I. Project Title: Translocation of northern pike from the Yampa River upstream of Craig, Colorado.

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III. Project Summary

Northern pike is a large esocid native in many North American drainages that has been widely stocked outside of its natural drainages for sportfishing purposes. Stocking of northern pike outside of its natural range can have many negative effects on native and endangered fishes, existing sport fisheries or commercial fisheries such as salmon in the Pacific Northwest (Conover 1986). Specifically, negative effects may include, but are not limited to, altering entire communities through top down effects (Colby et al. 1987), colonization of pike beyond the introduction point (McMahon and Bennett 1996), and competition with, and predation on, existing fish in the system (Findlay et al. 2000).

Northern pike have become well established in the Yampa River, Colorado, probably from escapement from Elkhead Reservoir (a reservoir on Elkhead River, a tributary to the Yampa River) where it was originally stocked to provide public fishing opportunities. Since escapement, northern pike have established a large, reproducing population in the Yampa River (Nesler 1995; J. Hawkins, Colorado State University, personal communication). The large population provides a source for continual movement of pike into the lower Yampa River and further downstream into the Green River where it coexists with three endangered fishes — Colorado pikeminnow (*Ptychocheilus lucius)*, razorback sucker (*Xyrauchen texanus*), and humpback chub (*Gila cypha*). Northern pike provide a significant predatory risk to these species, especially juveniles and small adults of Colorado pikeminnow and razorback sucker and a significant predatory risk to other native species in the basin (Martinez 1995; Nesler 1995). Northern pike were identified as presenting a significant risk to endangered fishes by a majority of upper basin researchers in surveys conducted during the late 1980's (Hawkins and Nesler 1991).

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) has established an active program to control nonnative fishes in the main rivers of the upper basin to assist in recovery of the endangered fishes found there. To date, the Recovery Program has initiated nonnative reduction efforts for channel catfish, smallmouth bass, and northern pike in the Yampa and Green rivers, channel catfish and smallmouth bass in the Colorado River and small cyprinids in the Colorado and Green River drainages. In some cases, such as the Yampa River, northern pike have been removed from the main channel and stocked into off-channel impoundments to provide fishing opportunity for local anglers.

Temporarily reducing the pike population through mechanical means appears to be an option (Lentsch et al. 1996, Tyus and Saunders 2000), although complete eradication is unlikely. A small, non-reproducing population of northern pike in the Gunnison River was reduced with relatively little effort applied at a time when pike were vulnerable (McAda 1997). Initial sampling efforts in the Yampa River suggest that substantial numbers of northern pike can be captured during spring when they enter shallow floodplain habitats for spawning (Nesler 1995; U.S. Fish and Wildlife Service, unpublished data).

This is the fifth year of sampling on this project and the fifth unique study design. In the first two years fyke netting was used to remove pike from the Yampa River and in 2003 and 2004 a combination of electrofishing and fyke netting were used. As Recovery Program policy on nonnative fish management dictates, this project incorporates adaptive management wherein the study design and methods change on a yearly basis as we learn new and better capture techniques. Noteworthy recommendations to this years study, resulting from the 2004 nonnative fish management workshop were to increase overall effort, add a fall pass if flows were available for sampling, eliminate fyke netting, and to target concentration areas during two passes. Escapement of fishes from Elkhead Reservoir due to a fish screen failure caused an emergency implementation of sampling techniques to target and remove fish from downstream of the Elkhead confluence. Objectives of this study are to reduce numbers of adult northern pike in the study reach, determine population size and structure of northern pike in the study reach and the subsequent changes in the population size and structure after translocation, determine if sampling identified concentration areas is effective, maintain public support for the Recovery Program by providing off-channel angling opportunities, and to monitor the native fish community and smallmouth bass population in the study area.

IV. Study Schedule: To be continued as needed

V. Relationship to RIPRAP:
GREEN RIVER ACTION PLAN: YAMPA AND LITTLE SNAKE RIVERS
III.A.1.b Control northern pike.

III.A.1.b(1) Remove and translocate northern pike and other sportfishes from Yampa River

VI. Accomplishments of FY 2005 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Study Site

The Yampa is a relatively free flowing river that originates on the west slope of the Rocky Mountains and flows 320 km to its confluence with the Green River. The portion of the Yampa that makes up the study site flows through low gradient agricultural lands. Seasonal flows in the study reach fluctuate between 100 and 13,000 cubic feet per second (USGS, provisional data), however in recent years flows have typically been lower.

All sampling for this study was conducted in a 38-mile reach of the Yampa River between Hayden and Craig, CO (hereafter referred to as the removal reach, Figure 1). The study reach was broken into two-mile segments. The two-mile segments allow for movement of fish to be more accurately monitored, identification of juvenile and adult fish concentration, and areas of high catchability.

Materials and Methods

Northern pike were collected using two pulsed DC electrofishing boats, each sampling opposite sides of the river except where large backwaters were present. In this case, both boats sampled the backwater on the same side of the river. Seven electrofishing passes were made between April 18th and June 9th 2005 and coincided with spring runoff. The scheduled fall pass was not completed due to a lack of water. During the first electrofishing pass all pike were marked and released. During the next six electrofishing passes pike were removed from the Yampa River, placed in fish hauling boats and trucks, and stocked into ponds accessible to the fishing public. During passes three and four, concentration areas identified in 2004 were targeted. In addition, concentration areas identified in 2005 below the Elkhead confluence were also targeted. The original sampling plan was altered due to fish screen failure at Elkhead Reservoir and the resulting fish escapement.

Pike were marked using a T-bar tag with an individual tag number and were finclipped as a means of a double tag to meet population estimation assumptions. All northern pike were scanned for the presence of passive integrated transponder (PIT) tags that are being used by other investigators studying pike in the basin. Lengths of northern pike, discharge, and capture reach were recorded.

All smallmouth bass captured were tagged with T-bar tags, and total length (TL) and capture reach recorded before being released. Bluegill and crappie were counted, measured (TL), and released on pass 1 and euthanized on all subsequent

passes. Total lengths were obtained from a sub sample of bluegill and crappie. The number and location of any unusual species encountered were recorded. The number of mountain whitefish encountered was recorded during passes 6 and 7. All other native fish were measured (TL), and released. Listed species encountered were handled according to Recovery Program protocol.

Movement Determination and Population Estimation Techniques

Movement Determination

In 2003, only upstream or downstream pike movement could be determined and estimates were poor at best (Pfeifer et al. 2003). In 2004 we were able to make a more accurate determination of movement using an averaging formula that incorporates the standardized two-mile reach system and the reach or exact location a tagged fish was recaptured in or released in. Movement in 2005 was again determined in this fashion (See Finney and Haines 2004).

Movement was analyzed both between years and within the 2005 sampling period. Within sampling period movement may be affected by our intensive sampling. Fish tagged and released in a lotic ecosystem may exhibit a "fallback response" to being captured and marked, wherein they drift downstream upon release (Moser and Ross 1993, Hughes 1998). We consider between year movements to be without bias and therefore more accurate.

Population Estimation Techniques

Population estimates for northern pike were accomplished using standard Petersen mark-recapture techniques. Estimates were only derived for adult fish (>300mm, CDOW unpublished data) due to low capture probabilities of juvenile fish. Population estimates for native fish or smallmouth bass were not possible due to low numbers sampled and few if any subsequent recaptures.

Results and Discussion

Northern Pike Population Estimation and Removal Effectiveness

One thousand four hundred and seven northern pike of all sizes were captured during the study of which 1,097 were removed. The adult population estimate of northern pike in 2005 was 1,748 (432-3,064 95% C.I.). Of the estimated 1,748 adult northern pike in the 38-mile stretch of upper Yampa River from Hayden to Craig, 813 were removed. Despite a 46.5% decrease, we were unable to show a significant decrease in catch rates over the study time (d.f. = 6, F = 1.65, P = 0.255, Figure 2). In addition to the 813 adult fish removed, 284 juvenile pike were removed in 2005.

The influx of northern pike from Elkhead Reservoir (explained in a section below) makes an accurate population estimate difficult due to assumption violations. The immigration also makes it difficult to determine our removal effectiveness. We are quite effective at removing the adult fish during the removal period (e.g. reduce population 46%), but long-term effectiveness is unknown because of immigration from outside the study reach and recruitment of juveniles confounds long-term trends.

Length frequency of pike captured in 2005 (Figure 3) reveals the large class of juvenile pike. Mean length of northern pike removed was different between passes as it was in 2004 (d.f. = 6, F= 20.699, P < 0.001, Figure 4). The significant difference in 2005 is due to the capture of many juvenile pike in pass 3 when concentration areas that contained many small pike (i.e. river mile 150, discussed below) were targeted. There is no significant difference in mean length between passes when pass 3 is removed from analysis (d.f. = 5, F= 1.49, P = 0.19). In 2005, the immigration of Elkhead escapees and the recruitment of juvenile pike likely influenced our ability to reduce larger size classes, which we were able to do in 2004.

Northern Pike Movement

One hundred and thirty one northern pike tagged and recaptured during 2005 were analyzed for movement. We removed 13 fish from this analysis because they moved less than 2 miles downstream. Average movement was 12.69 miles downstream (range 13 miles upstream to 82.5 miles downstream, Figure 5). Of the 118 movements analyzed, 25 did not move, 74 moved downstream (mean movement 24.3 miles), and 19 upstream (mean movement 1.87 miles upstream). In addition to the pike included in this analysis, two pike from our study were recaptured in Lodore Canyon in July of 2005, having moved downstream over 125 miles in less than 4 months.

Movement of northern pike was detected 45 times from fish that had been tagged in previous years. Average movement was 16.68 miles downstream (range 77.7 miles downstream to 7.5 miles upstream, Figure 5). Thirty five times pike were detected moving downstream and 10 times upstream.

Northern pike in the removal area are moving downstream in the spring and there are several possible explanations. One may be competition for resources in the area is high and fish are seeking better foraging habitat downstream. Fish from downstream may be seeking quality spawning habitat in the spring before our sampling and our data displays the post spawn movement back downstream or, perhaps, pike may be moving in response to high fluctuating seasonal flows and their effect on habitat availability. Finally, fish from Elkhead Reservoir may be exhibiting a “fall back” response and drifting downstream after entering the Yampa.

Targeting Concentration Areas

During passes 3 and 4, we targeted areas of concentration identified in 2004, the large backwater at river mile 150, and concentration areas identified in 2005 below the Elkhead confluence where reservoir fish presumably entered the river. A comparison of CPUE between pass 2, passes 3 and 4 (concentration sampling), and pass 5 reveals that we were mildly effective at targeting concentration areas above the Elkhead confluence. Catch per unit of effort (pike/hr) went from 3.03 on pass 2 to 4.78 on the concentration passes, and then decreased to 4.35 on pass 5, the next reach-wide pass. In the reach with the large backwater, CPUE dramatically declined after the concentration passes, going from 28.35 (pass 2), to 23.14 (concentration passes) to 7.52 on pass 5. Below the confluence, where the Elkhead escapement occurred, CPUE also declined across passes 2-5. Catch per unit of effort went from 7.56 (pass 2) to 5.52 (concentration passes) to 3.86 (pass 5).

The selective removal of fish below Elkhead confluence and the immigration of Elkhead fish into the river made it difficult to determine if we were effective at targeting concentration areas in 2005. The statement that identified concentration areas can be effectively targeted to increase overall removal efficiency is loosely supported by the data. Once again, Elkhead escapement and juvenile recruitment made it difficult to ascertain our effectiveness. The absence of escapement from Elkhead will make determining the validity of this approach more effective in the future.

Northern Pike at River Mile 150

At river mile 150 on the Yampa River there is a large backwater. The large backwater is the old river channel that has been cut off and contains a large amount of aquatic vegetation. Localized areas of pike concentration coincide with low velocity vegetated areas (Desantos 1991). The backwater has contained large amounts of northern pike in previous studies (See Finney and Haines 2004 and Pfeifer et al. 2003). The 2005 data indicate that river mile 150 is a very unique and dynamic portion of the study area that requires special attention.

In 2005, we captured 350 juvenile northern pike below 300mm TL in the entire study area, compared to 52 in 2004. Of these 350, 319 (0.911) came from the large backwater. In 2004, 29 (0.557) juvenile pike came from the large backwater. Proportions of juvenile northern pike captured in 2004 and 2005 were 0.047 and 0.277, respectively. Lengths of northern pike outside the large backwater were larger on average than those within the large backwater (Figure 6). The differences in mean lengths between fish in the large backwater were significantly different than those in the rest of the study area (d.f. = 1823, t = -12.40, P = <0.001). We detected no significant reduction in catch rates of northern pike in 2004 or 2005, however, there was a significant reduction in catch rate in the large backwater over 10 passes (d.f = 9, F = 20.154, P = 0.002, Figure 7).

Northern Pike Tag Returns and Escapement from Yampa State Wildlife Area

In 2005, due to a communication breakdown between CDOW and USFWS personnel, the tag return box at SWA was not checked in a timely fashion. The box was checked once, very late in the year. Because of this the tag return rate was only 4.6% (50 of 1097). We believe that true tag return rates were higher. Poor tag return is likely the result of anglers not being able to insert tags into a full tag return box.

Maximum discharge at the USGS Craig Gauge in 2005 during the study period was 9800 CFS as compared to 4820 in 2004. This allowed for a longer and higher connection of the river with SWA ponds where pike were stocked in 2005. We recaptured 9 pike in the river in 2005 that were stocked into SWA ponds in 2005. Of note, one of these fish had a hook in its mouth. All 9 of these fish were stocked before connection and one was recaptured before connection, indicating it may have been restocked into the river by an SWA angler.

Elkhead Escapement of Northern Pike

Empirical data lends support to escapement of northern pike from Elkhead Reservoir. The most telling piece of information is the CPUE differences above and below the confluence of the Elkhead River between 2004 and 2005.

In comparing CPUE differences, we assumed that all northern pike coming from Elkhead remain downstream of the Elkhead confluence in the Yampa River during our sampling period. We feel this assumption is valid based on the differences in CPUE between areas downstream and upstream of the Elkhead confluence in 2004 and 2005 (Figure 8) and from the downstream movement trends of recaptured fish in 2005. The CPUE in 2-mile subreaches above the confluence decreased in all but one reach between 2004 and 2005 (Figure 8). Conversely, the CPUE in reaches below the confluence increased or remained analogous in 2005. Catch per unit of effort in 2005 above the confluence was 3.11 pike per hour where as it was 6.03 below the confluence. Conversely, CPUE was 7.98 above the confluence and 5.35 below in 2004.

It is important to note that CPUE in 2005 was depressed compared to 2004, for reaches below the Elkhead confluence. In 2004, we had equal effort by subreach throughout the entire study area, whereas in 2005 we concentrated efforts on several occasions below the Elkhead confluence. The targeting of fish below the Elkhead confluence shrinks CPUE as more fish are removed from the river during subsequent removal passes. For illustration of this point, the total number of pike removed in each reach for 2005 is included in Figure 8.

In addition to the evidence from CPUE, several less telling, yet important tidbits of information point to the escapement of northern pike from Elkhead. First, in 2004 we captured 2 fish over 1000mm (both above the confluence) while in 2005 we captured 5 over 1000mm (4 below the confluence). This is despite the fact that we were very effective at removing larger fish in 2004. We feel strongly that these fish came from Elkhead where pike growth rates are higher than those of the Yampa River (CDOW, unpublished data). Similarly, we had no significant effect at removing larger northern pike in 2005. This may be due to an immigration of larger average size pike from Elkhead. We had no significant decline in CPUE in 2005 as would be expected. Twenty-three northern pike were found to have marks above and beyond normal spawning injuries and were considered "beat up". These fish may have received these marks from coming through the screen on Elkhead Reservoir and down the spillway. Finally, tagged smallmouth bass released in Elkhead Reservoir were captured in the Yampa River below the confluence, suggesting that if smallmouth bass escaped, than northern pike may have also escaped.

Smallmouth Bass

Thirty-four individual smallmouth bass were captured during the study period. Again, movement estimates and population estimation were not possible due to low numbers of recaptures. Smallmouth bass were distributed around the mouth of Elkhead Creek and near the bottom of the study area (Figure 9). Of note, we captured a smallmouth bass further upstream in the river system than we had in previous years.

Of the 13 smallmouth bass that had been previously tagged by other investigators, eleven of them had been previously captured in the river and re-released in the Elkhead reservoir, 2 in 2005 and 9 in 2004. As in 2004, smallmouth bass encounters increased as the sampling period progressed (Figure 10). Recaptures of tagged fish within the study reach showed most fish moved upstream. This indicates a late spring, early summer upstream migration.

Bluegill and Crappie

In 2003 and 2004 zero bluegill and four crappie were encountered in the study site. In 2005, 322 crappie and 422 bluegill were encountered in the river (Table 1). A larger size range of crappie was observed (Figure 11). All crappie and all but 12 bluegill were captured below the confluence of Elkhead Creek (Figure 12).

Catch per unit of effort remained similar for crappie across all passes while it increased during pass 4 for bluegill (Figure 13). This possible immigration of bluegill into the sample reach during pass 4 may be associated with an increase in discharge from Elkhead Creek.

Native Fish

The native fish community in the study area was reported in 2004 to be poorly represented; a total of 12 native fish were captured (Finney and Haines, 2004). In 2005 it was quickly recognized by field crews that a strong influx of mountain whitefish had occurred since the end of 2004 sampling. Whitefish counted on passes 6 and 7 of the 2005 sampling effort totaled 137. Sub reaches where mountain whitefish were captured are shown in Figure 14. No pure strain native suckers were observed in 2005 and no chubs were captured. One Colorado pikeminnow was captured at river mile 137.2 (Finney, In Press).

Unique Fish Encounters

Above and beyond the usual fish that have been encountered in the study section by Pfeifer et al. (2003), Finney and Haines (2004), and Nesler (1995), several unique captures occurred in 2005. We captured one largemouth bass, four green sunfish, and three black bullheads. We believe that these captures are associated with the escapement of fishes from the Elkhead Reservoir as all were captured at or below the Elkhead confluence.

VII. Recommendations:

1. Collect angler tag returns 3 times a week
2. Continue with 7 passes
3. Continue monitoring the native fish community
4. Compile and analyze movement data from all Yampa River northern pike in order to more accurately determine seasonal and size dependent movement in the entire river system.

VIII. Acknowledgements

The authors wish to thank numerous seasonal personnel for their help in the field, Billy Atkinson, John Hawkins, Tom Nesler, Lori Martin and Chris Hill for providing tag data. Tim Modde provided valuable comments on an earlier version of this document.

IX. Project Status:

The project is considered on track but minor revisions are suggested. It is subject to review prior to continuation.

X. FY 05 Budget Status:

A. Funds provided: $137,609
B. Funds expended: $137,609
C. Difference: -0-
D. Percent of the FY 2005 work completed: 100
E. Recovery Program funds spent for publication charges: -0-

XI. Status of Data Submission:

Data will be sent to the database manager in 2005. Data are currently being entered in Microsoft™ Excel spreadsheets.

XII. Signed: Sam Finney — November 8, 2005
Principal Investigator — Date

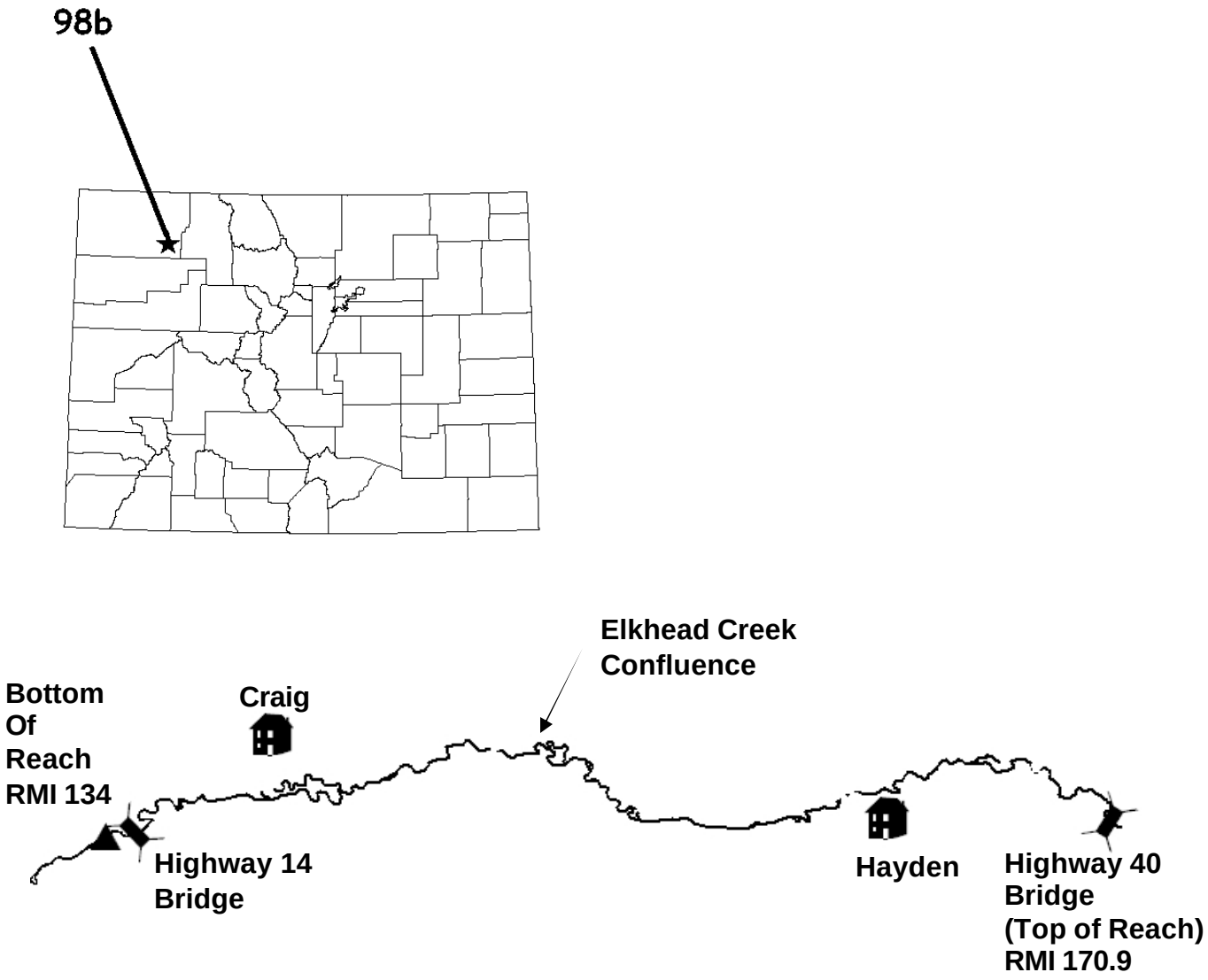

Figure 1.? Upper Yampa River Study Site. RMI= River Mile.

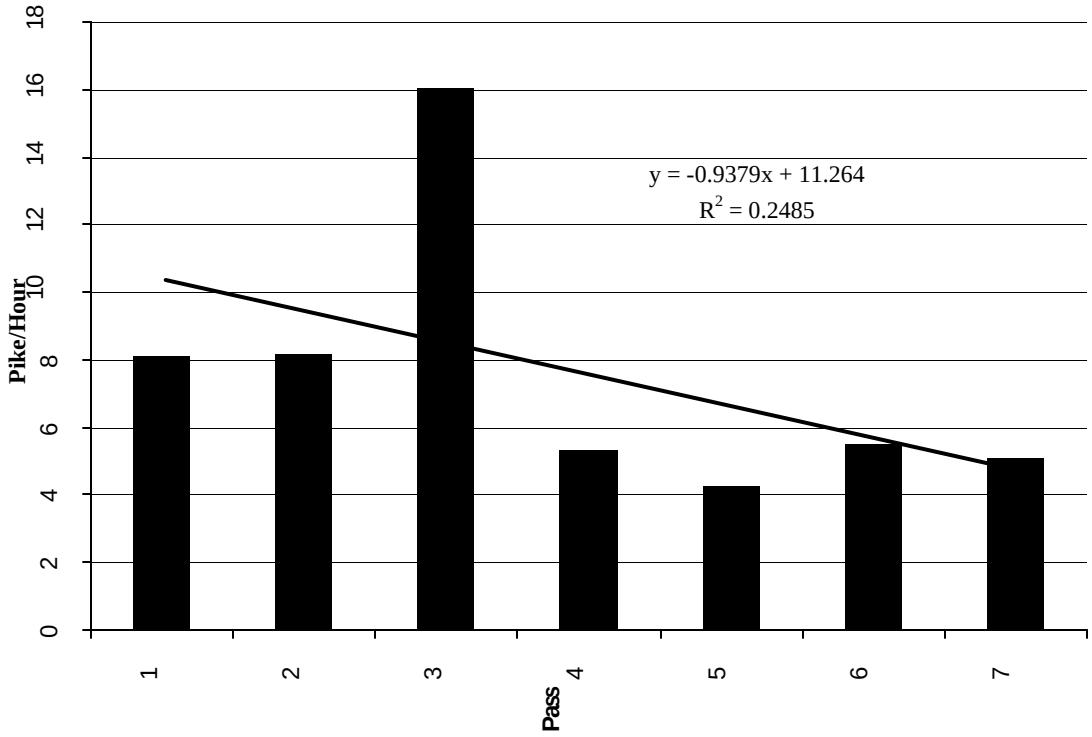

Figure 2. Catch per unit of effort of northern pike by pass, 2005.

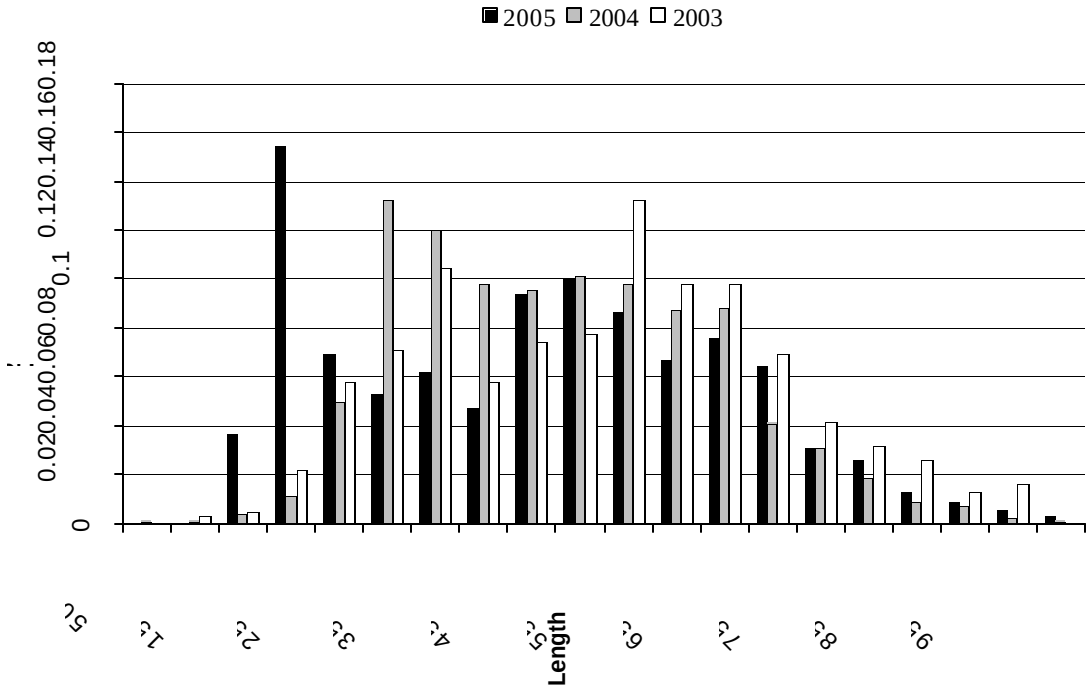

Figure 3. Length frequency of Yampa River northern pike, Spring, 2003-2005.

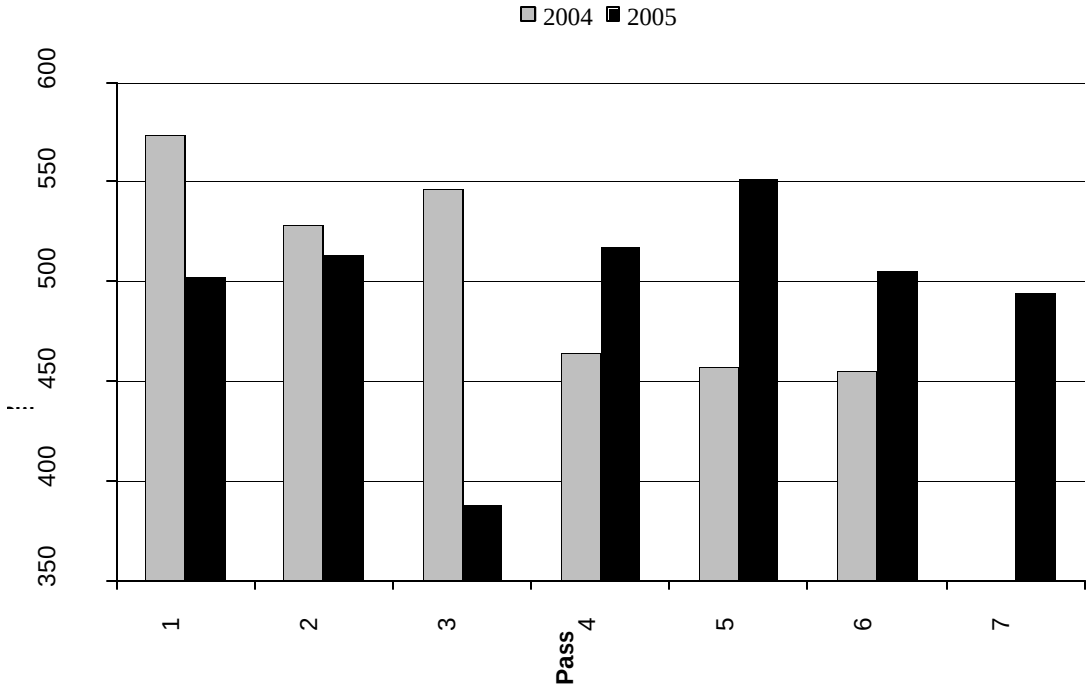

Figure 4. Mean length of northern pike by pass in 2004 and 2005 in the upper Yampa River, Colorado.

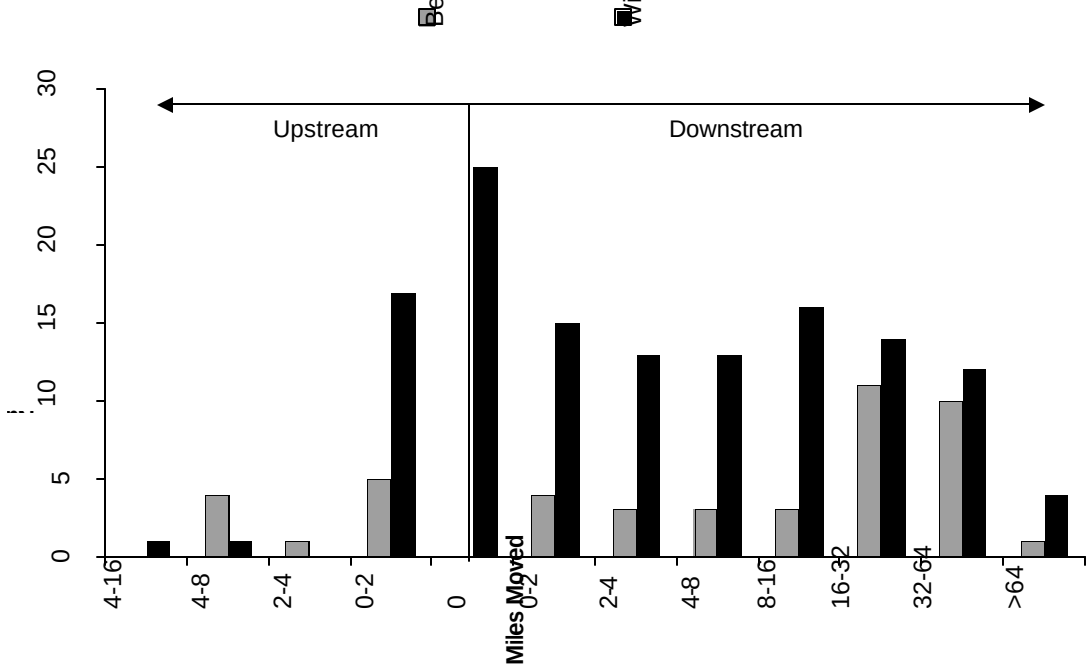

Figure 5. Illustration of the upstream and downstream movements of northern pike.

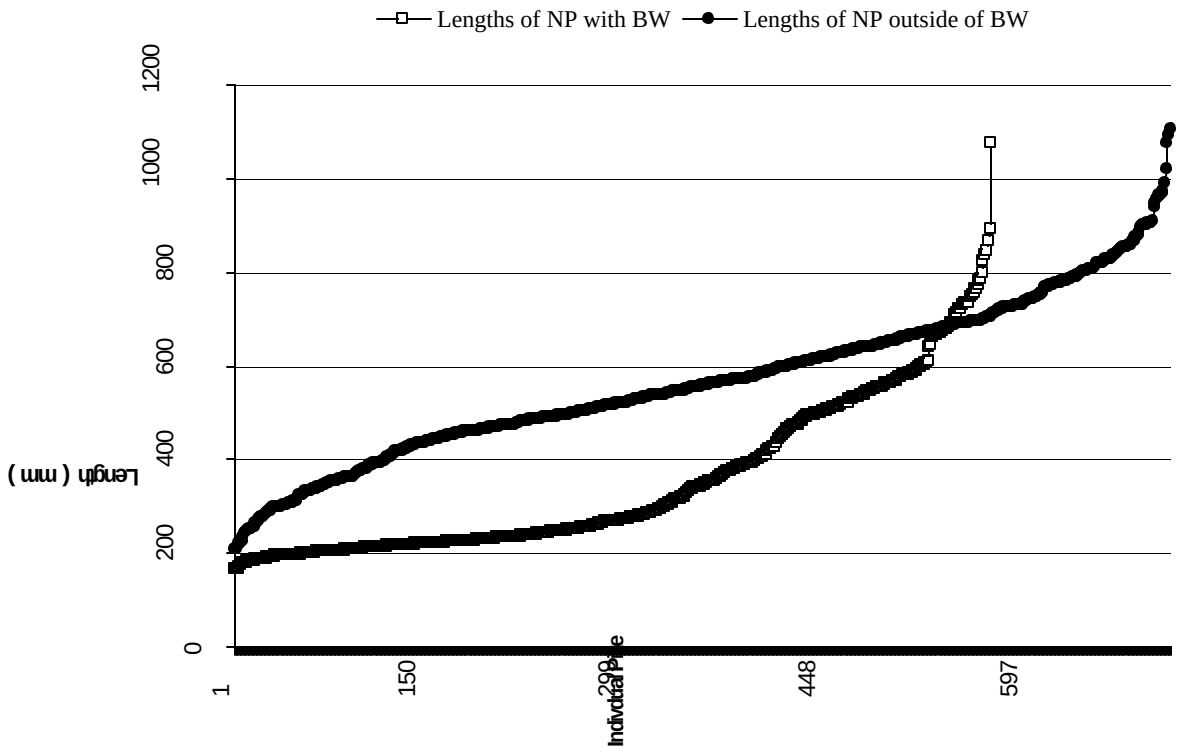

Figure 6. Lengths of all northern pike (NP) collected in river mile 150 backwater (BW) and outside of river mile 150 backwater in 2005.

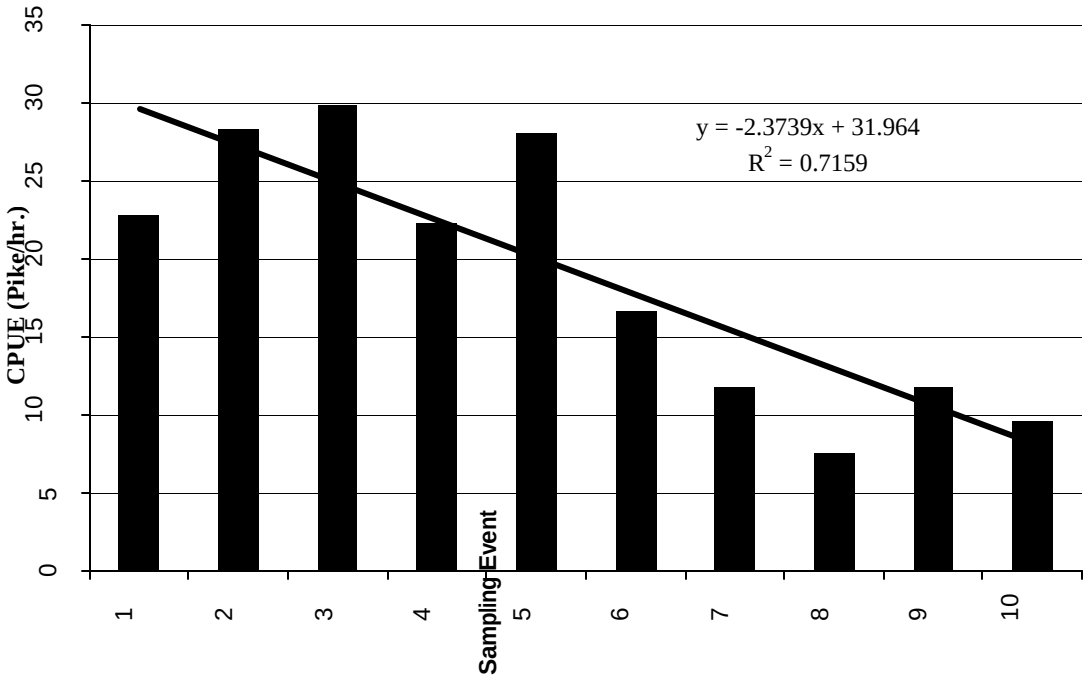

Figure 7. Reduction in catch per unit of effort (CPUE) of northern pike in the Yampa River at river mile 150.

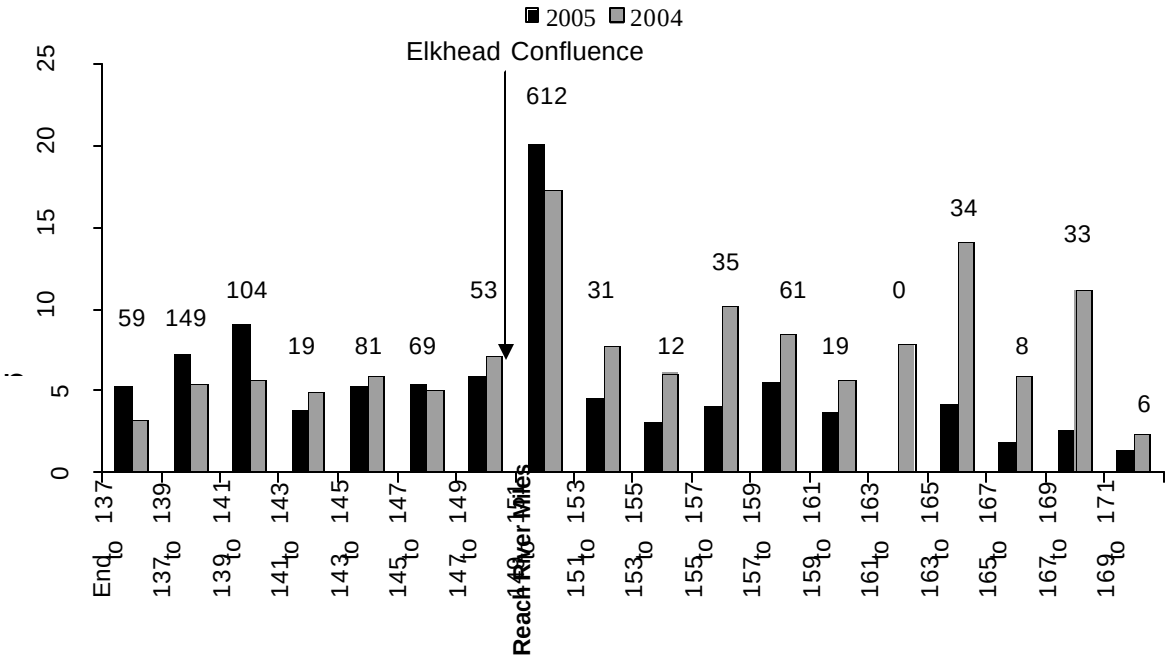

Figure 8. Catch per unit effort (CPUE) for two-mile subreaches in 2004 and 2005. Numbers over the histogram bars indicate the number of pike removed in each individual subreach in 2005. The location of the Elkhead confluence is indicated.

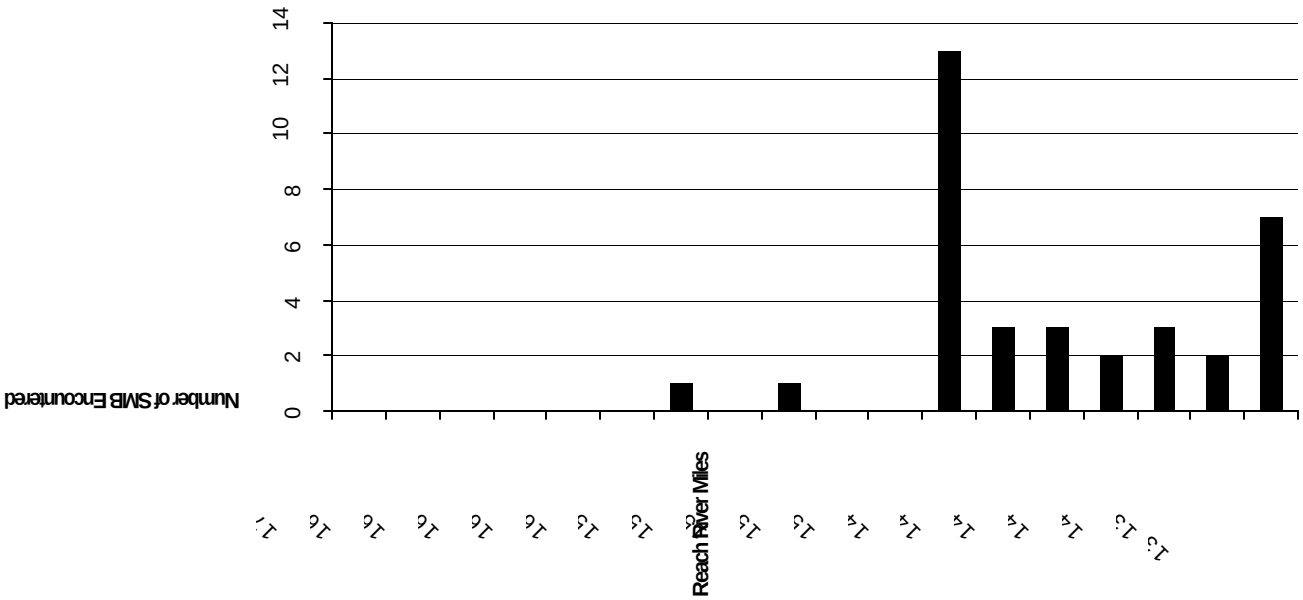

Figure 9.? Smallmouth bass (SMB) encountered by river mile in the Yampa River, Spring 2005.

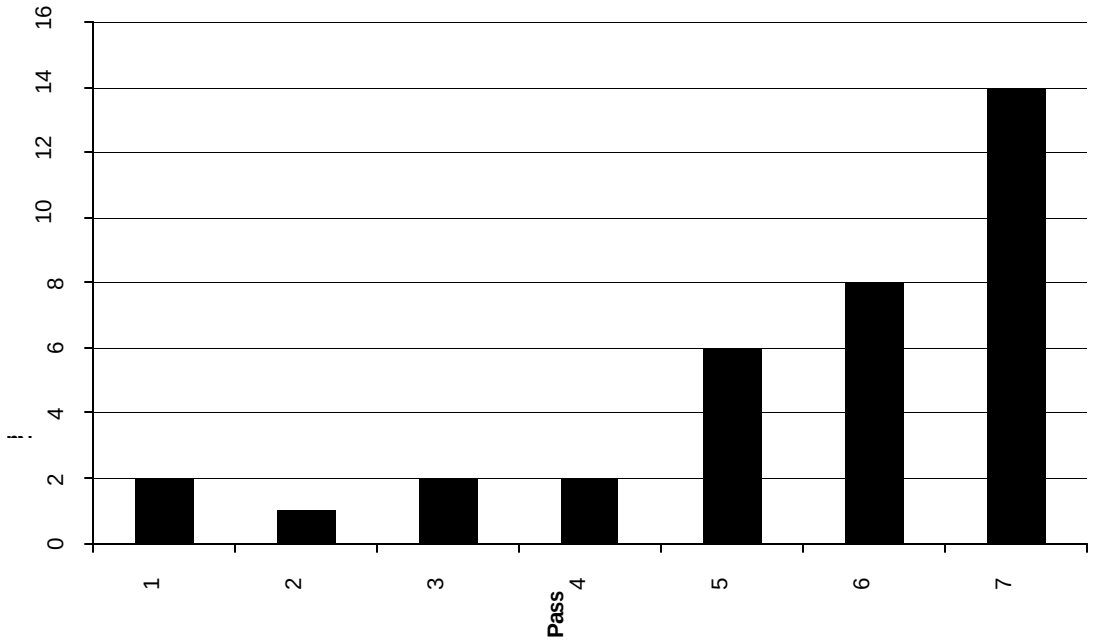

Figure 10.? Smallmouth bass (SMB) encountered by pass in the Yampa River, Spring 2005.

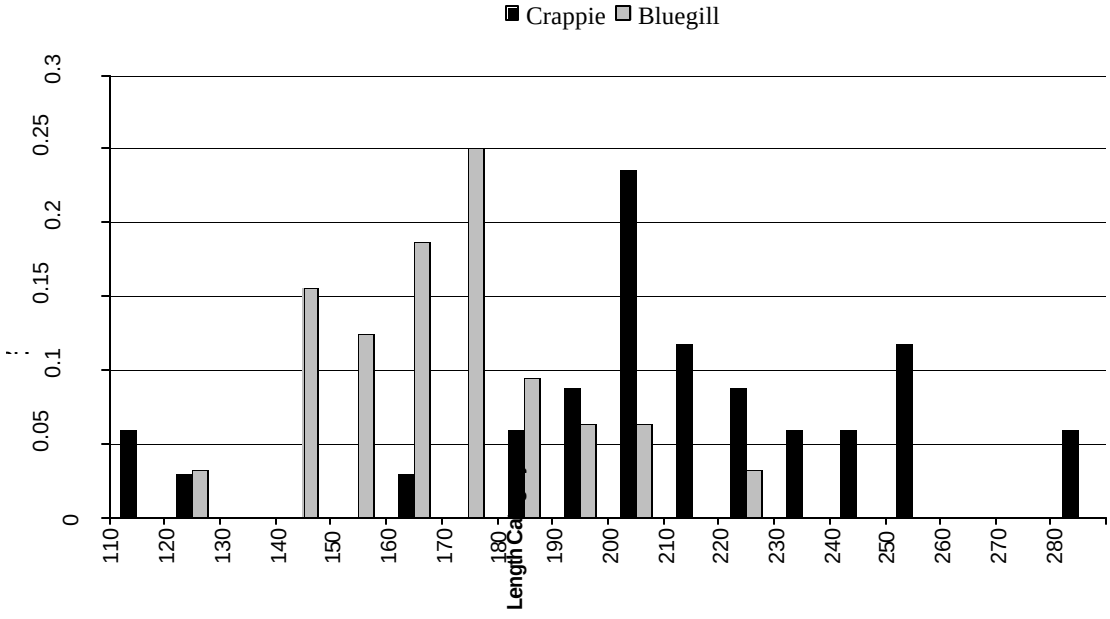

Figure 11.? Length frequency of crappie and bluegill from the Yampa River, Spring 2005.

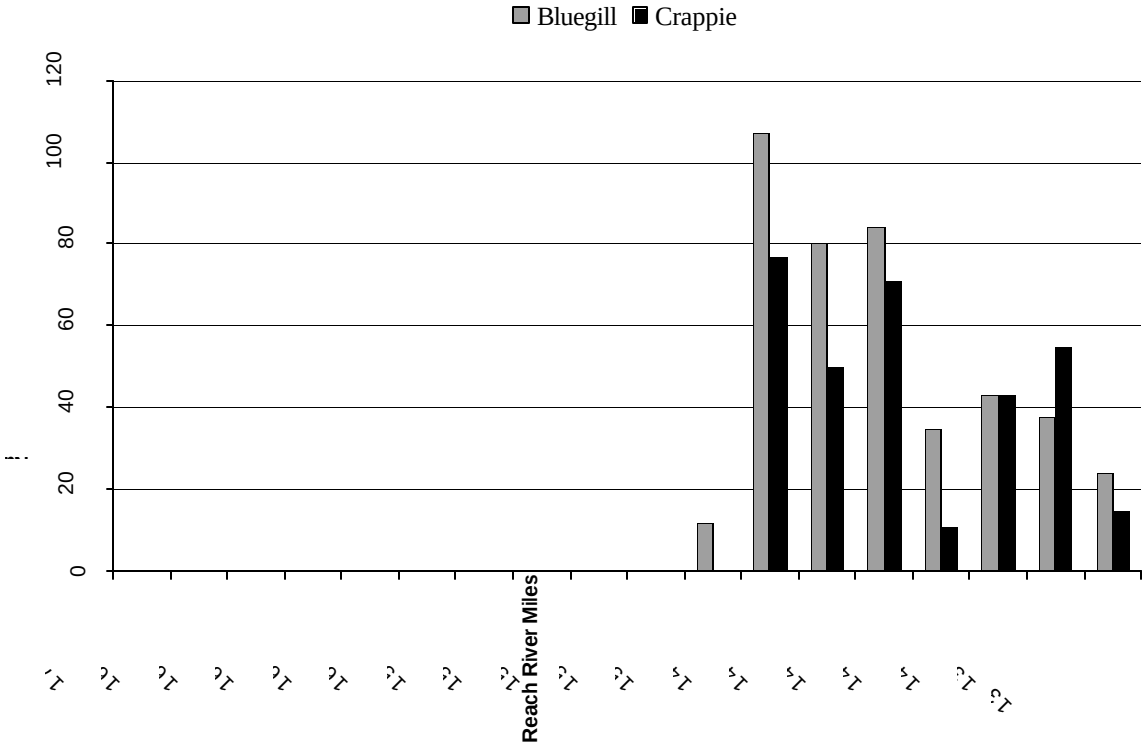

Figure 12.? Crappie and bluegill captures by reach from the Yampa River, Spring 2005. The Elkhead River confluence is at river mile 149.

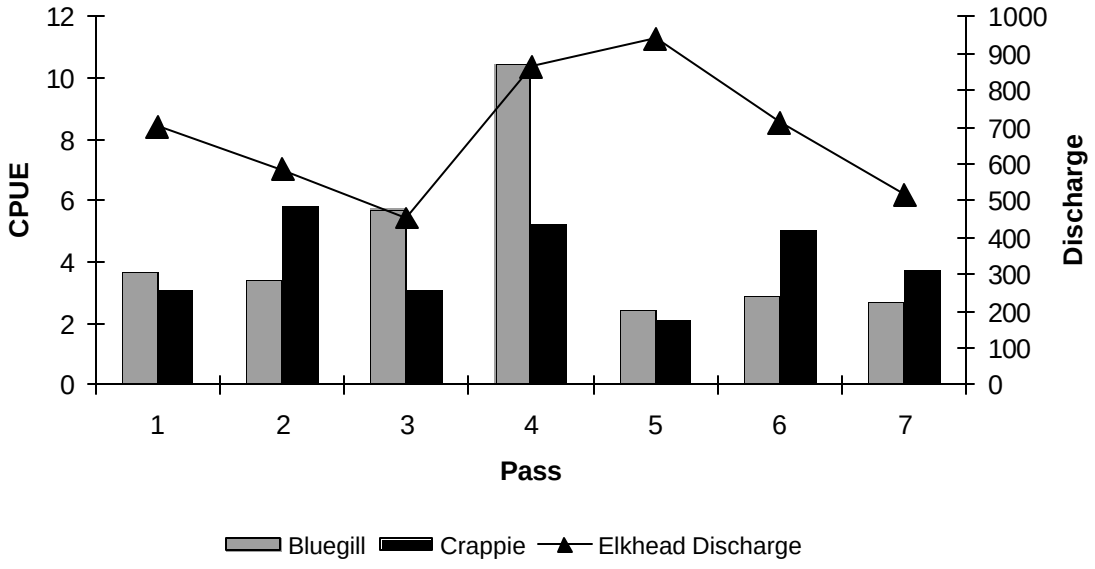

Figure 13.? Catch per unit of effort (CPUE) of crappie and bluegill by pass from the Yampa River, Spring 2005. Discharge from the Elkhead Creek is inserted.

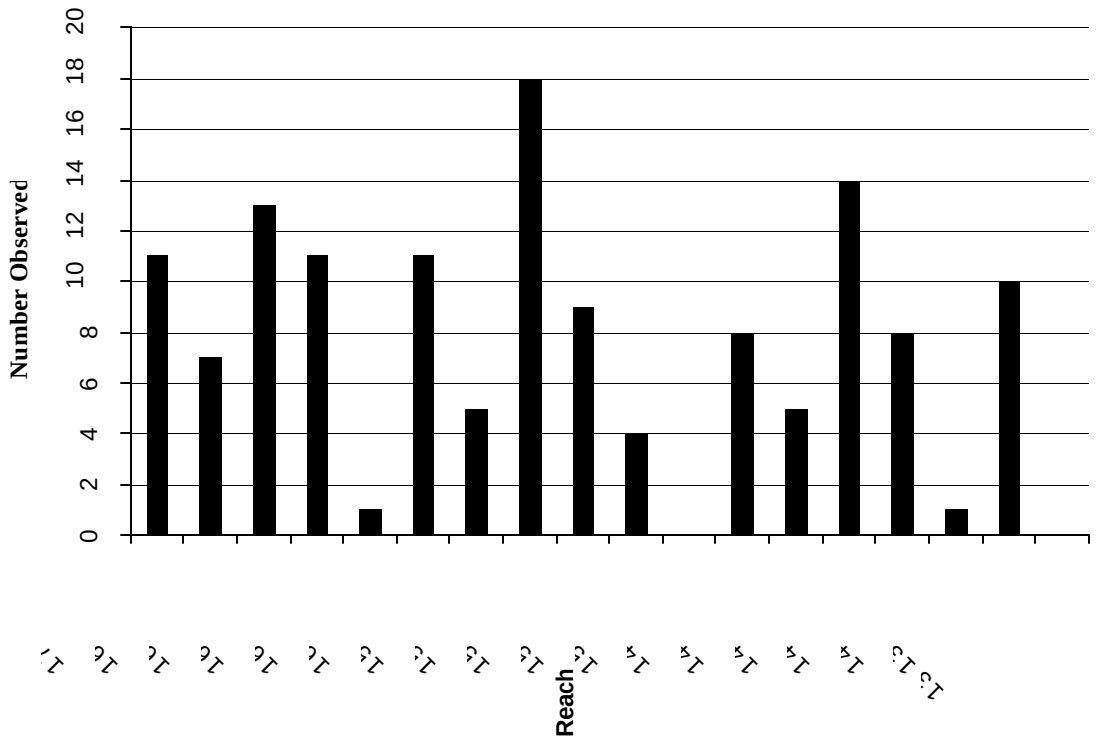

Figure 14.? Mountain whitefish observed by reach during passes 6 and 7 in the Yampa River, Spring 2005.

Table 1. Final disposition of bluegill and crappie captured in the Yampa River, Spring 2005.

	Bluegill	**Crappie**
Released	59	52
Euthanized	360	267
Given to CDOW	3	3
Total	**422**	**322**

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