2 megawatt, five-turbine, run-of-the-river hydroelectric facility located at the confluence of the Blackfoot and Clark Fork Rivers approximately 8 km upstream from Missoula, Montana (Figure 1). Milltown reservoir has an approximate 6 hectare storage

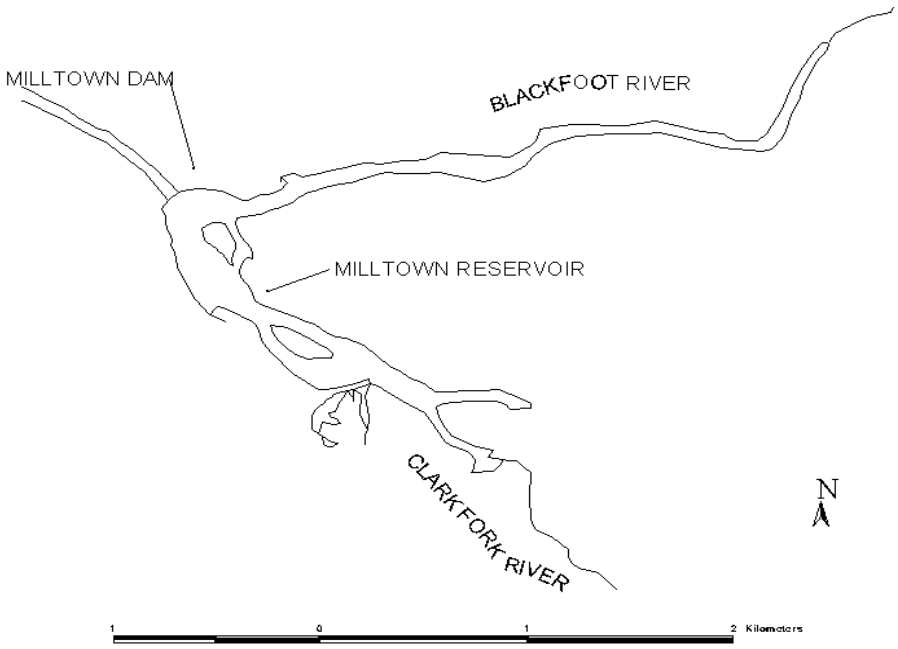

Figure 1. Milltown Reservoir and adjacent Blackfoot and Clark Fork Rivers.

capacity, and water flows over the spillway in a 12 m drop. Above the reservoir, mean annual flows in the Clark Fork and Blackfoot Rivers are 30 and 46 m^3/s, respectively. The combined mean annual flow at Milltown Dam is 84 m^3/s and captures a drainage area of approximately 15,541 km^2.

Sampling design

In March 2000, I gill netted northern pike in order to determine spawning times. Water temperature data were collected with continuously recording thermographs (StowAway® Tidbit®, Onset Corp.) in several locations in Milltown Reservoir to determine a relationship between spawning activity to temperature. Discharge data were collected at a USGS stream gauge (station #12340500) located 5 km downstream of the dam to determine stage heights of the spawning period.

Pike sampling in the reservoir was conducted in the spring, summer and fall 2000. I used between three and five experimental gill nets with 5-7m panels ranging in bar size from 20 mm to 50 mm (a combination of floating and sinking nets). Locations of net sets were recorded on 1:24,000 scale or better maps in the field and later transferred into a GIS layer. Gill nets were set generally during the day and checked on one-hour intervals after which all northern pike and other species were removed. Pierce (1997) found that biases from differences in pike

catchability due to fish size were small, and age 1 and older pike were easily recruited into the sampling gear (personal observation).

I collected length (TL, mm), weight (kg, g), scales and sex for all northern pike, and at least 50 from each season were sacrificed to determine stomach contents. Northern pike that were not sacrificed were tagged with colored numeric Floy™ FD-67 anchor tags and released. Pierce and Tomcko (1993) found that annual tag loss was less than 1.8% in pike, however, Schrier and Coble (1991) found that Floy tagged pike grew significantly less but maintained condition factors similar than similar aged non-tagged pike. For this reason, tag return data for growth rate information should be viewed with caution.

Results

Spawning Times

Beginning March 8, 2000 I netting Milltown reservoir to determine spawning times of northern pike. Overall, I captured 118 northern pike, 6 largescale suckers and 1 yellow perch

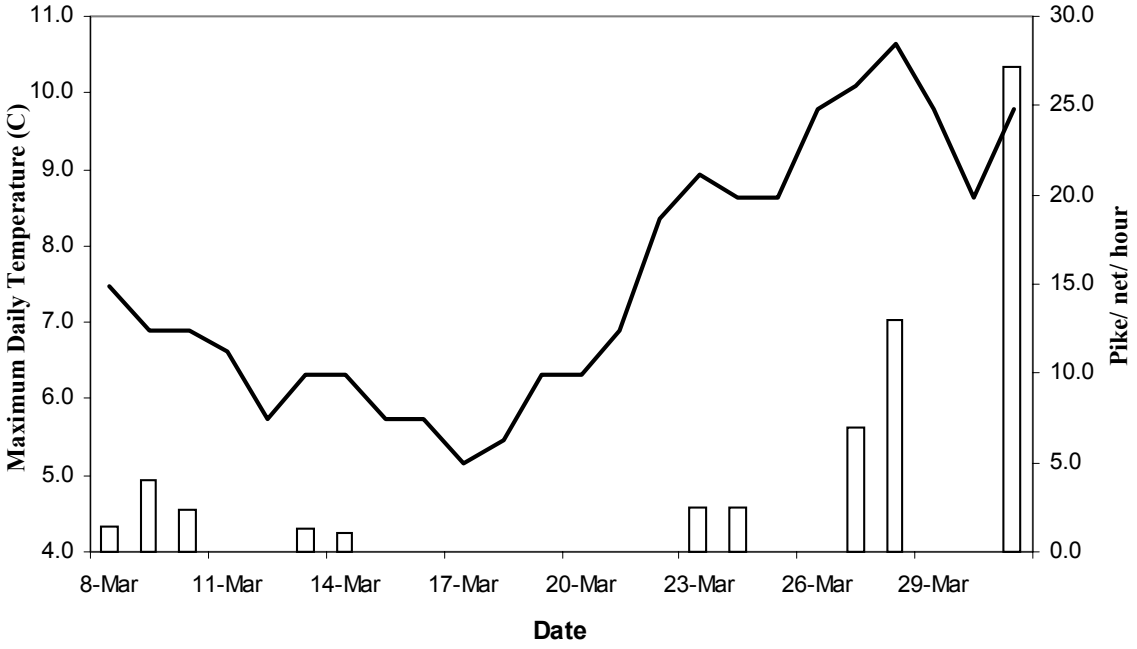

Figure 2. Northern pike catch standardized to pike caught per net, per hour in Milltown Reservoir, 2000, plotted against maximum daily water temperature. Solid line is maximum daily water temperature and vertical bars are number of northern pike per net per hour.

(*Perca flavescens*), netting about 3 times per week. I suspect the spawning period began around March 24, based on ripeness of females and activity of fish; spawning peaked March 31 (Figure 2) and continued for 5 days.

Most of the spawning northern pike were age 3 and 4, between 500 and 650 mm TL, based on scales from 24 pike. I recaptured 12 northern pike that I had tagged in 1999 and I was able to get an estimate, although violating some assumptions. However, the estimate was approximately 2,500 northern pike (age 1 and older). This is similar to the estimates I performed in 1999 (between 1,800 and 3,600).

Food Habits

In order to determine food habits of northern pike in Milltown Reservoir, and seasonal shifts in diets, I captured northern pike in 3 out of the 4 seasons in 2000, representing early spring (pre-spawn), late spring (high water) and fall/ onset of winter. I removed stomachs of the northern pike and determined frequency of occurrence of each prey species in each northern pike. Generally, northern pike were captured during the day in experimental gill nets; I tried to

get a minimum of 50 pike stomachs per season and prey was identified to species and subspecies if possible.

Pre-spawn early spring

Between March 8 and March 24, I analyzed the contents of 57 northern pike stomachs. Largescale sucker (LSS), northern pikeminnow (NSQ) and mountain whitefish (MWF) were the most abundant species in the stomachs during this time period (Figure 3). The majority of stomachs were empty and corresponds to low activity prior to spawning.

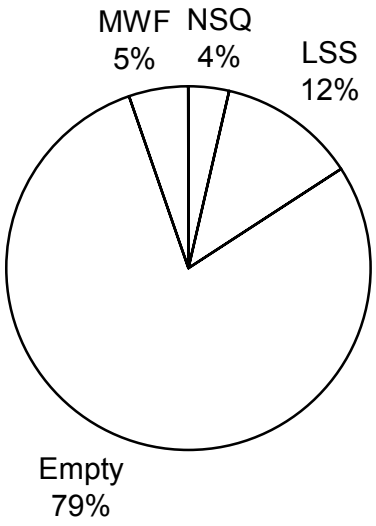

Figure 3. Stomach contents of 57 northern pike in Milltown Reservoir, March 2000.

High water

To determine food habits during high water and to determine if northern pike in Milltown Reservoir were eating out migrating juvenile bull trout or westslope cutthroat trout, I collected

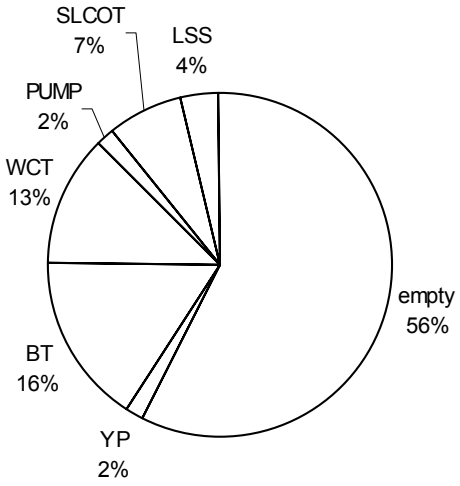

Figure 4. Stomach contents of 56 northern pike in Milltown Reservoir, May 2000.

pike on 8 days from Milltown reservoir from May 3- May 17,2000. Fish were collected from 2 experimental gill nets that were set between set between 1.5 and 3 hours; all northern pike were sacrificed. In all, I collected 56 pike, 32 of which had empty stomachs. In the remaining 24 stomachs, nine bull trout (BT, mean length 200 mm) were collected from nine stomachs (Figure 4). Additionally, seven westslope cutthroat trout (WCT) or rainbow trout were collected from seven stomachs. The remaining eight stomachs contained slimy sculpins (SLCOT, *Cottus cognatus*), dragonfly nymphs, largescale suckers, yellow perch (YP), and a pumpkinseed (PUMP, *Lepomis gibbosus*). Bull trout were the single most abundant species collected in this time series. No bull trout were sampled from stomachs on May 3 or May 17 and this appears to represent a relatively short window under which predation on out-migrating bull trout is high

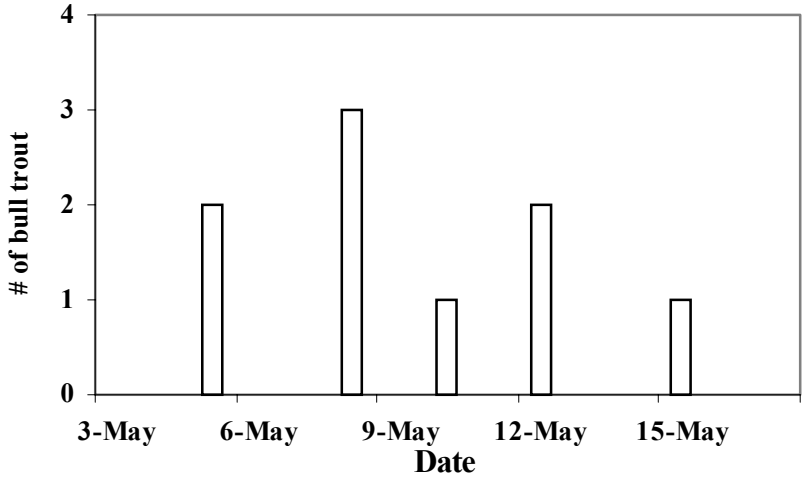

Figure 5. Frequency of occurrence of bull trout in northern pike stomachs

(Figure 5).

Fall/ Onset of winter

In order to determine the food habits of northern pike in Milltown Reservoir in the fall/ onset of winter I gill netted the reservoir in October and November. My hypothesis was that

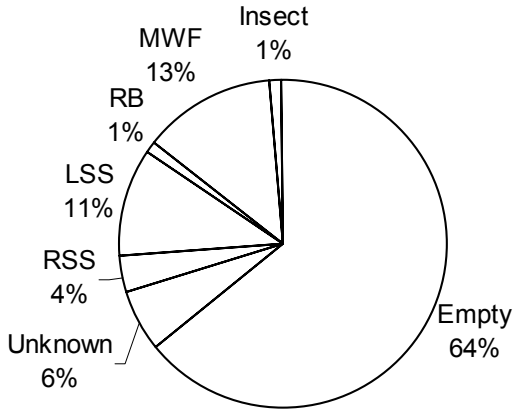

Figure 6. Stomach contents of 84 northern pike collected in Milltown Reservoir in fall 2000.

bull trout and westslope cutthroat tout may be out-migrating at this time of the year with the onset of winter. Out migrations of juvenile bull trout and westslope cutthroat trout are often bimodal, meaning some move out in the spring some in the fall. I captured 84 northern pike during fall sampling from October 17-Novemer 6. Mean length 520 (SD 148, range 235-850. Largescale suckers and mountain whitefish were the most abundant species found in pike stomachs during this time (Figure 6).

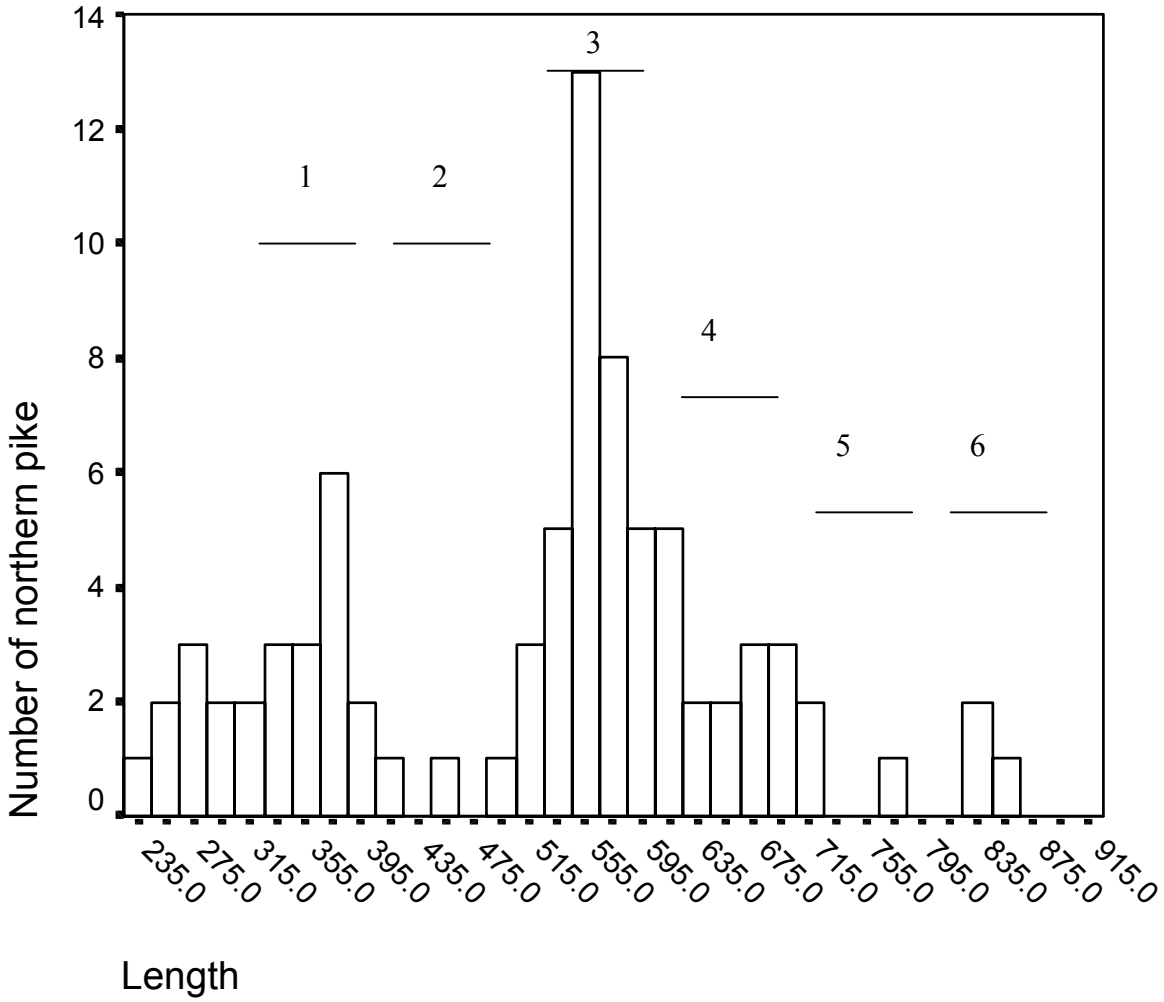

Figure 7. Length frequency histogram for northern pike captured in Milltown Reservoir in fall 2000. Ages of pike are superimposed over lengths, and show a decline in recruitment following the 1999 drawdown.

Tag returns and movement

I received 17 tag returns for northern pike in Milltown reservoir including 6 from anglers. Of these fish many demonstrated movement in the reservoir and 1 demonstrated movement from Seeley Lake to Milltown Reservoir. Several of the tagged northern pike I recaptured moved over 2-km from their capture locations but remained in Milltown Reservoir.

Species composition/ population monitoring

As a result of drought conditions this summer, we did not proceed with the plans to draw Milltown Reservoir down to strand and kill young of the year (YOY) and age 1 northern pike. This appeared to be very effective when it was done in 1999, as I observed thousands of dead YOY and age 1 pike, and subsequent gill netting I conducted confirmed the absence of those age classes (age 1 and 2) in the population (Figure 7). Those two age classes are easily recruited into the gill nets and should be the most abundant age classes of fish. Hopefully next summer I will be able to draw down the reservoir. Similarly, as a result of the fire restrictions, I was unable to conduct the pike population monitoring netting series. Since this is a time dependant activity it will have to wait until next August.

Discussion

It appeared that the 1999 drawdown removed many age 1 and young of the year (YOY) northern pike from the reservoir population. In 1999 during the reservoir drawdown, I visually observed thousands of dead and stranded northern pike. These fish affected by the drawdown would be age 1 and age 2 in 2000. Age 1 and age 2 northern pike range in size from 290-370 mm and 371-485 mm TL respectively, and are susceptible or recruited to the sampling gear. In fall 2000 gill net sets (Figure 7), these sizes or ages of northern pike were noticeably absent from the nets. These ages should be the most abundant age classes in the Reservoir.

This tactic of drawing the reservoir down to 6 feet in late August appears to be effective at affecting survivorship of age classes of juvenile northern pike. However, despite the success, this practice must be performed annually in order to be effective. For example, in 2000 because of low stream flows the reservoir was not drawndown and YOY escaped. This drawdown tool needs to occur annually and probably in combination with another suppression technique in order to be effective, similar to integrated pest management (IPM).

As a result of fire closures, I could not perform monitoring in August. This time period is critical to monitor northern pike populations. In August, because of long term data, I can determine trends such as species composition, condition factor and relative abundance to compare to past years. Because this was not conducted in 2000, I cannot fully explain trends in northern pike densities or fitness of individuals. However, based on the sampling that I conducted in 2000, it appears that the densities have not declined significantly though the age structure changed (see above), nor has condition factor decreased.

Despite the lack of accurate timing and procedures for sampling, it appears that the densities of pike have not substantially changed since 1999 when I first sampled pike in the reservoir. At that time because of the high daytime catch, (approximately 5 pike per net per hour; Schmetterling 2000). I concluded that this population would quickly decline similar to the findings of Berg (MFWP, unpublished data) in several Clearwater Lakes. Based on the available food source in the reservoir, it appeared at that time that northern pike had eradicated the resident prey base, reducing prey species by over 60%. However, it appears that the high amount of recruitment into the reservoir, as evidenced by seasonal food shifts, may overcome the lack of a stable, suitable prey base and provided enough forage for a continued northern pike population. Furthermore based on recaptures of tagged northern pike from 1999, and 2000 the population seems to be at approximately 1,500-3,500 individuals (Age 1 and older), despite the large amount of variation, and violation of some assumptions, the estimates are similar to those I performed in 1999.

Bull trout were the single most abundant species collected from nortehrn pike stomachs over a 3-week period in May during high water. No bull trout were sampled from stomachs of pike in any other time period and appear to represent a relatively short window under which predation on out-migrating bull trout is high. Juvenile westslope cutthroat trout and bull trout typically out-migrate in the spring during high flows and have another peak in the fall at the onset of winter (Shepard et al. 1984). By gill netting at high flows and at the onset of winter I tried to determine if pike were having a noticeable effect on juvenile bull trout and westslope cutthroat trout.

Northern pike in Milltown Reservoir exhibit seasonal shifts in diet, which correspond to movement of fish through the reservoir. In early spring they eat residents of the reservoir (juvenile northern pikeminnow and largescale suckers, and invertebrates) early high water they

eat slimy sculpins, during high water they eat westslope cutthroat trout and bull trout, in late summer (from Schmetterling 2000) YOY mountain whitefish and juvenile largescale suckers, and at the onset of winter juvenile mountain whitefish.

The relatively high rate of predation of bull trout by northern pike I observed in the spring 2000, may have been a function of the unusually low stream flows. This drought may have concentrated both predator and prey, and may have made sampling more efficient. In a higher water year the volume of the reservoir would be greater, turbidity would be higher (pike are visual predators; Craig 1996) and juvenile bull trout and westslope cutthroat trout would move through the reservoir more quickly. This may reduce the likelihood of predation and also the detection of the predation.

Spawning is influenced by gradually increasing water temperatures in the spring and there is a strong positive relationship between northern pike activity and increasing water temperature. In 2000, this time period coincided with the low elevation run-off. The timing of spawning and run off events would make a drawdown to expose eggs problematic in Milltown Reservoir. Because of the strong relationship with water temperature future monitoring of water temperatures and hydrograph will determine if a spring drawdown is a useful management tool.

Tag returns showed movement of northern pike within the in the reservoir and recruitment from Seeley Lake. These data were obtained from both angler catch and recaptures in gill nets. Although based on a small sample size (n=1) the movement of fish from the Seeley Lake to Milltown Reservoir is still occurring. This suggests that control programs in the Reservoir need to account for recruitment from outside the system and may need to occur in conjunction with recruitment controls in the Clearwater Lakes (e.g., trapping at the outlet of Salmon Lake).

Most of the spawning pike were age 3 and 4, between 500 and 650 mm TL, based on scales from 24 pike. These ranges are similar to the standard length for age values for pike elsewhere Hickley and Sutton (1984). In the future, comparing lengths to the known growth curves can determine ages. Further aging of 64 northern pike in the fall and late spring confirmed these ages and correspond to other high growth populations. Of 12 recaptured fish tagged in August 1999, growth averaged 48 mm, and similarly corresponds to published growth curves (Hickley and Sutton 1984), even with Floy tags.

Because Milltown Dam limits or restricts downstream passage of adult fish during low flow periods, bull trout and northern pike come in contact with one another. Although predation does not always occur (particularly with adult bull trout) competition is a concern. For example post spawning adults and downstream migrating non-spawning adults in the fall can not move downstream over Milltown Dam. Gillnetting data from the fall period showed bull trout were the most abundant trout captured in this netting series (or any series). Although it is based on a small sample size, the trend does reflect the potential for negative interactions.

Conclusions

From the preliminary work completed this year it appears that northern pike densities have not declined in number in the reservoir population, recruitment is still occurring from outside the system, and seasonal predation on bull trout is high. Future work needs to determine timing and number of bull trout entering Milltown Reservoir, escapement from the Blackfoot and Clark Fork Rivers and determine actual losses of bull trout to predation by northern pike. Furthermore because of the high density of northern pike in the reservoir other fish species

which travel to or though the reservoir are at risk. By continuing to trap at Milltown Dam to monitor returns of fish that theoretically passed downstream through the reservoir, I could monitor trends of escapement. Since I now have 3 years of data from the upstream fish trap at the dam (Schmetterling and McEvoy 2000; Schmetterling and Liermann 2000) future comparisons could be made. I expect to see declines in abundance of several fish species whose upstream migrations are impeded by Milltown Dam as a result of predation in the reservoir. A long-term approach needs to be taken to suppress the northern pike population in the reservoir. Northern pike in Milltown Reservoir are one more perturbation to native fish that limits the resiliency of populations of fish in the area impacted by Milltown Dam.

Acknowledgements

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