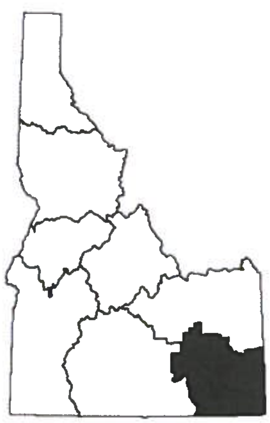
FISHERY MANAGEMENT INVESTIGATIONS

IDAHO DEPARTMENT OF FISH AND GAME

FISHERIES MANAGEMENT ANNUAL REPORT

Virgil Moore, Director

SOUTHEAST REGION
2010



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LOWLAND LAKE AND RESERVOIR SURVEYS AND INVENTORIES

ABSTRACT

Bear Lake sculpin *Cottus extensus* were sampled from Bear Lake, Idaho, during the new moon phase from August 10 through 17. We sampled sculpin at three locations (First Point, Gus Rich, and Utah State Marina) and at two depths. Sculpin density was highest in deep trawls and averaged about 100 adult sculpin per trawl whereas mean sculpin density was considerably less in shallow trawls (35/trawl). First Point had the highest overall mean sculpin density of 96/trawl followed by Utah State Marina at 87/trawl and Gus Rich at 23/trawl. The overall mean adult sculpin catch per trawl was 69, the second highest observed since 1996. The overall mean catch of 69 sculpin/trawl converts to a population estimate of over 2 million adult sculpin, well above the minimum sculpin population as defined in the Bear Lake Management Plan.

Coldwater fishery evaluations were completed on two southeast Idaho reservoirs. Both of the reservoirs (Treasureton and Daniels) are currently managed under trophy trout regulations: 2 trout, none under 20", no bait and barbless hooks only. The primary goal of the surveys was to collect baseline data for biennial evaluation of the trophy trout regulation and to evaluate an immerging avian predation issue. Over the last few years Treasureton Reservoir has experienced avian predation problems. Double-crested Cormorants *Phalakros auritus sp.*, on their annual spring migration to northern breeding colonies, consistently stopover to rest and feed in many of Franklin County's irrigation reservoirs including Treasureton Reservoir. In 2009, most of the 19,500 rainbow trout *Oncorhynchus mykiss* (RBT) fingerlings that were stocked into Treasureton in the spring were lost to Double-crested Cormorant (DC) predation. We responded in two ways to mitigate for this loss. First, we back-filled the loss by stocking surplus catchable trout in May (1,955) and October (1,650) of 2010. Second, we adjusted the stocking schedules for most of the reservoirs in the county so that RBT were planted after DC had left the area (mid-June). Our results suggest we were successful in our mitigation efforts (back-filling with catchable RBT) and by delaying spring stocking until June, we were able to prevent losses to avian predation. The RBT fishery in Daniels Reservoir appears to be performing well with 75% of the fish sampled being slightly below 50 cm (20 inches) and 25% above.

Warmwater fishery evaluations were completed on four southeast Idaho reservoirs during the summer of 2010. The primary goals of these surveys were to collect relative abundance information for pan fish species and monitor largemouth bass *Micropterus salmoides* (LMB) proportional stock densities (PSD). The surveys are part of a monitoring program completed every two to three years. Glendale Reservoir had the highest LMB PSD estimate of 84 followed by Condie (36), Johnson (12) and Lamont (8). Glendale and Condie Reservoirs are poised to provide excellent LMB angling over the next few years. Of the four reservoirs surveyed, Lamont Reservoir had the highest bluegill *Lepomis macrochirus* (BG) PSD (20) followed by Johnson Reservoir at two while the rest of the reservoirs had PSDs of zero.

INTRODUCTION AND OBJECTIVES

Bear Lake Sculpin Trawling

Bear Lake is a 28,328 ha lake located in northern Utah and southeast Idaho. The Utah-Idaho border roughly bisects the 32 km long lake in half and the lake is between 8 - 13 km wide. It has a maximum elevation of 1,806 m above sea level. The maximum depth, when at full pool, is 63 m and average depth is 26 m. Most of the lake bed is covered in fine marl sediment. Primary and secondary production is thought to be limited by precipitation of calcium carbonate, which strips phosphorous from the water column Birdsey (1989). The precipitate also gives the lake its famous turquoise iridescence.

St. Charles, Swan, Big Spring, and Fish Haven creeks are the primary natural tributaries to the lake. In addition to the natural tributaries, Bear River is diverted into Bear Lake. In 1911, a canal was constructed to divert the Bear River at Stewart Dam into Bear Lake. The water delivery system stores spring runoff water in Mud Lake which gravity flows into the northeast corner of Bear Lake. Rocky Mountain Power operates, through a legal decree (Kimball Decree), the top 6.4 m of the lake as irrigation storage. The stored water is pumped out of the lake during summer irrigation and delivered back to the Bear River through the outlet canal.

Bear Lake's fish community supports four endemic species: Bonneville whitefish (*Prosopium spilonotus*), Bear Lake whitefish (*Prosopium abyssicola*), Bonneville cisco (*Prosopium gemmifer*), and Bear Lake sculpin. In addition to the four endemic species, Bear Lake provides habitat for one of two remaining native adfluvial stocks of Bonneville cutthroat trout (*Oncorhynchus clarkii utah*) (BCT).

In 2010 the Bear Lake Management Plan (Plan) was finalized. The Plan specifically outlines a monitoring program for Bear Lake sculpin. Bear Lake sculpin (sculpin) have been monitored since the 1980's first by Utah State University and later by the State of Utah. In 2010, Idaho Department of Fish and Game (IDFG) took over monitoring responsibilities. The management objective for Bear Lake sculpin, as stated in the Plan, is to maintain a minimum population of 1 - 2 million adult sculpin which translates to a mean density of 25 – 50 age-1 (or older) sculpin captured per trawl. If sculpin numbers fall below a mean density of 25 adult sculpin per trawl (1 million sculpin) then lake trout (*Salvelinus namaycush*) stocking will cease and cutthroat trout stocking maybe reduced until the sculpin population rebounds. Bear Lake sculpin monitoring occurs biennially with the next sampling effort scheduled for 2012. For complete details on the Plan see Tolentino and Teuscher 2010.

Largemouth Bass Surveys

In the early 1990s a comprehensive research study was initiated to better understand the biology of LMB in Idaho (Dillon 1991). A conclusion of that work indicated that water temperature was a key factor controlling LMB productivity. Several other studies described growth potential of LMB across their natural range (McCauley and Kilgour 1990; Beamesderfer and North 1995). Those studies coupled with Dillon (1991) identify the maximum growth potential for LMB in the predominately cold water lakes and reservoirs in Idaho. However, many other factors can contribute to the population structure and success of a LMB fishery. Most importantly are harvest, lake productivity, and interaction among fish species (i.e., competition and predation). Monitoring of those variables is necessary to maintain or improve LMB fisheries in southeast Idaho.

Since 1990, several changes have been implemented in southeast Idaho's LMB fisheries. Some of those changes include: 1) restricting harvest, 2) introducing tiger muskellunge *Esox lucius x E. masquinongy*, yellow perch *Perca flacescens* (YP), and crappie *Pomoxis sp.*, and 3) increases in the number of competitive angling tournaments. To evaluate the impact of those changes, the Department monitors the LMB populations at approximately 2 - 3 year intervals. Sampling goals were to collect enough LMB to estimate PSD.

Trophy Trout Surveys

Daniels Reservoir is a 152 ha reservoir situated at an elevation of 1,573 m. Located in Oneida County, Daniels Reservoir is owned by the St John's Irrigation Company and was constructed in 1970. As with all new reservoirs, it enjoyed high productivity during the first few years after construction. Anglers remember abundant, fast-growing trout caught in the 1970s. Non-game fish, notably Utah suckers *Catostomus ardens*, then colonized the reservoir. Department personnel chemically renovated Daniels Reservoir in 1988. It currently has a trophy trout regulation of two trout, none under 20", combined with a barbless hook no-bait restriction.

Treasureton Reservoir is located on Battle Creek in Franklin County. Its primary function is irrigation storage and flood control. Secondarily, the reservoir provides excellent sportfishing opportunities. The dam and reservoir are owned and operated by the Strongarm Reservoir Company. At full capacity, the reservoir is at 1,645 m elevation, covers 58 ha and contains 2,280,000 m^3 of water. The reservoir had been managed as a year-round fishery based on plants of catchable and fingerling rainbow trout. In 1994, reservoir management changed to quality management with a two trout (none between 12 and 16 inches) limit. In 2008, management again changed to a two trout (none < 20") harvest limit. Both Treasureton and Daniels reservoirs contain a monoculture of triploid RBT.

The goal of the surveys was to collect RBT from both bodies of water to assess the size structure of each population and to establish a baseline for biennial evaluation of the trophy trout regulation.

METHODS

Bear Lake Sculpin Trawling

Bear Lake sculpin were sampled during the new moon phase in August. We sampled sculpin with a semi-balloon otter trawl with a head rope of 4.9 m attached to two otter boards. The net had a mesh size of 12.7 mm with the cod-end containing a 5.0 mm mesh liner. We sampled at three locations (First Point, Gus Rich, and Utah State Marina; Figure 1) and at two depths: where the top of the thermocline intersected with the lake bed (10.0 m) and where the bottom of thermocline intersected with the lake bed (18.0 m). At each location a total of 6, 20-minute trawls were conducted (3 at the top and 3 at the bottom of the thermocline) for a total of

18 trawls. While trawling, boat speed was maintained as close to 1 m/s as possible. Trawling began at about 2100 hrs and ended at approximately 0400 hrs. All adult (>35 mm) Bear Lake sculpin and non-target fish encountered were counted and measured (total length) to the nearest mm and released. Young-of-the-year sculpin were counted and released.

Largemouth Bass Surveys

Electrofishing surveys were completed on four southeast Idaho reservoirs. All of the reservoirs are small (< 200 ha), shallow, and productive. Table 1 shows reservoir name, elevation, surface area, species composition, and current LMB harvest regulations.

LMB and potential prey species abundance were evaluated using shoreline electrofishing. Target species for electrofishing included LMB, BG, crappie, and YP.

Catch-per-unit-effort (CPUE) was used to compare the relative abundance of LMB among the different reservoirs. The CPUE data were collected using night-time shoreline electrofishing with boat-mounted equipment. All electrofishing was completed between 2100 and 0400 hours. Netting effort varied depending on catch rates. The first priority was to obtain a random sample of all species. In some waters, BG or YP densities were too high to continually net those species and achieve the sample goal for LMB. In such cases, selective netting for LMB was implemented. Size selective netting periods for LMB were not included in CPUE or PSD analysis. Fish were weighed to the nearest 10 g and measured for total length.

Trophy Trout Surveys

Electrofishing surveys were completed on both reservoirs in the fall of 2010. We used a boat mounted electrofishing unit to survey both bodies of water. Surveys were conducted from 2100 to 0400 hours at each location. Daniels Reservoir was sampled on September 21 and Treasureton Reservoir on September 23. Over the past decade we conducted these surveys during the spring but high water conductivity coupled with extensive macrophytic growth made fish collection difficult. Therefore we decided to switch to fall sampling since it would likely provide more consistent sampling conditions.

RESULTS AND DISCUSSION

Bear Lake Sculpin Trawling

Sculpin trawling occurred from August 10 through August 17, 2010. Sculpin density was highest in deep trawls and averaged about 100 adult sculpin per trawl whereas mean sculpin density was considerably less in shallow trawls (35/trawl; Figure 2). First Point had the highest overall mean sculpin density of 96/trawl followed by Utah State Marina at 87/trawl and Gus Rich at 23/trawl. The overall mean adult sculpin catch per trawl was 69, the second highest observed since 1996 (Figure 3). The overall mean catch of 69 sculpin/trawl converts to a population estimate of over 2 million adult sculpin, well above the minimum sculpin population as defined in the Plan (Tolentino and Teuscher 2010). Therefore no management action is warranted at this time.

Largemouth Bass Surveys

Catch rates of warmwater species varied markedly among reservoirs. BG were most abundant in Johnson Reservoir followed by Lamont Reservoir. LMB were most abundant in Condie Reservoir followed by Lamont, Johnson and Glendale reservoirs, respectively. Crappie were only observed in Glendale and Condie reservoirs (Table 2).

PSD for LMB were greatest in Glendale and Condie reservoirs. PSD for LMB from Glendale was the highest on record calculated from fishery survey data. On several occasions data collected from bass tournament participants yielded higher PSDs than what was observed in 2010 but these results are biased because tournament anglers tend to save their largest fish for weigh-in. The decrease in PSD at Condie Reservoir can be explained by the presence of several cohorts in the 100 – 300 mm range rather than an absence of LMB over 300 mm (Figure 4).

PSD trends for most of the southeast reservoir fisheries are highly variable (Table 3). Protective harvest regulations may moderate the fluctuations in PSDs, but do not appear to guarantee quality fishing. For example, Condie Reservoir is managed using the trophy bass rule of no harvest of LMB under 508 mm. Despite the conservative harvest rule, the PSD in 2010 was just 36 (Table 3) well below what was observed just two years ago. It is also possible that reservoir water levels going into the winter play a role as well.

Similar to LMB, BG PSDs were also variable in the reservoirs surveyed. Lamont Reservoir had the highest PSD (20) followed by Johnson (2) and Condie (0; Table 2). BG are present in Glendale Reservoir however, we were unable to sample any during the survey. We suspect that during the survey, BG were occupying deeper portions of the reservoir and were therefore not susceptible to shoreline electrofishing methodology.

Trophy Trout Surveys

RBT size structure has been variable in both reservoirs over much of the past decade. In 2000, both reservoirs supported large populations of RBT over 400 mm in length regardless of which angling regulation was in play (Figure 5). It is likely that low reservoir levels going into the winter season drive the size structure growth rate of these populations more so than angling regulations. For example, Daniels has been under the same angling regulation for many years. During this time, the fishery has experienced both wet (late 1990's) and dry (mid 2000's) years. In wet years (1999 and 2000) the trophy component of the fishery has been maintained but in dry years (2005) catch of fish over 500 mm declines (Figure 5). Furthermore, when a wet year follows several dry years there appears to be a lag time of about one to two years before the fishery fully recovers. We experienced a wet year in 2009 and it appears the fishery in both reservoirs responded positively in 2010 (Figure 5).

Over the last few years Treasureton Reservoir has experienced avian predation problems. DCs, on their annual migration to northern breeding colonies, consistently stopover to rest and feed in many of Franklin County's irrigation reservoirs including Treasureton Reservoir. In 2009, most of the 19,500 RBT fingerlings that were stocked into Treasureton in the spring were lost to DC predation (Figure 5). We responded in two ways to mitigate for this loss. First, we back-filled the loss by stocking surplus catchable RBT in May (1,955) and October (1,650) of 2010. Second, we adjusted the stocking schedules for most of the reservoirs in the county so that RBT were planted after DC had left the area (mid June). The length-frequency histogram in Figure 5 suggests that we again lost the fingerlings stocked into Treasureton in June 2010 but we do not think this is the case. Fingerlings were also absent from the Daniels Reservoir (no DC predation problem) collection suggesting that these fish were likely foraging in the pelagic area of the reservoirs on zooplankton during the time of the surveys and were not susceptible to shoreline electrofishing methodology.

The results of the Treasureton survey revealed an interesting trend. Over the past two years the number and size of individuals captured that were above 500 mm has been increasing. In 2009 51% of the total catch was above 500 mm whereas 73% were above 500 mm in 2010. The most notable result of the 2010 survey was that we captured three individuals that were over 675 mm – the first time we have ever sampled RBT this large at Treasureton Reservoir. We attribute the positive change in the size of RBT captured at Treasureton to the success of our triploid trout program that was initiated there in 2001. Never before has any cohort of diploid RBT stocked in Treasureton performed as well, in terms of size, as the triploid stock we are currently using.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor avian predation issues on Treasureton Reservoir and adjust stocking plan as needed.

2. Stock 100 to 200 >14" largemouth bass into Johnson Reservoir to improve the bass and BG fishery.

Table 1. Species composition and harvest regulations for reservoirs included in the 2010 warmwater fishery evaluations.

Water	Elevation (m)	Surface Area (ha)	Species Composition	Harvest Regulations
Glendale	1,509	93	LMB[a], BG[b], CR[c], YP[d], RBT[e]	2 none under 16"
Condie	1,500	58	LMB, BG, YP, TM[f]	2 none under 20"
Lamont	1,485	37	LMB, BG, RBT, YP, CR, TM	6 none under 12"
Johnson	1,487	20	LMB, BG, YP, TM, RBT	6 none under 12"

[a] Largemouth bass.
[b] Bluegill.
[c] Crappie.
[d] Yellow perch.
[e] Rainbow trout.
[f] Tiger musky.

Table 2. Catch-per-hour of electrofishing effort in four southeast Idaho reservoirs. Proportional stock density (PSD) values for largemouth bass and bluegill are shown in parenthesis.

Reservoir	BG[a]		CR[b]	LMB[c]		YP[d]	Grand Total
Glendale	0		2	57	(84)	28	87
Condie	67	(0)	2	208	(36)	21	298
Lamont	159	(20)	0	151	(8)	0	310
Johnson	297	(2)	0	108	(12)	13	418

[a] Bluegill.
[b] Crappie.
[c] Largemouth bass.
[d] Yellow Perch.

Table 3. Trends in proportional stock density (PSD) for select largemouth bass populations in reservoirs of southeast Idaho. Values in parentheses were based on data obtained from largemouth bass fishing tournaments. Devils, Twin Lakes, and Winder were not sampled in 2010.

Year	Condie	Devils	Glendale	Lamont	Twin Lakes	Winder
1986				13		
1987						
1988	30		9		25	10
1989						
1990						
1991						
1992				3		
1993	21		6	1		25
1994	58					
1995	(76)		(86)	1		
1996						
1997	(73)		(94)			
1998			83			
1999	43		(75)		0	
2000			(97)			
2001						
2002	97		56	8	0	0
2003	14					
2004						
2005			(100)			
2006	20	7	56	13	48	78
2008	90	65	23			
2010	36		84	8		

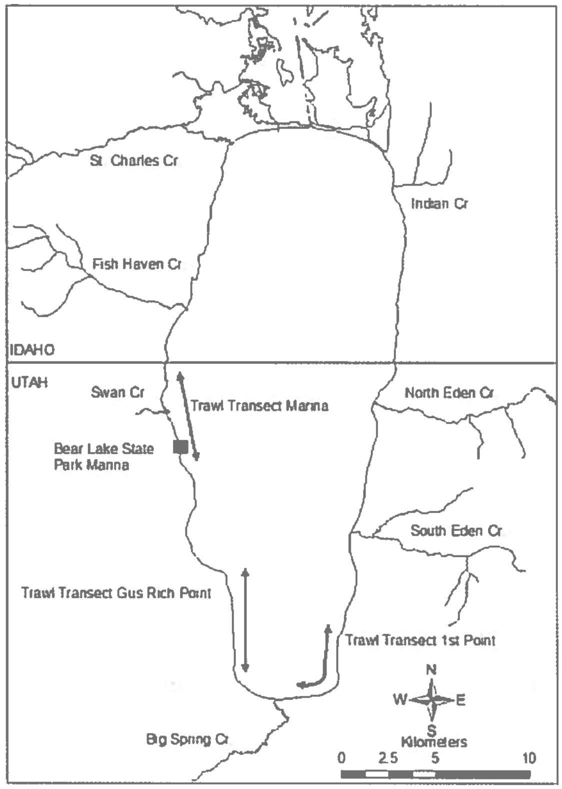

Figure 1. Locations within Bear Lake, Idaho/Utah, where Bear Lake sculpin were sampled via bottom trawl in 2010.

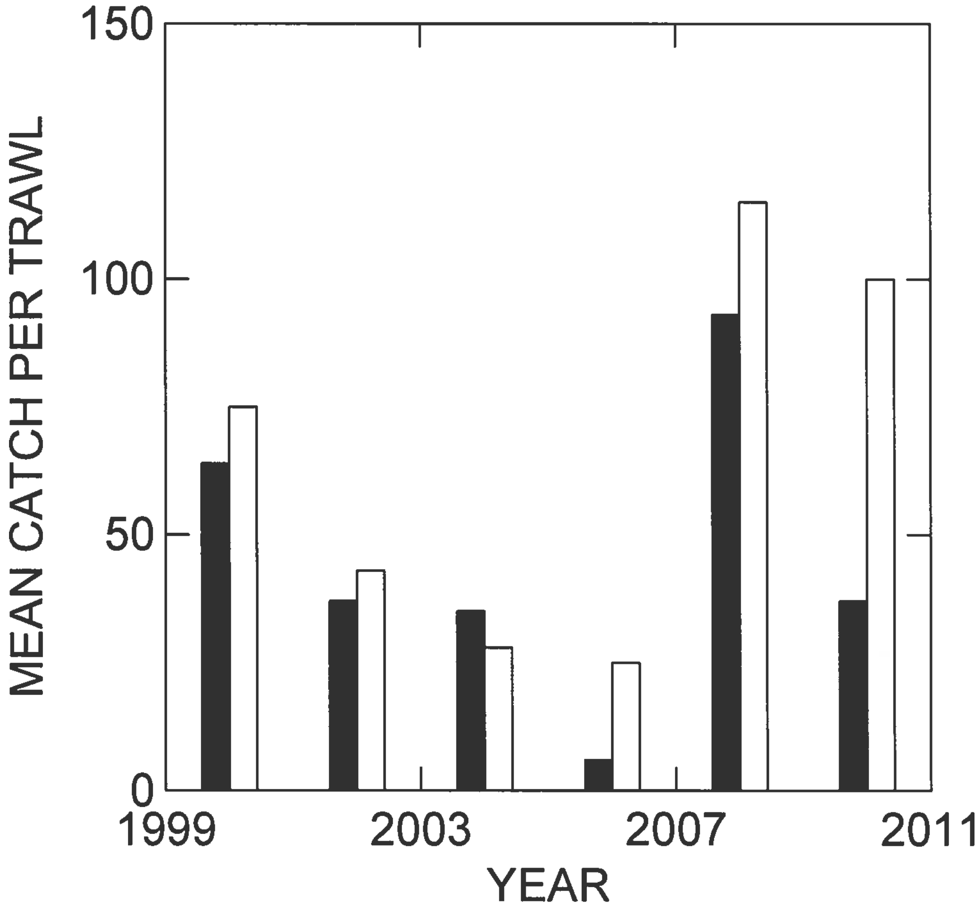

Figure 2. Mean Bear Lake Sculpin catch-per-trawl. Black bars represent samples collected from the top of the thermocline where it intersected with the lake bed (10 m) and the white bars represent samples collected from the bottom of the thermocline where it intersected with the lake bed (18 m). All trawls were 20 minutes in duration.

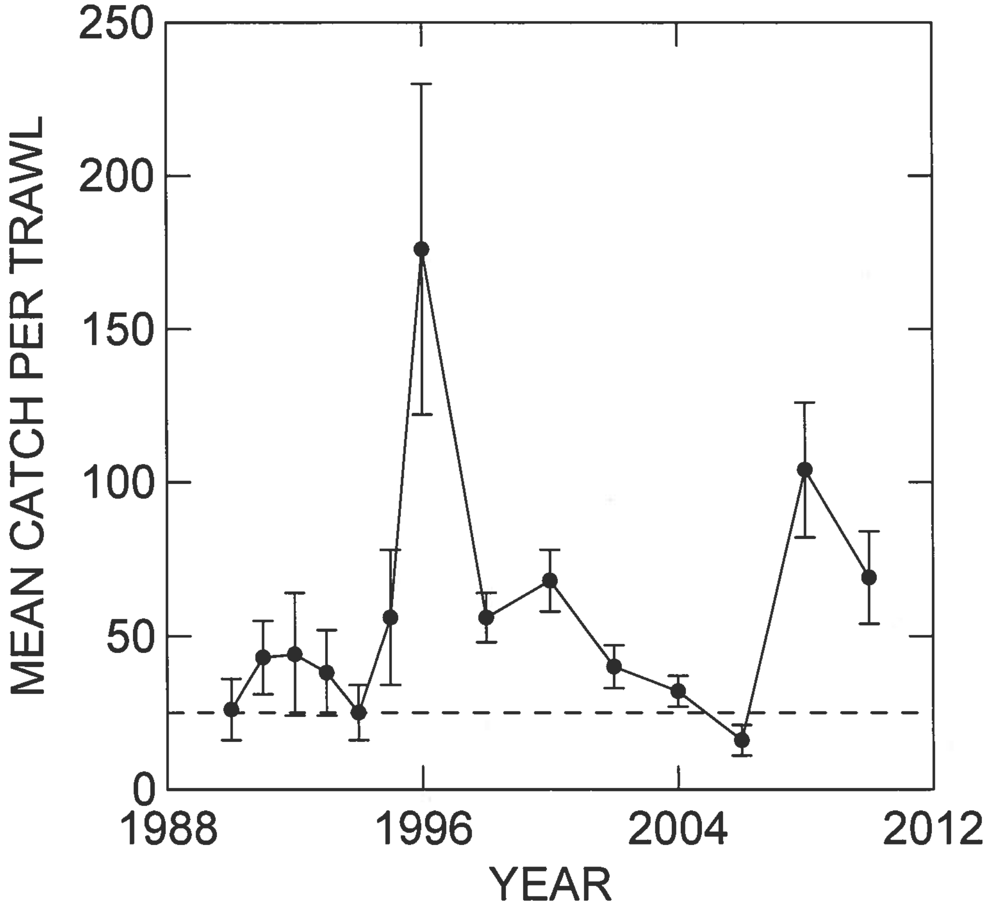

Figure 3. Mean catch (●) and standard error (I) per trawl for Bear Lake Sculpin collected from Bear Lake Idaho/Utah. Each trawl was 20 minutes in duration. The horizontal dashed line represents the minimum acceptable Bear Lake sculpin population of 1 million as defined in the Bear Lake Management Plan (Tolentino and Teuscher 2010).

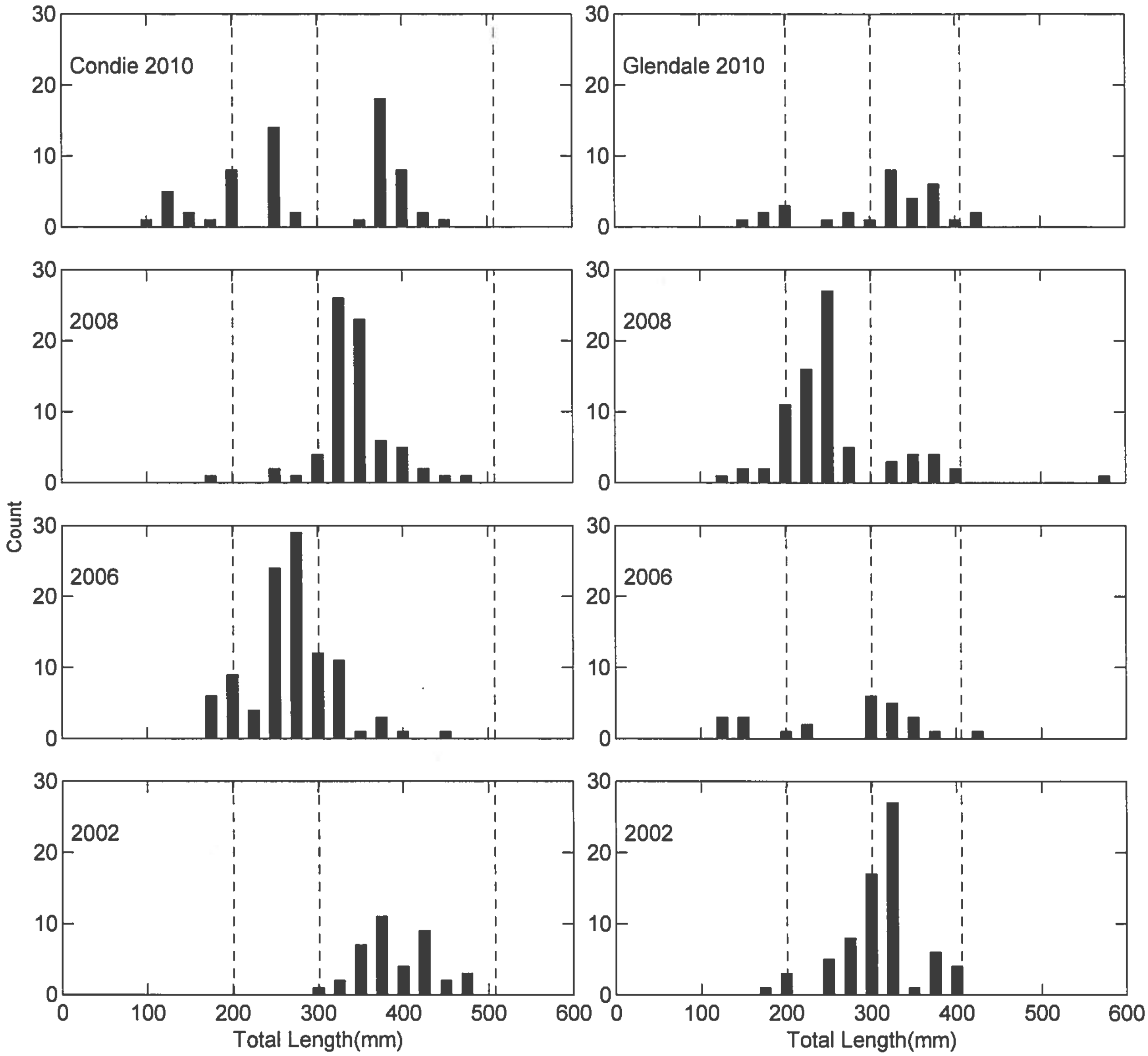

Figure 4. Largemouth bass length frequency distributions from Condie and Glendale Reservoirs. The vertical dashed lines represent largemouth bass stock length (200 mm), quality length (300 mm) and minimum harvest length (508 mm and 406 mm).

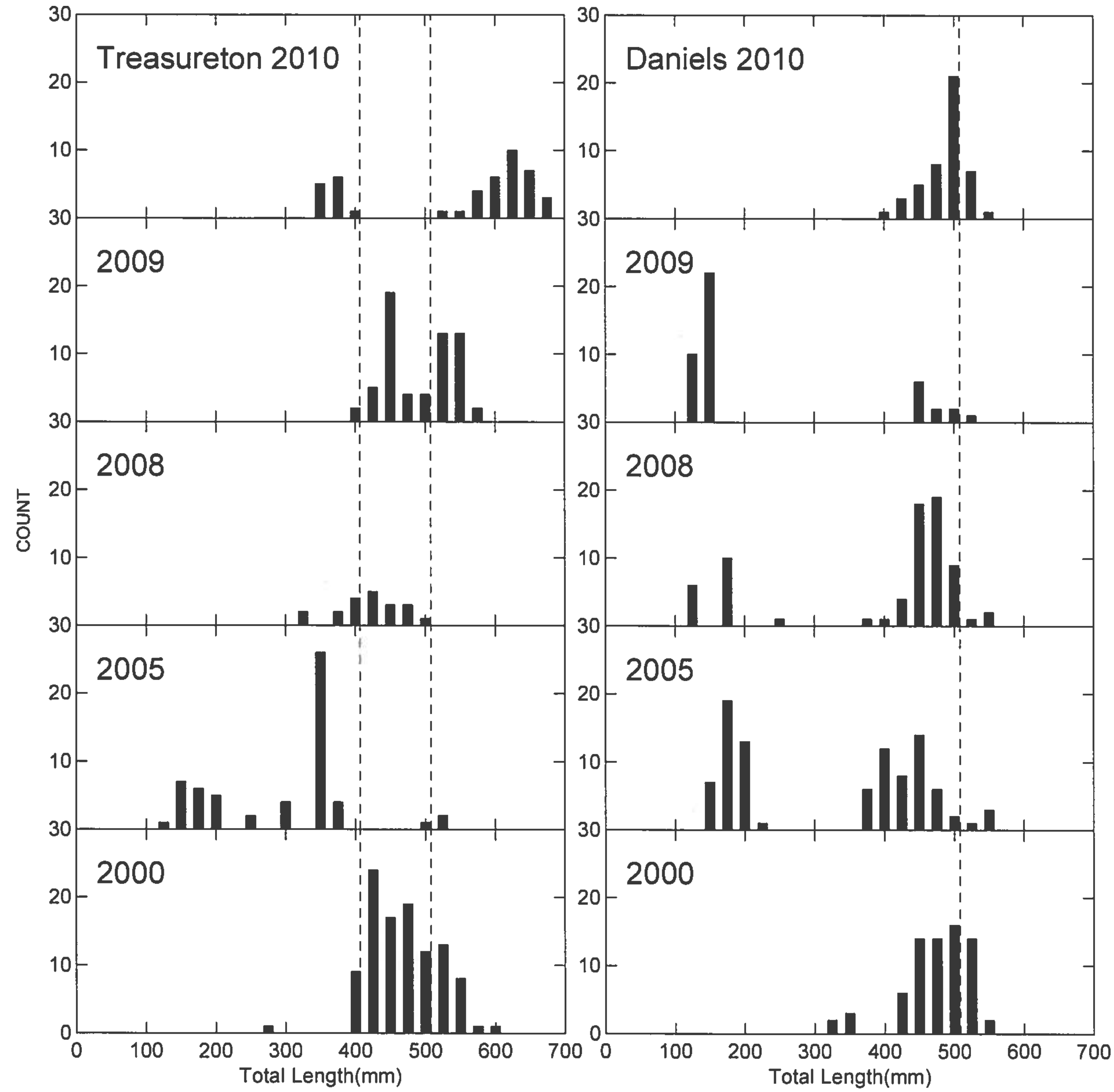

Figure 5. Length frequency distribution of rainbow trout collected from Treasureton and Daniels Reservoirs. Both reservoirs are managed under a trophy trout regulation (2 trout, none < 20", no bait, barbless hooks). The left dashed line in the Treasureton plots represents the 16" minimum length regulation that the reservoir was previously managed under and the right, the new trophy trout size limit of > 20". The vertical dashed line in the Daniels plots also represents the trophy trout minimum length limit of 20". Both reservoirs were sampled in the fall of 2010. Spring surveys were conducted all other years.

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RIVER AND STREAM INVENTORIES AND SURVEYS

ABSTRACT

A remote creel technique (using digital cameras to count vehicles) coupled with angler interviews was used to estimate fishing pressure on the Snake River from American Falls Dam downstream to the Pipeline access area. A total of 15,566 cars were counted from the digital images. We interviewed a total of 194 angling groups on 45 different days during the angling season. Average group size was 2.2 anglers. Total angling effort was an estimated 34,245 hours (15,566 cars X 2.2 anglers per group). The combined catch rate of RBT and smallmouth bass *Micropterus dolomieu* (SMB) per angler hour was 0.5 fish. The harvest rate on RBT was 65% compared to only 12% for bass. The mean size of RBT harvested was 451 mm total length. The average harvest length of SMB was 373 mm total length.

The adfluvial stock of Yellowstone cutthroat trout *Oncorhynchus clarkii bouvieri* (YCT) in the Blackfoot River continues to suffer from drought and predation by American white pelicans *Pelecanus erythrorhynchos* (AWPE). The total run in 2010 was 938 fish. No bird lines were set to reduce AWPE predation at the mouth of the river because the water levels in the reservoir were rising during the YCT migration. We were unable to estimate density of YCT in the upper Blackfoot River due to the low number of marked fish collected during the recapture survey. The lack of recaptures in the catch was not due to poor electrofishing efficiency but rather to losses attributed to AWPE predation.

We tagged at total of 1,203 YCT and 180 Utah chubs *Gila atraria* and Utah suckers collected from the Blackfoot River system with Half Duplex (HDX) Passive Integrated Transponder (PIT) tags in 2010. Of the 180 Utah chubs and Utah suckers tagged and fed to AWPE, 37 were recovered from the nesting colonies on Blackfoot Reservoir. These 37 recoveries equated to a depositional rate of 20.5%. When applied to YCT tags recovered from the AWPE nesting colonies we derived predation rates on YCT. For example, if we recovered 10 YCT tags from the islands and applied the correction factor to this number we would obtain an estimate of predation ($10 \div 0.205 = 49$). So in this example the minimum number of YCT actually consumed by AWPE was 49. Adult YCT were consumed at a rate of 8% while juveniles (≤ 224 mm) had a predation rate of 71%. Juvenile YCT are migrating to the reservoir in May, June, and early July and then again in the fall. We think this life history behavior puts them at higher risk to AWPE predation than older age classes. We do not know at this time if this high predation rate is constant throughout the AWPE breeding season or if it is relatively short lived. If the predation rate is constant over the entire AWPE breeding season then AWPE are preventing the expansion of the YCT population to historical levels.

Pruess Creek, a tributary of the Thomas Fork, was treated with rotenone on November 10, 2009 to remove non-native RBT and their hybrids. We returned to evaluate the renovation on August 26, 2010. We conducted fishery surveys at three sites using a Smith-Root backpack electrofishing unit. The three sample sites were located 200 m downstream of the three rotenone drip can locations. We sampled 1 Bonneville cutthroat trout, 8 dace *Rhinichthys sp.*, 5

mountain suckers *Catostomus platyrhynchus* and 5 sculpin *Cottus sp.* No RBT or their hybrids were detected.

In 2010, IDFG personnel determined that the BCT monitoring program would be better represented by dropping some of the sites and streams initiated in 2006, while adding other streams throughout the four BCT management units in the Bear River drainage. Two segments of the mainstem Bear River in each management unit were also included. Every year, IDFG personnel will sample streams in two of the four management units and the mainstem Bear River segments in one management unit. In 2010, we sampled six streams composed of 13 sites which incorporated some of the new BCT monitoring locations. Mean population densities of BCT decreased in Preuss Creek but increased in Dry Creek relative to 2008 estimates and the composition of BCT remained at 100 percent in both creeks. Overall, mean BCT densities were 3 BCT/100 m^2 (±1; range 0 – 13) for all streams sampled. The highest mean BCT densities were observed in Stockton Creek (8 BCT/100 m^2). The percent composition of BCT in relationship to other salmonids sampled was variable between streams with Bailey Creek having no BCT to 100 percent in Third Creek.

INTRODUCTION

Snake River Creel and Angler Opinion Poll

The Snake River below American Falls Dam is one of the most popular river fisheries in the southeast region. Annual fishing effort in the tailwater fishery varies from 30,000 to 60,000 angler hours. Pressure is focused during June and July. The fishery is largely defined by the opportunity to catch trout over 400 mm in length. However, over the past two decades, fishing for hatchery introduced white sturgeon *Acipenser transmontanus* and SMB have diversified the fishery and increased its popularity.

Past studies of the fishery focused on maximizing return-to-creel and evaluating the impacts of upstream reservoir management. In summary, most of the trout caught in the tailwater originate from hatchery stocking that occurs in American Falls Reservoir (Casey 1967; Heimer 1984; Heimer and Howser 1990; Smith 1991). RBT stocked in the reservoir enjoy excellent growth prior to being entrained to the downstream fishery. Entrainment survival was estimated at 65% (Hiemer and Howser 1990).

A unique feature of the tailwater fishery has been a short season closing one month prior to most seasonal river fisheries. The early closure has been question by anglers in recent years. An organized effort to open the fishery during the winter months to catch-and-release fishing was initiated by interested anglers in 2009. The last creel survey of the tailwater fishery was completed in 2002. The purpose of this work was to collect current angling success information and complete an angler opinion survey of the proposed winter fishery.

Yellowstone Cutthroat Trout Monitoring

There are two long term monitoring programs in place for YCT in the upper Blackfoot River. They are adult spawning counts and population estimates within the Blackfoot Wildlife Management Area (BWMA) located about 51 km above the reservoir. The spawning counts have been completed every year since 2001. The population surveys are completed less frequently.

In 1994, IDFG, with assistance from the Conservation Fund, purchased the 700 ha ranch and began managing the property as the BWMA. The BWMA straddles the upper Blackfoot River, with an upper boundary at the confluence of Lanes, Diamond, and Spring creeks and a lower boundary at the head of a canyon commonly known as the upper narrows. Approximately 9 km of river meander through the property along with 1.6 km of Angus Creek, which is a historical YCT spawning and rearing stream. Since purchasing the BWMA, IDFG has completed periodic population estimates to monitor native YCT abundance.

Predation Rates of Yellowstone Cutthroat Trout by American White Pelicans on the Upper Blackfoot River and Blackfoot Reservoir

During the past eight years, fisheries and wildlife crews have been investigating interactions between AWPE and YCT in the Blackfoot Reservoir/River system in southeast Idaho. Early work focused on estimating consumption and bird scarring rates of YCT by AWPE. Later research focused on estimating predation rates of YCT by AWPE using radio telemetry. All of this early research has focused on the impacts of AWPE on adult YCT but little has been done to assess the impacts of AWPE on juvenile YCT in the upper Blackfoot River.

Blackfoot Reservoir is located in the southeast corner of Idaho at an elevation of 1,685 m. The reservoir covers 7,284 ha (Figure 6). The fish community is dominated by Utah chub, Utah sucker, YP, and common carp *Cyprinus carpio*. YCT and hatchery-stocked RBT make-up less than 5% of the species composition in the reservoir. RBT and various species of cutthroat trout have been stocked in the reservoir since its impoundment in 1912. Recently, cutthroat trout stocking was terminated to reduce the potential interaction with native YCT and triploid RBT are now stocked in the fall after piscivorous birds have left the area for the winter.

Blackfoot River flows into the southeast corner of the reservoir and is approximately 39 km in length from its origin to its confluence with the reservoir (Figure 6). The adult spawning populations of YCT in the upper Blackfoot River has varied markedly over the past 15 years and has not benefited from closing sport fish harvest. Predation loss by AWPE is likely contributing to the low YCT population. The fish community in the river is largely comprised of YCT, redside shiner (*Richardsonius balteatus*), Utah sucker and speckled dace (*Rhinichthys osculus*).

This sections describes our effort to quantify the impacts of AWPE on adult and juvenile YCT populations in Blackfoot Reservoir and the upper Blackfoot River. The specific questions addressed in this study include: 1) What is the predation rate of adult YCT by AWPE and 2) what is the predation rate of juvenile YCT by AWPE?

Preuss Creek Renovation Evaluation

In July 2007, IDFG was notified by Trout Unlimited that RBT, and hybrid cutthroat x rainbow trout were sampled from Preuss Creek. The non-native trout were unexpected and appeared to be associated with a man-made pond filled by an unscreened diversion of Preuss Creek. The pond was located on private property in the lower reaches of Preuss Creek. To assess the extent of hybridization in Preuss Creek, IDFG regional fisheries staff completed a systematic sampling effort over the entire length of Preuss Creek. A total of 35 sites were surveyed using a Smith-Root LR-24 electrofisher. Sites were distributed at 400 m intervals. Results of the survey suggested that hybridization appeared to be limited to the lowest 4.8 km of Preuss Creek. Therefore, in order to limit the potential of RBT and hybrids invading the upper portions of Preuss Creek, IDFG personnel conducted a rotenone project on the lower reaches above and below the man-made pond in 2009.

Bonneville Cutthroat Trout Monitoring

BCT are one of three native cutthroat trout sub-species in Idaho. The distribution of BCT, in Idaho, is limited to the Bear River Drainage. In the early 1980s, distribution and abundance data for this native trout were deficient. Initially, to better understand BCT population trends and the potential influence of natural and anthropogenic processes, a long-term monitoring program was initiated for three tributary streams of the Thomas Fork Bear River (Preuss, Giraffe, and Dry creeks). These streams were to be sampled every other year. Although, in 2006, as part of the BCT Management Plan (Teuscher and Capurso 2007), additional streams were added to the BCT monitoring program to implement a broader representation of BCT population trends from across their historical range in Idaho. These additional monitoring streams included Eightmile, Bailey, Georgetown, Beaver, Whiskey, Montpelier, Maple, Cottonwood, Snow slide, First, Second, and Third creeks, and the Cub River. Finally, in 2010, IDFG personnel determined that the monitoring program would be better represented by dropping some of the sites and streams initiated in 2006, while adding other streams throughout the four BCT management units in the Bear River drainage (Figure 7). The monitoring program consists of three streams and eight sites in the Pegram management unit, six streams and 14 sites in the Nounan management unit, four streams and nine sites in the Thatcher management unit, and four streams and eight sites in the Riverdale management unit (Table 4). Streams will be sampled biennially and in addition to the tributaries, two segments of the Bear River will be surveyed. Mainstem Bear River segments in each management unit will be sampled every four years. In 2010, IDFG personnel sampled six streams composed of 13 sites which incorporated some of the new BCT monitoring locations (Figure 7).

METHODS

Snake River Creel and Angler Opinion Poll

A remote creel technique was used to estimate fishing pressure on the river from the American Falls Dam downstream to the Pipeline access area. That reach of river is an estimated 4.6 km. The remote creel method replaces instantaneous counts with hourly car counts from digital images. The remote creel method works well for fisheries with a limited number of access sites and for waters where angling is the primary reason for accessing the water or parking in the areas photographed. The tailwater fishery below American Falls Dam fits those criteria. Total angling effort was estimated by counting cars that were parked at the common access sites. For the American Falls Dam tailwater fishery, the river is accessible from three primary locations; the power plant, 3-teir Park, and the pipeline. A total of four remote digital cameras were deployed at those access sites. The cameras were set to take hourly photographs of the parking lots. The digital images were reviewed in the office. Total angling effort (hours fished) was estimated by summing the total number of cars counted in the hourly photographs and multiplying that number by the average group size (anglers-per-car). The hourly car counts are analogous to an estimate of group angling hours.

Angler interviews were also completed during 2010. The interviews were used to estimate catch rates, harvest statistics by species, and group size. Angler interview times were split into a morning and evening time slot. Random days and interview times were selected so that three interview periods were completed each week. Each week one weekend day and a two weekdays were sampled for interviews. The interview periods were set for three hours and clerks were instructed to creel anglers that completed fishing.

In addition to collected standard creel data, we asked angler preferences regarding a proposed fishing rule change. Anglers were shown a diagram of existing rule structure (dates and harvest rules) and the proposed changes. In addition to collected responses during the interviews, angler report card boxes were set up at the access points. The report card boxes were stocked with 8" X 5" post cards printed with fishing rule preference questions. Angler opinions collected at public meetings, office walk-ins, random mail survey, and non-random internet survey are also presented here. The random mail survey was issued to 1,000 anglers that purchased angling licenses in the southeast region in 2010.

Yellowstone Cutthroat Trout Monitoring

An electric fish migration barrier was installed in the Blackfoot River in 2003. The barrier includes a trap box designed using Smith-Root Inc. specification. The barrier components include four flush mounted electrodes embedded in Insulcrete, four BP-X.X.-POW pulsators, and a computer control and monitoring system. The computer system can be operated remotely, records electrode outputs, and has an alarm system that triggers during power outages. Detailed descriptions of these components and their function can be obtained at www.smith-root.com.

The electric barrier was operated from April 20 to June 25, 2010. Prior to observing fish at the trap, field crews checked the live box several times a week. On several occasions YCT were angled below the trap, processed and released above the trap. Once fish began entering the trap, it was checked at least once a day. Fish species and total lengths (mm) and weights (g) were recorded. YCT were visually checked for bird scars. Bird scar monitoring began in 2004 (Teuscher and Scully 2004). Scar rates were associated with increases in AWPE feeding in the Blackfoot River downriver of the trap. All salmonids handled at the trap were injected with a 32 mm HDX PIT tag purchased from Oregon RFID (oregonrfid.com). These fish were tagged so they could be included in a AWPE predation study currently underway.

We estimated YCT abundance within 8.7 km of the BWMA reach of the Blackfoot River in 2010. The estimate was completed using mark-recapture methods. Fish were sampled with drift boat-mounted electrofishing gear. All YCT captured were injected (marked) with a 23 mm PIT tag (oregonrfid.com). Fish were marked on July 13 and recaptured July 19, 2010. Data were analyzed using Fish Analysis + software package (Montana Fish Wildlife and Parks 2004). All YCT caught were measured for total length (mm) and weighed to the nearest g.

Predation Rates of Yellowstone Cutthroat Trout by American White Pelicans on the Upper Blackfoot River and Blackfoot Reservoir

HDX PIT tags were used to tag YCT in this study. The tags measured 23 or 32 mm in length and 3.85 mm in diameter and were purchased from Oregon RFID (www.oregonrfid.com). The 23 mm tags were injected in to YCT measuring 120 - 350 mm total length while the 32 mm tags were injected into YCT greater than 350 mm. We tagged YCT at three locations during the 2010 field season: Blackfoot Reservoir, upper Blackfoot River, and at our adult trap situated on the lower Blackfoot River (Figure 8). Adult YCT tagged in the reservoir were captured either by trap net or electrofishing, adult YCT tagged in the lower river were captured at the adult trap and adult and juvenile YCT tagged in the upper river were captured via boat electrofishing. All fish tagged were released in the general vicinity of where they were captured (Figure 8).

We also deployed PIT tag detection antennas at two locations on the Blackfoot River (Figure 8). These antennas were constructed on site using 8 gauge plastic coated braided wire, and PVC pipe and fittings. Each antenna was custom fabricated to cover the entire stream bottom at each location. The antenna deployed on the upper Blackfoot River measured 27 m X 0.5 m while the antenna installed on the lower Blackfoot River, below our adult trap, measured 15 m X 1 m. Both antennas were rectangular in shape and were placed entirely under water with their horizontal plane parallel to the bottom (Figure 9).

Utah chubs and suckers were also PIT tagged. Chubs and suckers were collected from the reservoir via trap net, PIT tagged, injected with air via hypodermic syringe and then fed to AWPE. If a tagged fish was not observed being consumed, it was excluded from the analysis. After AWPE left their nesting sites on Blackfoot Reservoir (Willow and Gull Islands) we went there to recover the PIT tags known to be consumed by AWPE and any other PIT tags (from YCT) that were deposited there (Figure 8). A grid was laid out on the islands and we covered each grid with a backpack PIT tag detector purchased from Oregon RFID (www.oregonrfid.com; Figure 10). The purpose of this exercise was to determine a depositional rate of PIT tags on the islands so this rate could be applied to the YCT tags we also recovered. We tagged a total of 180 chubs and suckers that were consumed by AWPE. Of these 180 tags, we recovered 37 from the islands which provided us with a deposition rate of 20.5%. We then applied this rate to YCT tags we recovered from the islands to arrive at a corrected predation rate. For example, if we recovered 10 YCT tags from the islands and applied the correction factor to this number we would obtain an estimate of predation ($10 \div 0.205 = 49$). So in this example, the minimum number of YCT actually consumed by AWPE was 49.

Preuss Creek Renovation Evaluation

Preuss Creek was chemically treated on November 10, 2009 with Synpren liquid rotenone at a concentration of 2 mg/l for about six hours (Table 5). A total of three drip stations were deployed. Drip stations were spaced about 1 ½ hours apart based on stream flow travel time (Figure 12). Due to the presence of ice in the creek at the time of treatment, we were unable to complete the fishery survey needed to evaluate the project in 2009.

We evaluated the chemical renovation of Preuss Creek on August 26, 2010. We conducted fishery surveys at three sites for 100 m using a Smith-Root backpack electrofishing unit (Figure 11). The three fishery sample sites were located 200 m downstream of the three drip can locations. We sampled 1 BCT, 8 dace., 5 mountain suckers and 5 sculpin. We will return to sample these sites in 1 to 2 years to reevaluate the project. The success of this rotenone treatment will ultimately be determined after a couple of reevaluation efforts.

Bonneville Cutthroat Trout Monitoring

In order to calculate mean BCT densities in monitoring streams, we sampled at least two sites within each stream using multiple pass removal techniques with backpack electro-fishing equipment. At each site, a segment of stream (approximately 100 m) was sampled, which included block nets at the downstream and upstream boundaries. Stream measurements included length (m) and average width (m), so the area (m^2) of the stream sampled could be calculated. The number of fish sampled in each pass was entered into Microfish 3.0 software (Microfish Software, Durham, NC, USA), which calculated a population estimate and used Microsoft Excel (*Data analysis add-in)* to calculate the standard error. This estimate was divided by the area (m^2) sampled and then multiplied by 100 to obtain the number of BCT/100m^2. The percent composition of BCT in relationship to other salmonids was calculated by dividing the number of BCT by the total number of all salmonids sampled. Mean densities and percent composition for an entire stream was calculated by averaging the mean values from each site within a particular stream.

RESULTS AND DISCUSSION

Snake River Creel and Angler Opinion Poll

A total of 15,566 cars were counted from the digital images. Seasonal patterns are shown in Figure 12. We interviewed a total of 194 angling groups on 45 different days during the angling season. Average group size was 2.2 anglers. Total angling effort was an estimated 34,245 hours (15,566 cars X 2.2 anglers per group). The combined catch rate of trout and bass per-angler-hour was 0.5 fish. The harvest rate on RBT was 65% compared to only 12% for bass. The mean size of RBT harvested was 451 mm total length. The average harvest length of SMB was 373 mm total length.

Public response to the proposed rule change on the Snake River below American Falls Dam was mixed. A total of 819 anglers responded to the proposed rule change. Table 6 shows responses from the September public meeting in American Falls, anglers that were contacted directly while fishing the river (creel results), anglers that voluntarily filled out angler report cards that were available to them at the boat ramp below the dam, and anglers that came to the regional office to submit comments (walk-ins). Results from anglers that fish the river were evenly split (184 support and 186 opposed). Of the anglers that did not support the rule, the major concern with the proposal was the early harvest closure. A significant number of the 186 anglers that opposed the rule said they would support a rule change that kept the existing bait and harvest season closure of October 31.

Table 7 shows results from the random mail and non-random internet surveys. Based on past random mail surveys issued in the southeast region, we estimate that only 2.8% of anglers answering the random survey fished the Snake River below American Falls Dam. Therefore, only about 10 (0.028 X 364 = 10) anglers that responded to the random mail survey fish the Snake River tailwater fishery below American Falls Dam. We do not know how many of the non-random internet respondents fished the river.

Yellowstone Cutthroat Trout Monitoring

In 2010, a total of 938 adult YCT were collected at the migration trap. The escapement count was similar to what observed in 2002 and 2009 and was the highest observed since 2001. About 12% of the YCT observed in the trap had fresh bird scars (open wounds) and another 8% had old bird scars (wounds that were healed or nearly so). Fish that exhibited old bird scars probably acquired them while in the reservoir or during a previous spawning run. Scarring rates have varied from no visible scars on fish collected in 2002 to a high of 70% scarred in 2004. Scarring rates may be related to the predation rate by pelicans, but no information is available to determine the relationship. Variation in scarring rates is likely impacted by the overall number of AWPE feeding on the river below the migration trap, water levels and clarity, and hazing efforts exerted on the birds to reduce predation impacts. The hazing efforts were described by Teuscher and Scully (2008). Escapement and bird scar trends are shown in Table 8.

We experienced an unusual migration season in terms of weather in 2010. Water temperature was about 2°C cooler on average during May in 2010 than previous years. During prior migration seasons, 50% of the spawning run had passed the trap on or around May 16th (± 6 days). In 2010, 50% passage did not occur until May 29th, nearly two weeks later than average. It is not known if this delay negatively impacted YCT spawning success in the upper Blackfoot River.

A total of 578 YCT were sampled on the BWMA during the mark and recapture electrofishing surveys which was similar to numbers sampled in recent history (Table 9). However, due to insufficient recaptures of age-1 fish we were unable to calculate a reasonable population estimate for the BWMA in 2010 (Table 9). We think the reason we recaptured so few age-1 fish was due to AWPE predation. As mentioned previously, all fish encountered during this survey were also PIT tagged. Twenty-four PIT tags belonging to age-1 fish tagged at the BWMA were recovered at the AWPE nesting colonies on Blackfoot Reservoir. This represents a minimum predation rate of nearly 15%. If the tag deposition rate (0.205) obtained from the AWPE predation study (See page 35) is applied to the fish tagged on the BWMA, actual predation by AWPE is closer to 117 age-1 fish or nearly 71%. Interestingly only one other PIT tag belonging to an age-3 fish was recovered on the nesting islands suggesting that age-1 fish seem to be the most vulnerable to AWPE predation on the BWMA. This is probably the case since some of these age-1 fish are out-migrating to Blackfoot Reservoir which likely makes them more vulnerable to AWPE predation than fish that remain on the BWMA (Teuscher and Scully 2003). At this time we do not know if AWPE key on age-1 fish for a brief period of time or throughout the summer so it is impossible to determine the overall impact on the upper Blackfoot River YCT population.

In past surveys of the BWMA reach, juveniles (< 300 mm) dominated catch. Thurow (1981) reported that about 80% of the fish caught during population surveys were less than 300 mm total length. Results from 1995, 2005, 2006, 2009, and 2010 surveys show similar ratios of juvenile cohorts (Figure 13).

Predation Rates of Yellowstone Cutthroat Trout by American White Pelicans on the Upper Blackfoot River and Blackfoot Reservoir

Overall, 1,203 YCT were PIT tagged during 2010. A total of 1,038 adult YCT were tagged with 901 being tagged at the adult trap, 59 at Blackfoot Reservoir and 78 (≥ 225 mm) on the upper Blackfoot River. We also tagged 165 juvenile (≤ 224 mm) YCT collected from the upper Blackfoot River (Table 10).

The number of YCT lost to AWPE predation varied between adult and juvenile (≤ 224) size classes. Past radio telemetry research has indicated that adult (spawners) YCT mortality rates are high (83%) with about 21% of the mortality attributed to predation by AWPE (Teuscher 2004). We currently have a graduate student conducting a telemetry study similar to the one mentioned above. His preliminary results indicate an AWPE predation rate of about 36% which is slightly higher than observed in 2004 but is similar to the results we obtained via PIT tags (34%; Green, Master's Thesis, In Progress). The AWPE population was estimated to be 1,734 in 2010, nearly identical to the estimate of 1,748 in 2004. Given that AWPE numbers were similar between the two years, one would expect the predation rate to be similar as well but that was not the case. We think the difference in predation rates between 2004 and 2010 can be attributed to tagging location. In 2004, YCT were telemetry tagged at the trap which is located above the reach of river where AWPE predation is the highest. So, YCT captured at the trap had a higher probability of surviving the remainder of their spawning migration than fish that had yet to navigate the lower river. In 2010, all YCT were (PIT and telemetry) tagged at-large in the reservoir. Therefore, these groups were better suited to capture the extent of AWPE predation than the group of fish tagged in 2004. We suspect that had the test group of fish used in 2004 been tagged in the reservoir they too would have been preyed upon at rate similar to that of the 2010 groups.

As mentioned before, all of the previous research to date has focused on adult YCT AWPE interactions, mainly because it was thought AWPE predation was only significantly affecting this size class of YCT. However, we now know this is not the case. In 2010, of the 165 (≤ 224 mm) YCT tagged in the upper Blackfoot River, 24 of them were consumed by AWPE. When corrected, this represents 117 juvenile YCT consumed by AWPE which translates to a staggering predation rate of 71% (Table 10). Juvenile YCT are migrating to the reservoir in May, June, and early July and then again in the fall. We think this life history behavior puts them at higher risk to AWPE predation than older age classes. We do not know at this time if this high predation rate is constant throughout the AWPE breeding season or if it is relatively short lived. If the predation rate is constant over the entire AWPE breeding season then AWPE are preventing the expansion of the YCT population to historical levels.

This research will continue in 2011. We plan to double our PIT tagging efforts in the upper Blackfoot River to increase our sample size. Furthermore, we will be exploring the possibility of installing several PIT tag detection antennas on Gull Island. The purpose of the antennas will be to provide temporal predation information i.e. when and for how long AWPE are impacting upriver juvenile and adult YCT.

Preuss Creek Renovation Evaluation

On August 26th of 2010, 10 months after the initial treatment, we sampled approximately 600 m of stream to determine the efficiency of the rotenone treatment. We sampled 1 BCT, 2 trout *sp.*, 8 dace *sp.*, 5 mountain suckers and 5 sculpin *sp.* We will return to sample these sites in 1 to 2 years to reevaluate the project. The success of this rotenone treatment will ultimately be determined after a couple of reevaluation efforts.

Bonneville Cutthroat Trout Monitoring

Mean population densities of BCT decreased in Preuss Creek but increased in Dry Creek relative to 2008 estimates and the composition of BCT remained at 100 percent in both creeks (Table 11; Table12). Overall, mean BCT densities were 3 BCT/100 m^2 (±1; range 0 – 13) for all streams sampled. The highest mean BCT densities were observed in Stockton Creek (8 BCT/100 m^2). The percent composition of BCT in relationship to other salmonids sampled was variable between streams with Bailey Creek having no BCT to 100 percent in Third Creek. Stockton Creek was a new stream added to the monitoring program in 2010 and had a BCT composition of 97% (Table 13).

There are a number of variables that may be influencing population trends in BCT monitoring streams, which include annual precipitation, water temperature, irrigation, grazing, etc. Given the sensitive status of BCT and recent petitions to list the species under the Endangered Species Act, it is important to identify and correlate variation in BCT densities that appear to be associated with environmental variables. For example, in the Thomas Fork drainage, where BCT population estimates have been conducted over a 30 year period, there is a correlation between the running three-year average of annual accumulated precipitation, collected from the Slug Creek Divide Snotel site, and the current years BCT estimates (Figure 14).

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor Bonneville cutthroat trout populations.
2. Continue with implementation of the Pelican Management Plan.
3. Continue pelican predation study on the upper Blackfoot River and Blackfoot Reservoir.

Table 4. The number of sites in 20 monitoring streams within the four BCT management units, including the length (km) of stream sampled, total stream length (km), and the percent of stream sampled.

Management Unit	Stream	Sites	Stream Sampled (km)	Stream Length (km)	% Sampled
Pegram	Dry Ck.	2	0.2	13.4	1.5
	Giraffe Ck.	2	0.2	5.7	3.5
	Preuss Ck.	4	0.4	22.0	1.8
	Bear River	2	17.2	61.2	28.1
Nounan	Bailey Ck.	2	0.2	9.9	2.0
	Eightmile Ck.	3	0.3	23.6	1.3
	Georgetown Ck.	3	0.3	21.8	1.4
	Montpelier Ck.	2	0.2	36.0	0.6
	Pearl Ck.	2	0.2	5.3	3.8
	Stauffer Ck.	2	0.2	14.5	1.4
	Bear River	2	18.8	94.5	19.9
Thatcher	Cottonwood Ck.	3	0.3	37.4	0.8
	Hoopes Ck.	2	0.2	13.5	1.5
	Trout Ck.	2	0.2	18.3	1.1
	Whiskey Ck.	2	0.2	5.1	3.9
	Bear River	2	18.0	37.8	47.6
Riverdale	Beaver Ck.	2	0.2	13.7	1.5
	Logan R.	2	0.2	4.7	4.3
	Maple Ck.	3	0.3	16.1	1.9
	Stockton Ck.	2	0.2	9.8	2.0
	Bear River	2	13.6	50.2	27.1
Malad	First Ck.	2	0.2	9.0	2.2
	Second Ck.	2	0.2	8.4	2.4
	Third Ck.	2	0.2	11.2	1.8

Table 5. Various elements of the Preuss Creek chemical renovation project that occurred on November 10, 2009.

Drip Station	Discharge (cfs)	Rotenone Applied (ml)	Rotenone Concentration (mg/l)	Start Time	End Time	Treatment Duration (hrs)
1	7.522	6,138	2	0850	1300	4.16
2	7.522	6,138	2	1300	1730	4.50
3	7.522	6,138	2	1030	1900	8.50
Total		18,414				17.16

Table 6. Public comments from anglers that fish the Snake River below American Falls Dam.

Forum	Support	Oppose	Total
American Falls Meeting	56%	44%	16
Creel survey	53%	47%	316
Voluntary Angler Report Cards	45%	55%	11
Walk-ins at the Regional Office	15%	85%	27
total by number	184	186	370
total by percentage	50%	50%	

Table 7. Random mail and non-random internet response to the proposed rule change on the Snake River. Because of significant differences in response, the non-random internet results were not pooled with the random mail results.

Type of Survey	Support	Oppose	No Opinion	Total
Random mail survey	62%	23%	15%	91
Non-Random internet	79%	19%	2%	426

Table 8. Yellowstone cutthroat trout escapement estimates for the Blackfoot River 2001-2010.

Year	Weir Type	YCT Count	Mean Length(mm)	% Bird Scars	Mean May River Discharge (cfs)	Adult Pelican Count
2001	Floating	4,747	486	No data	74	No data
2002	Floating	902	494	0	132	1,352
2003	Electric	427	495	No data	151	1,674
2004	Electric	125	478	70	127	1,748
2005	Electric	16	Na	6	388	2,800
2006	Electric	19	Na	38	453	2,548
2007	Electric	98	445	15	115	3,416
2008	Electric	548	485	10	409	2,390
2009	Electric	865	484	14	568	3,174
2010	Electric	938	468	12	248	1,734

Table 9. Yellowstone cutthroat trout abundance estimates collected from the Wildlife Management Area of the Blackfoot River, Idaho.

Year	Fish Marked	Fish Captured	Fish Recaptured	% Recaptured	Pop. Estimate	Pop. Estimate SD
2005	266	202	20	7.5	3,664	569.1
2006	339	450	57	16.8	3,534	352.3
2008	223	186	28	12.6	2,504	336.5
2009	279	319	44	15.8	2,567	286.5
2010	317	272	11	3.5	12,944	4,131.2
Mean[a]	277	289	37	13.2	3,067	386.1

[a] Calculated from 2005-2009.

Table 10. Number tagged, size class, tagging and recovery locations of Yellowstone cutthroat trout Passive Integrated Transponder (PIT) tagged in the Blackfoot River drainage, Idaho, in 2010. Blackfoot Reservoir = BFRES, Upper Blackfoot River = UBFR.

			PIT Tag Recovery Locations					
Size Class	Tag Location	Number Tagged	Adult Trap	Upper Blackfoot R.	Lower Blackfoot R.	Nesting Islands	Estimated Predation	Percent Predation
Adult	Trap	901	28	739	66	14	68	8
Adult	BFRES	59	25	27	16	4	20	34
≥ 225	UBFR	78	0	19	4	1	5	6
≤ 224	UBFR	165	0	45	4	24	117	71

Table 11. Bonneville cutthroat trout population densities (BCT/100 m^2) in Preuss Creek from 1981 through 2010. Fish less than 75 mm were not included in density estimates. Starting in 2004, cutthroat trout densities were estimated based on catch from a single electrofishing pass.

		Bonneville Cutthroat Trout / 100 m^2		
Stream	Year	Mean	Range	(+/-) 1 SE
Preuss Creek	1981	11.3	6.2 – 16.3	5.1
	1985	26.1	20.5 – 31.6	5.5
	1986	16.3	15.0 – 17.5	1.3
	1987	15.2	9.7 – 21.0	3.3
	1988	22.0	22.0 – 22.0	
	1989	1.9	1.0 – 2.6	0.5
	1990	3.3	3.1 – 3.5	0.2
	1991	2.3	0.3 – 3.6	0.8
	1993	3.4	0.3 – 6.3	1.5
	1995	3.2	1.7 – 5.9	0.9
	1997	8.8	4.9 – 14.0	2.2
	1998	3.2	3.2 – 3.2	
	2000	7.9	5.6 – 10.7	1.5
	2002	3.1	1.6 – 4.6	0.6
	2004	9.1	0.9 – 21.4	3.3
	2006	6.0	0.0 – 14.1	2.4
	2008	4.0	1.8 – 10.3	1.1
	2010	2.7	2.3 – 3.0	0.3

Table 12. Bonneville cutthroat trout population densities (BCT/100 m^2) in Dry Creek from 1981 through 2010. Fish less than 75 mm were not included in density estimates. Starting in 2004, cutthroat trout densities were estimated based on catch from a single electrofishing pass.

		Bonneville Cutthroat Trout / 100 m^2		
Stream	Year	Mean	Range	(+/-) 1 SE
Dry Creek	1987	14.4	14.4 – 14.4	
	1990	4.3	4.3 – 4.3	
	1993	0.0	0.0 – 0.0	
	1998	16.8	11.2 – 24.8	4.1
	2000	24.9	22.6 – 27.2	2.3
	2002	0.6	0.3 – 0.9	0.3
	2004	0.0	0.0 – 0.0	
	2006	3.1	0.0 – 5.2	1.2
	2008	1.4	1.4 – 1.5	0.1
	2010	2.0	1.9 – 2.0	0.1

Table 13. Descriptive values of BCT population trends from monitoring streams sampled in 2010.

				Bonneville Cutthroat Trout / 100 m^2			
Management Unit	Stream	Year	Sites	Mean	Range	(+/-) 1 SE	% Comp
Nounan	Bailey Creek	2006	1	0.0	N/A	0.0	0
		2008	1	2.8	N/A	0.6	12
		2010	1	0.0	N/A	0.0	0
	Eightmile Creek	2006	1	1.0	N/A	0.0	2
		2008	1	2.6	N/A	0.7	11
		2010	3	0.9	0.3 - 1.5	0.4	5
Riverdale	Stockton Creek	2010	2	8.0	3.0 - 12.9	5.0	97
Malad	Third Creek	2006	2	1.0	0.0 – 2.0	1.0	100
		2010	3	1.7	0.0 - 2.9	0.9	100

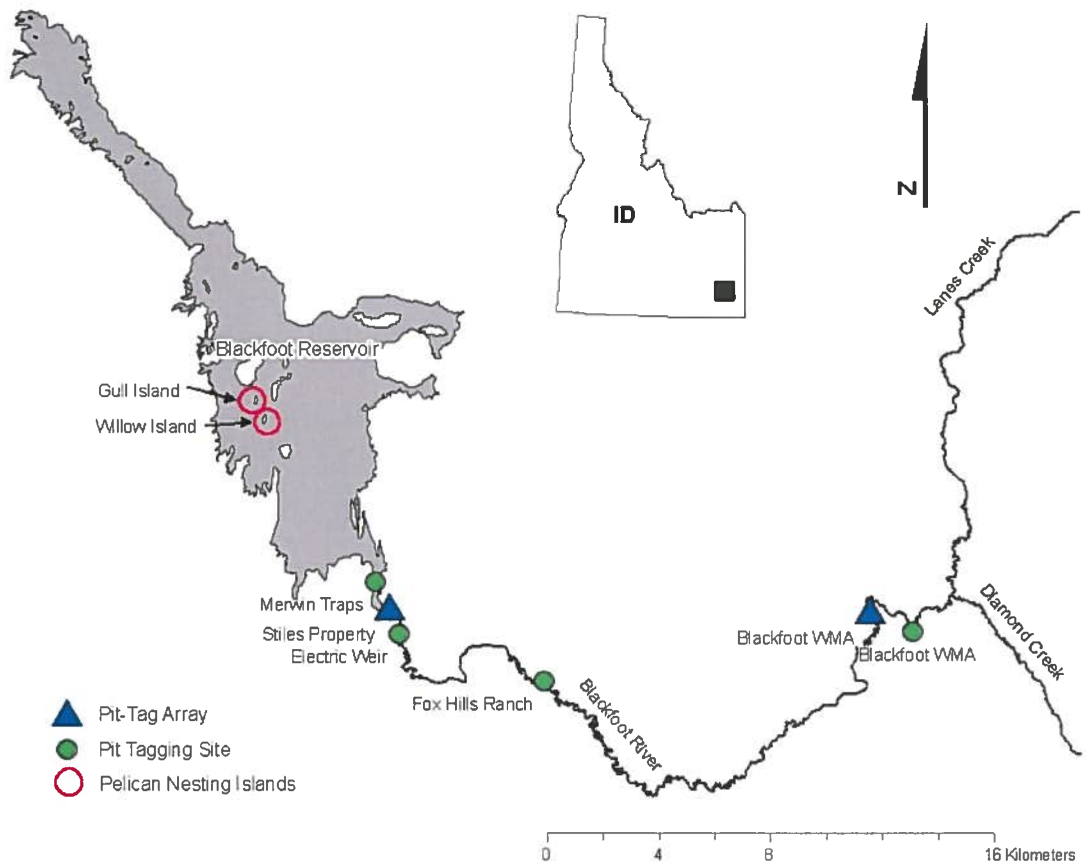

Figure 6. Map of study area showing Blackfoot Reservoir and the Blackfoot River located in southeast Idaho.

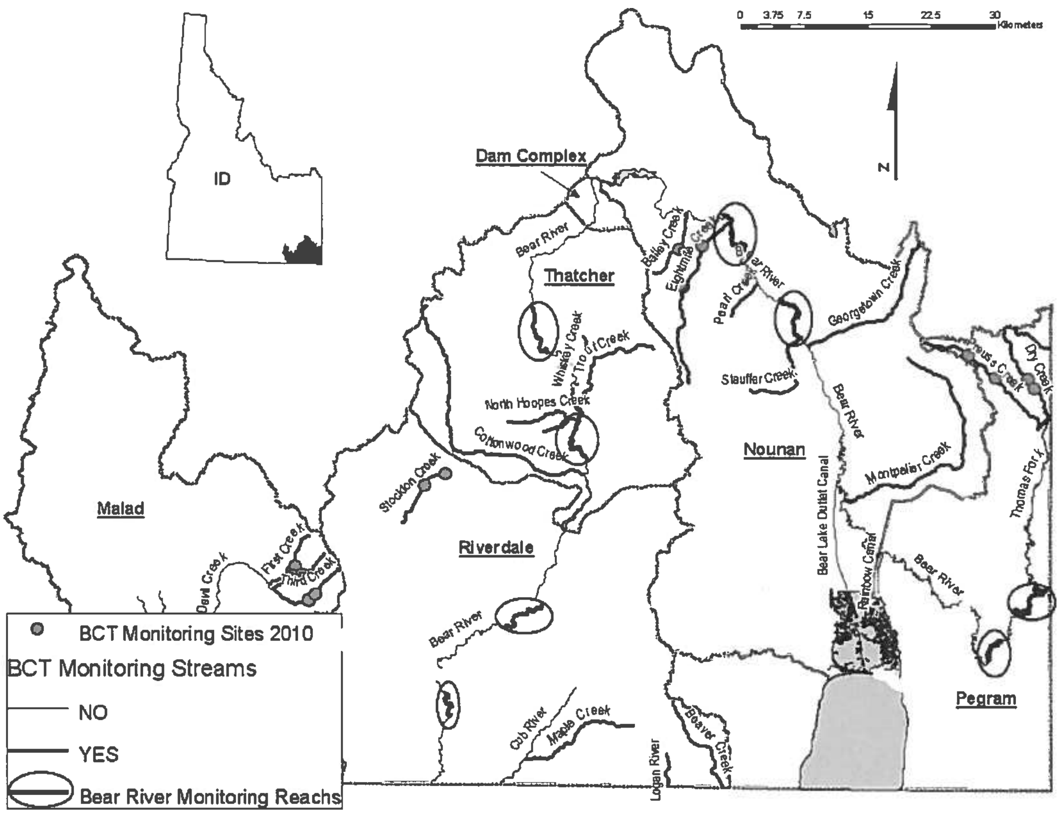

Figure 7. Map of the Bear River watershed in Idaho, including the four Bonneville cutthroat trout management units and 20 population monitoring streams, and mainstem Bear River monitoring sites. Gray circles represent sites sampled during the summer of 2010.

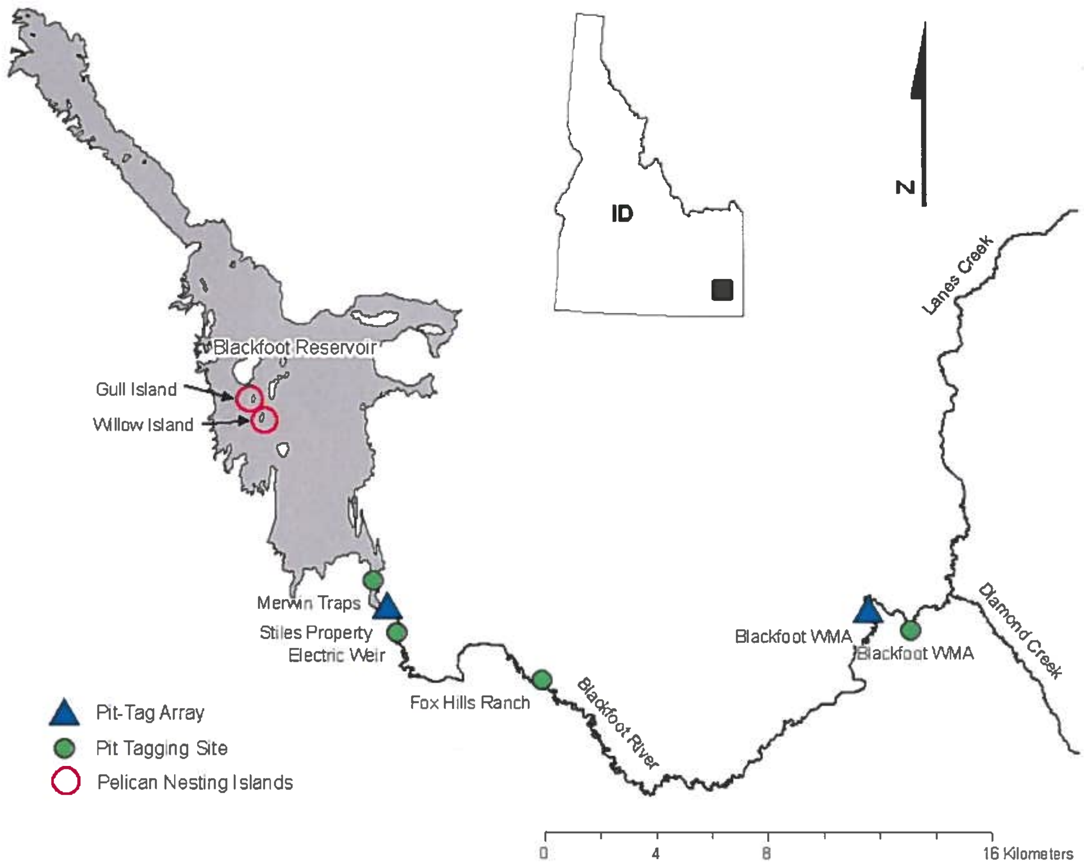

Figure 8. Locations in the Blackfoot River drainage where Yellowstone cutthroat trout were collected, Passive Integrated Transponder tagged, interrogated and released in 2010.

Figure 9. Typical Passive Integrated Transponder (PIT) detection antenna, similar in design to those installed in the Blackfoot River, Idaho, in 2010. Photo provided by Oregon RFID (www.oregonrfid.com).

Figure 10. Backpack Passive Integrated Transponder (PIT) tag detector used to recover PIT tags from the two American White Pelican nesting colonies on Blackfoot Reservoir, Idaho, in 2010. Photo provided by Oregon RFID (www.oregonrfid.com).

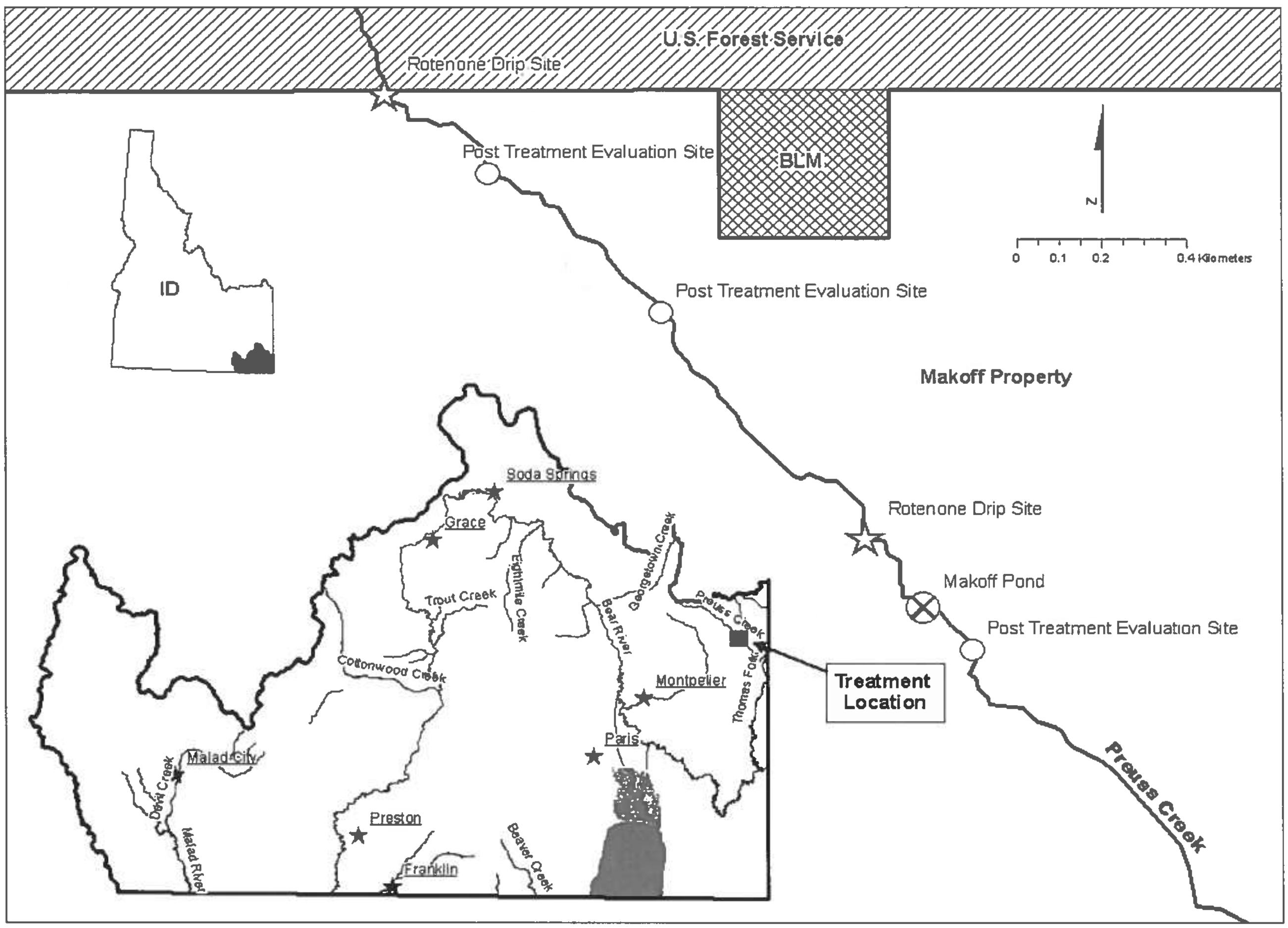

Figure 11. Locations where Synpren liquid rotenone was applied to Preuss Creek on November 10, 2009 and post treatment sample locations conducted on August 26, 2010.

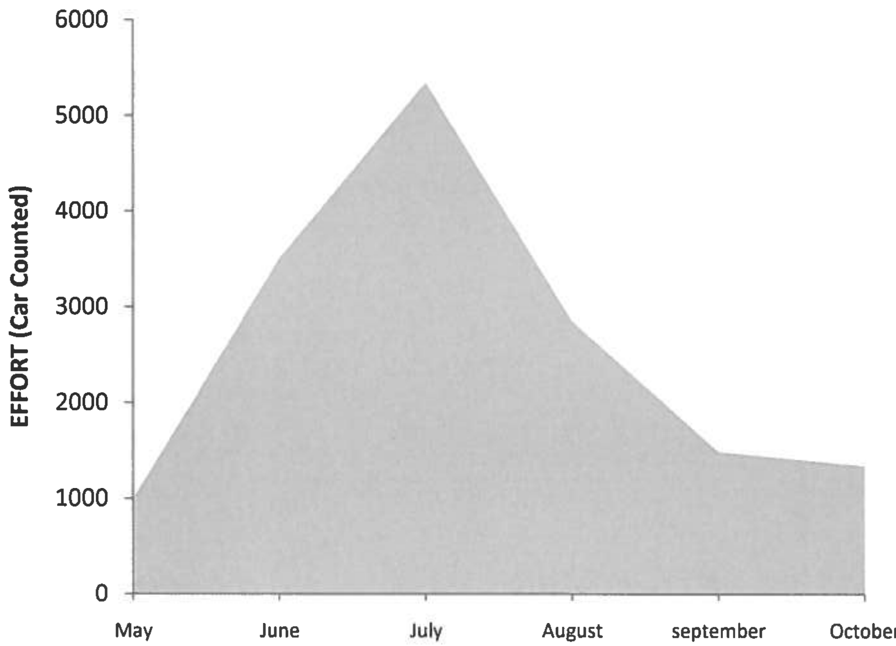

Figure 12. Seasonal effort (cars counted) at three access sites along the Snake River below American Falls Dam.

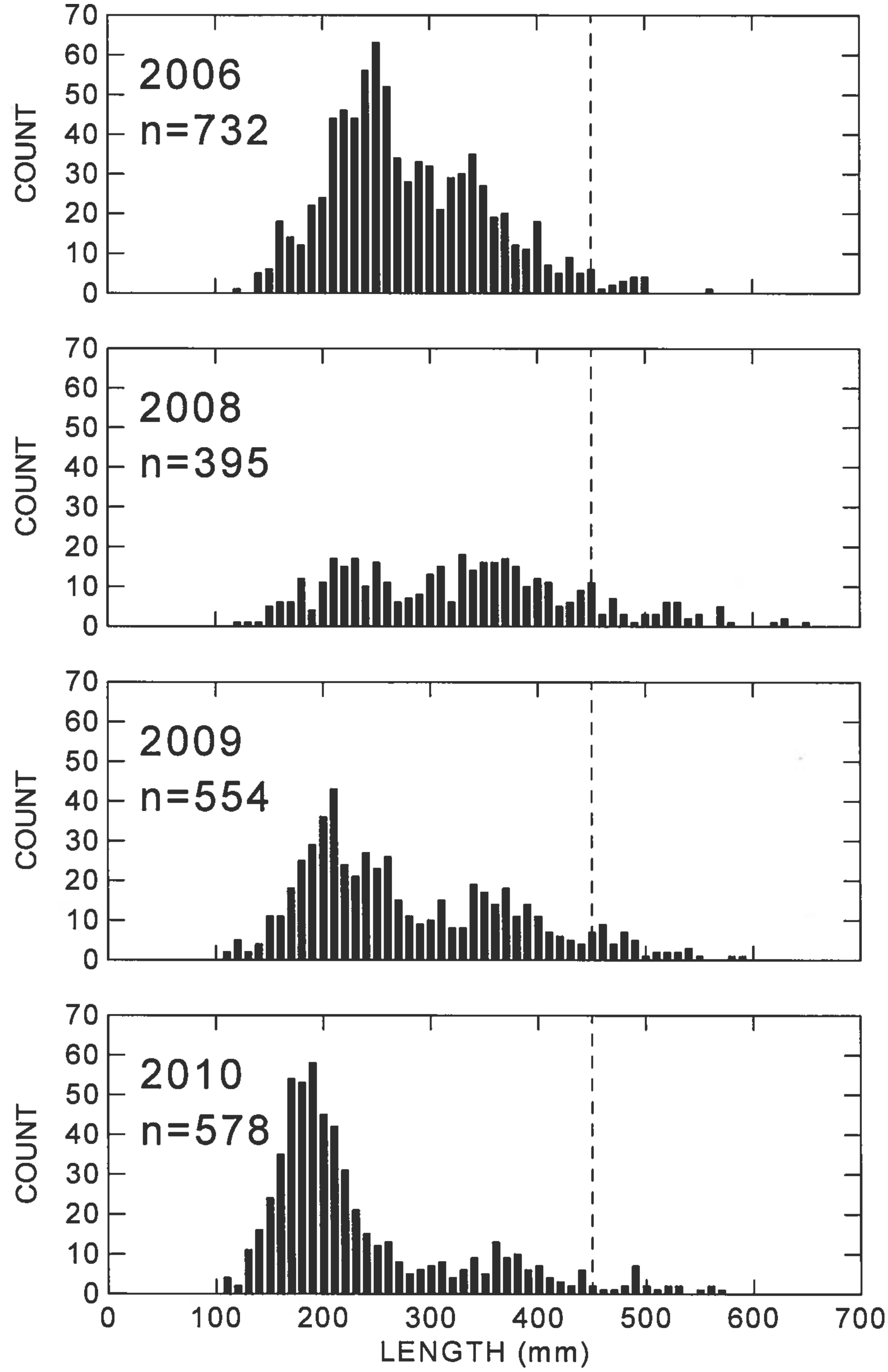

Figure 13. Length frequency distributions of Yellowstone cutthroat trout caught from the Blackfoot Wildlife Management Area of the Blackfoot River, Idaho. The majority of fish located to the right of the vertical dashed lines are likely post spawn adfluvial fish returning to Blackfoot Reservoir.

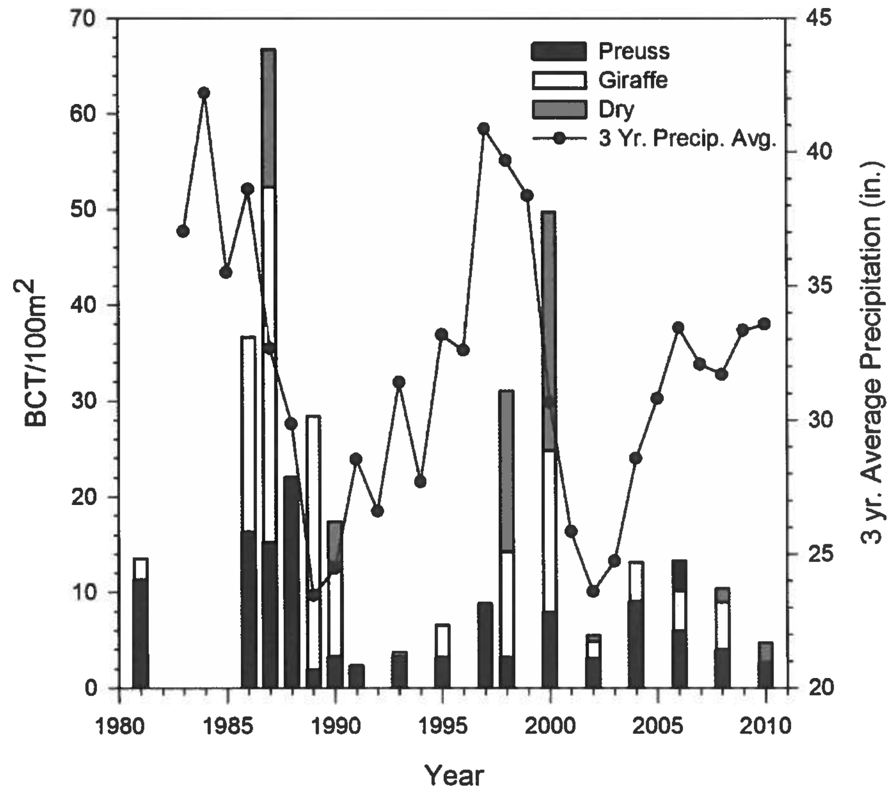

Figure 14. Bars represent Bonneville cutthroat trout population trends in the Thomas Fork tributaries and line shows the running three year average of accumulated precipitation recorded from the Slug Creek Divide Snotel site.

APPENDIX A: AMERICAN WHITE PELICAN PREDATION ON YELLOWSTONE CUTTHROAT TROUT IN THE BLACKFOOT RIVER SYSTEM, IDAHO.

American White Pelican Predation on Yellowstone Cutthroat Trout in the Blackfoot River System, Idaho.

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ABSTRACT

Growth of American White Pelican (AWPE) *Pelicanus erythrorhynchos* nesting colonies in southern Idaho since the early 1990s has generated concerns about the effect of pelican predation on Yellowstone cutthroat trout (YCT) *Oncorhynchus clarkii bouvieri* in the Blackfoot River System. Nesting AWPE on Blackfoot Reservoir have increased exponentially from 0 nesting birds in 1992 to a peak abundance of 3,418 in 2007. The abundance of YCT migrating up the Blackfoot River from the reservoir to spawn declined from 4,747 in 2001 to a low of 16 in 2006, rebounding to 938 in 2010.

Documentation of pelican predation impacts on YCT began in 2002 and includes estimates of pelican exploitation on YCT, evaluation of bird scarring rates, and use of automated digital photography. To date, findings include two separate estimates of direct predation on migrating YCT using radio telemetry. The most recent, minimum estimate was completed in 2007, where 9 of 27 (33%) radio-tagged YCT were consumed by nesting AWPE. In 2004, 70% of the upriver migrating YCT were injured by birds as evidenced by fresh scars. Since 2007, remote cameras have been deployed along the Blackfoot River to record hourly use by AWPE. Over 40,000 digital images have been analyzed providing counts of peak pelican foraging numbers, changes in foraging behavior related to water conditions, and diel foraging patterns. Bird scarring rates and the digital photography results suggest that pelican predation impacts on migrating cutthroat trout are inversely proportional to river flows.

Predation results prompted the Idaho Department of Fish and Game to develop a pelican management plan. Implementation of the plan began in 2010, with the return of badgers and skunks to one of the pelican nesting islands on Blackfoot Reservoir. Those species were removed from the nesting islands in the early 1990s to enhance goose production. The presence of badgers may discourage pelican nesting on the island. A nesting exclusion fence was also tested in 2010. The exclusion fence covered about 50% of a second island used by nesting AWPE. Aerial photographs and ground surveys confirmed that no AWPE nested within the exclosure during the entire nesting season, which suggests that non-lethal methods may exist for controlling AWPE recruitment in the future.

INTRODUCTION

The impact of piscivorous birds on commercially and socially important fish stocks has been a broad concern throughout North America and Europe (Harris et al. 2008) and potential negative effects of AWPE populations on such fisheries are no exception (Lovvorn et al. 1999; Glahn and King 2004; King 2005). The number of AWPE in North America approximately doubled between 1980 and 2002, increasing by nearly 5% annually during that period (King and Anderson 2005). Keith (2005) reported North American AWPE populations increasing from 30,000 in 1933 to about 100,000 birds by 1985, to 400,000 birds by 1995, values that, when plotted, suggest continent-wide exponential population growth. While most of the continental AWPE population breeds east of the Continental Divide, numbers have also increased in many parts of the west (Findholt and Anderson 1995a) and in the western metapopulation collectively (King and Anderson 2005; Murphy 2005).

In southern Idaho growth of AWPE nesting colonies since the early 1990s has generated concerns about the effect of their predation on salmonids, especially on YCT in the Blackfoot Reservoir and upper Blackfoot River system (IDFG 2009). The native YCT stock stages for its annual spawning run at the mouth of the Blackfoot River, which lies only 8 km from Gull Island, the nearest AWPE nesting colony. Nesting AWPE on Blackfoot Reservoir have increased from 0 nesting birds in 1992 to 200 nesting birds recorded in 1993 to a peak in 2007 of 3,416 adult birds. Since 2001, the abundance of adfluvial YCT migrating up the Blackfoot River from the reservoir to spawn declined from 4,747 in 2001 to a low of 16 in 2006, rebounding to 540 fish in 2008 and 938 in 2010.

The potential for AWPE to consume biologically meaningful numbers of salmonids appears low, based on some diet studies. Pelicans require shallow water (typically 0.3-0.65 m) or fish that can be reached within 1.3 m of the surface of deep water (Anderson 1991; Ivey and Herziger 2006). In lentic circumstances, this leads to a diet predominantly comprised of nongame fish such as chubs *Gila* sp., suckers *Catostomus* sp., and common carp *Cyprinus carpio* (Knopf and Evans 2004; Teuscher 2004). On Pathfinder Reservoir in Wyoming, over 83% of the biomass consumed by AWPE was composed of white suckers *Catostomus commersonii*, common carp, and tiger salamanders *Ambystoma tigrinum* (Findholt and Anderson 1995a). At Chase Lake, North Dakota, tiger salamanders comprised the majority of prey items in terms of occurrence frequency and volume (Lingle and Sloan 1980). However, AWPE are typically reported in the literature as highly adaptable, opportunistic foragers, readily selecting sites and prey that are most available (Hall 1925; Knopf and Kennedy 1980, 1981; Lingle and Sloan 1980; Flannery 1988; Findholt and Anderson 1995b), a trait that is problematic for some fish spawning aggregations. For example, AWPE seek out spawning concentrations of tui chub *Gila bicolor* at Pyramid Lake, particularly when they enter shallow littoral areas and display "quick jerking motions" associated with spawning (Knopf and Kennedy 1980). More recently, AWPE have been identified as a hindrance to conservation efforts for Cui-ui *Chasmistes cujus,* an ESA endangered adfluvial sucker that ascends the Truckee River from Pyramid Lake to spawn (Scoppettone and Rissler 2002). Because AWPE prey on adult Cui-ui immediately prior to spawning, their impact on this endangered species might be severe (Murphy 2005). Similarly, AWPE detect and use adfluvial YCT spawning aggregations in inlet rivers and streams. Davenport (1974) reported that adfluvial YCT were the preferred prey of AWPE in a study on Yellowstone Lake, an observation reiterated by Varley and Schullery (1996). In southeast Idaho, expanding AWPE are concentrating at the mouths of well known cutthroat trout spawning tributaries such as the Blackfoot River, and St. Charles and McCoy creeks (IDFG 2009). Documentation of the level of impact by AWPE predation on those cutthroat trout populations is lacking. In this study we estimate AWPE predation rates on migrating YCT in the Blackfoot River. Hourly foraging patterns and bird scars on YCT caused by AWPE are also reported.

STUDY AREA

Blackfoot Reservoir is located in the southeast corner of Idaho at an elevation of 1,685 m (Figure 1). The reservoir covers 7,284 ha. The fish community is dominated by Utah chub, Utah sucker *Catastomus ardens*, yellow perch *Perca flavescens*, and common carp. Yellowstone cutthroat trout and hatchery-stocked rainbow trout *Oncorhynchus mykiss* make up less than 5% of the species composition in the reservoir. Rainbow trout and cutthroat trout have been stocked in the reservoir since its impoundment in 1912.

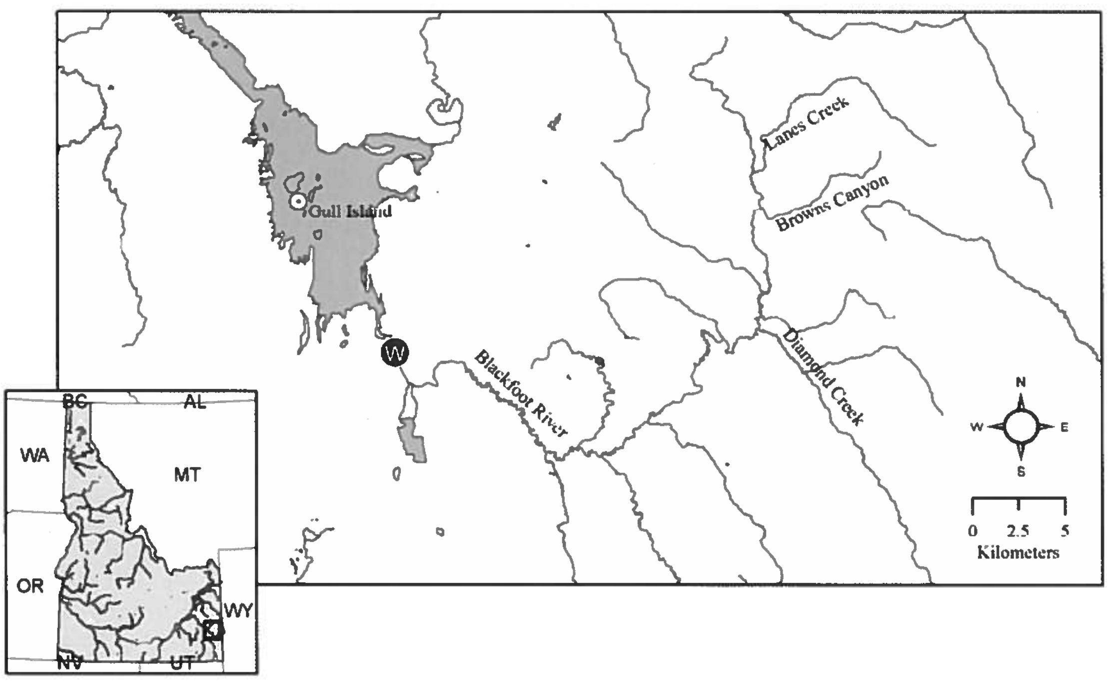

Figure 1. Study area showing the Blackfoot River, the Blackfoot Reservoir, Gull Island used by nesting AWPE, and the fish weir site (W) used for monitoring YCT escapement and collecting fish for implanting telemetry tags.

METHODS

In 2004 and 2007, radio transmitters were surgically implanted in YCT that were captured at the fish trap located on the Blackfoot River about 3.2 km upriver of the confluence with Blackfoot Reservoir (Figure 1). The radio transmitters were Advanced Telemetry Systems model F1300. Transmitters weighed about 11 g and were implanted in YCT ≥ 600 grams. The transmitter carried mortality signals that would deploy if held stationary for more than 24 h. The mortality indicators help determine mortality date, mortality location, and the potential cause of mortality (i.e., tags found in bird nests).

Surgery began by anesthetizing fish. Incisions were approximately 35 mm long, centered between the pectoral fins and pelvic fins. A grooved directional tool approximately 100 mm long was inserted into the incision and slid anteriorly, close to the flesh to prevent any contact with the internal organs. A 100-mm long catheter needle was inserted behind the pelvic fins and slid up the direction tool until it exits the opening of the incision. The antenna was inserted into the catheter needle and directed out the hole created behind the pelvic fins. The body of the tag was then inserted into the 35-mm incision. Incisions were closed with three or four stitches. Surgery times ranged from 6 to 8 min. Fish were placed in live wells filled with fresh water to recover and released about 100 m above the fish trap.

The AWPE predation rates were estimated by recovering fish telemetry tags from pelican nests on Gull Island. Several times during the nesting period, a boat was used to circle Gull Island. If a tag signal was received, the boat was docked and a person would recover the tag from the island. The predation rate estimate was made by dividing the number of telemetry tags recovered from pelican nests by the total number implanted in migrating YCT.

The IDFG monitors AWPE use of the Blackfoot River using automated digital photography. Figure 2 shows an example of one camera location that has been in place since 2007. Additional camera sites have been deployed to monitor most of the lower 3.2 km of river. However, for purposes of this paper and because it provides the only continual data set from 2007, only data collected from camera location three is analyzed for trend use. The digital images (taken hourly) provide estimates of overall AWPE use, diel foraging patterns, and seasonal changes in use. Table 3 shows the number of cameras deployed and operation period for each year.

To monitor the adfluvial YCT population trends, IDFG operates a spawning migration trap on the Blackfoot River (Figure 1). In addition to counting and passing YCT upriver to spawn, the trap has been used as the collection site to radio tag YCT and evaluate fish for bird scars. Since 2004, all YCT caught in the trap have been visually inspected for bird scars (Figure 3). A fish was determined to have a bird scar if it had a puncture hole or deep slash marks occurring on both sides of its body. The matching wounds criteria ensured that the marks were made by an AWPE attempting to hold the fish with its bill.

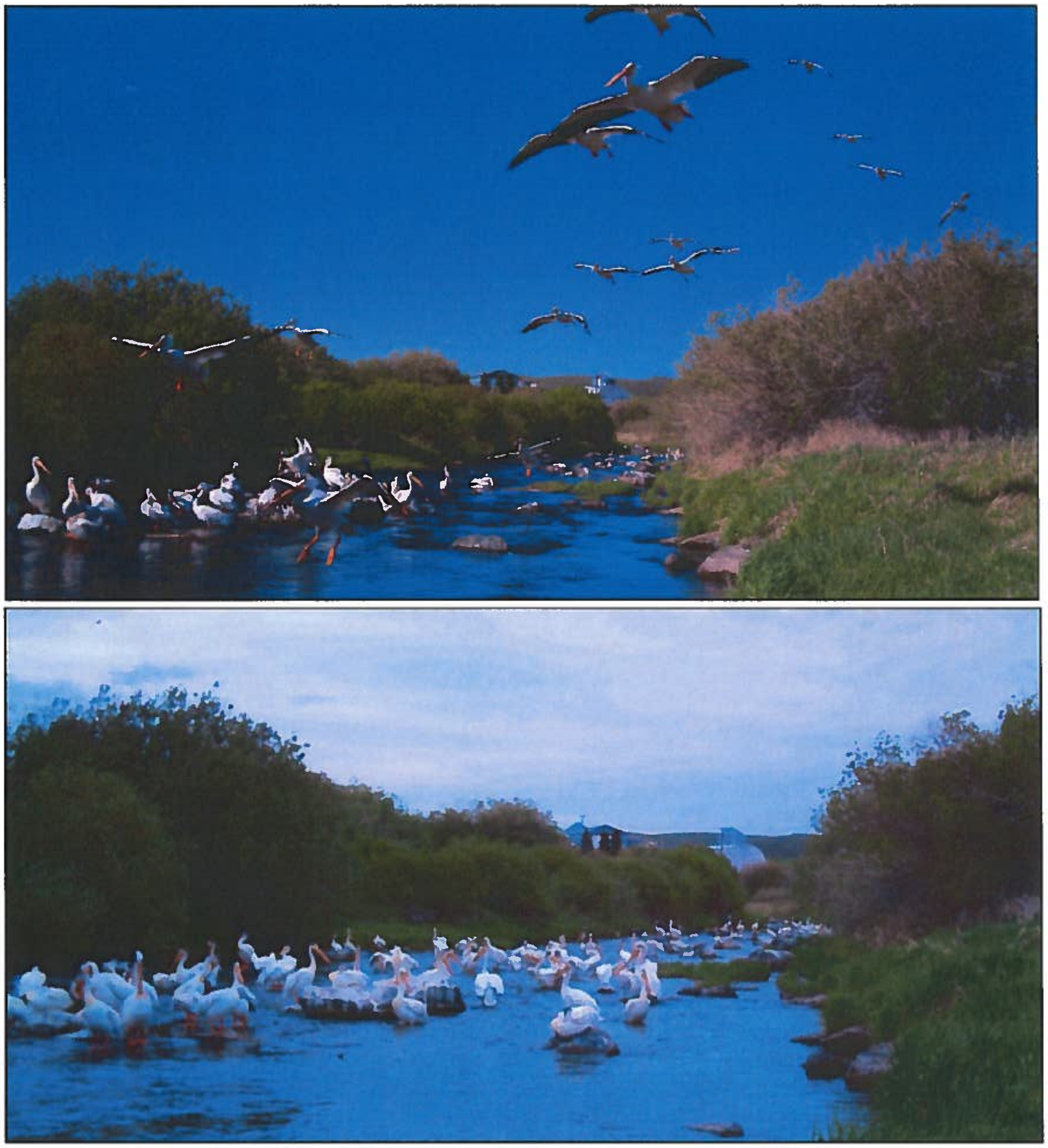

Figure 2. Digital images taken June 2007 that show AWPE use on the Blackfoot River. This camera location has been monitoring use of AWPE since 2007.

Figure 3. Birds scars on a YCT collected at the fish weir during its upriver spawning migration on the Blackfoot River.

Table 1. Sample details for remote digital photography used to document AWPE use on the Blackfoot River. The largest sample of images was collected in 2008 as a result of an attempt to observe AWPE foraging a night.

		Sample Size		
Year	Period	Cameras	Days	Images
2007	May 26-June 13	1	19	257
2008	May 13 – June 23	1	42	1,105
2009	May 8 – July 31	10	85	24,412
2010	May 1 – July 27	10	87	18,356

RESULTS

In 2004, we tagged 28 YCT collected at the Blackfoot River weir and four (14%) were recovered from AWPE nests on Gull Island. In a repeat study completed in 2007, 9 out of the 27 (33%) fish tags were recovered from AWPE nests. The two-fold increase in predation was similar to the relative increase in the AWPE population (Table 1). The nesting colony increased from 1,748 in 2004 to 3,416 in 2007.

Over 40,000 digital images have been reviewed to document AWPE use on the Blackfoot River. The images show that use on the river by AWPE begins as Utah suckers and YCT enter the river to begin their spawning migrations. Use continues through June and tapers off during the month of July. Changes in river flow also impact AWPE use. For example, over 5,340 AWPE were counted at one camera location during a 19-day period in 2007. At the same site, only 751 AWPE were counted during the same period in 2009. Average May river flows were 115 cfs in 2007 compared to 568 cfs in 2009 (Table 1). It was apparent from the digital images that many of the river rocks used by AWPE as foraging platforms in 2007 were under water in 2009.

Table 2. Numbers of YCT passed through the weir, AWPE nesting population, bird scarring rates, and average May discharge in the Blackfoot River. Bird scars were observed on YCT in 2003, but no daily scar records were kept.

Year	YCT escapement	AWPE nesting population	YCT with bird scars	Average May river discharge (cfs)
2001	4,747		None observed	74
2002	902	1,352	0%	132
2003	427	1,674	Observed	151
2004	125	1,748	70%	127
2005	16	2,800	6%	389
2006	19	2,548	38%	453
2007	98	3,416	15%	115
2008	548	2,390	10%	409
2009	865	3,174	14%	568
2010	938	1,734	12%	248

Remote digital photography showed significant annual variation in AWPE use of the Blackfoot River. In 2007, the mean hourly count of AWPE at the camera-4 location was 29.7 birds per hour. In 2009, observations of AWPE use at the same location average 1 bird per hour. Interestingly, the marked decline (96%) in river use occurred despite no change in the adult nesting population of AWPE (Table 2). Differences in spring river discharge likely explain the change in use by AWPE. In 2007, mean flows were 115 cfs compared to 568 cfs in 2009. The higher flows observed in 2009 inundated most of the foraging spots (rocks) used by AWPE. Average spring flows (May-June) explain most of the variation observed in AWPE use on the river (Figure 4). Table 3 summarizes mean hour counts recorded between 2007 and 2010.

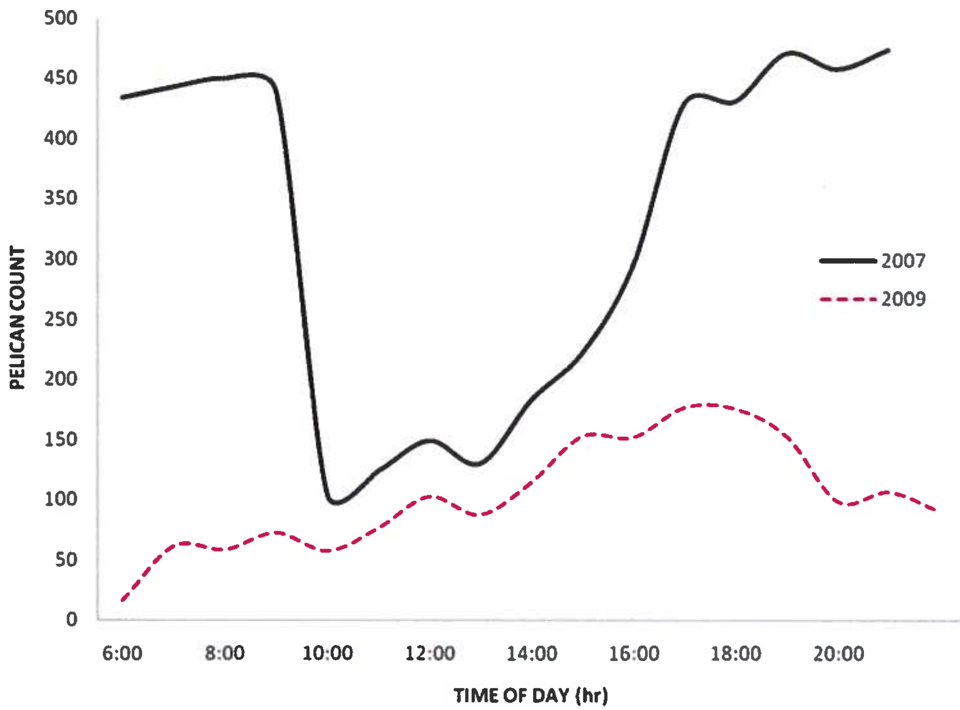

Figure 4. Hourly foraging patterns of AWPE at one camera location on the Blackfoot River. The counts for each hour were summed over a 19-d period from May 26 to June 13.

Foraging patterns of AWPE during the day also varied by year. In 2007, AWPE use on the river peaked in the early morning and evening hours. In 2009, bird numbers were lowest in the morning and steadily increased throughout the day and peaked at 1800 hours (Figure 4). In 2008 – 2009, the cameras were set to record digital images at night. Nighttime foraging by AWPEs was observed, but the field of vision within the images was only a few meters. Because of the limited field of vision, AWPE counts from night images were not compared to the daytime counts.

Based on bird scarring trends on migrating YCT, an intense foraging pattern by AWPE developed on the Blackfoot River over a 4-year drought period (2001 to 2004). In 2001, trap tenders monitoring YCT populations observed no bird scars on YCT (Table 1). In 2002, 125 YCT randomly selected from the adfluvial spawning run were photographed. None of the 125 fish had bird scars. It was during the 3rd consecutive low water year (2003) that trap tenders began noticing bird scars on YCT. In 2004, 70% of the YCT collected at the weir suffered from bird scars.

Table 3. Mean hourly counts of AWPE from camera-4 located on the Blackfoot River about 2 km from the river's confluence with the Blackfoot Reservoir.

	Year			
Time	2007	2008	2009	2010
5:00	54.0	0.7	0.2	2.4
6:00	33.4	0.6	0.6	4.0
7:00	31.6	0.4	0.6	3.9
8:00	32.1	0.7	0.7	4.2
9:00	41.6	0.5	0.6	3.8
10:00	34.3	2.6	0.7	3.1
11:00	9.1	1.6	1.0	1.7
12:00	11.9	1.0	0.9	1.7
13:00	10.8	0.9	1.1	1.9
14:00	14.8	2.8	1.5	3.0
15:00	19.2	1.6	1.5	3.5
16:00	24.1	3.4	1.7	3.3
17:00	34.7	5.5	1.7	3.7
18:00	33.3	5.9	1.5	4.2
19:00	37.1	5.0	1.0	4.4
20:00	39.4	3.8	1.0	4.2
21:00	43.5	2.8	0.9	4.1
Mean of means	29.7	2.3	1.0	3.4

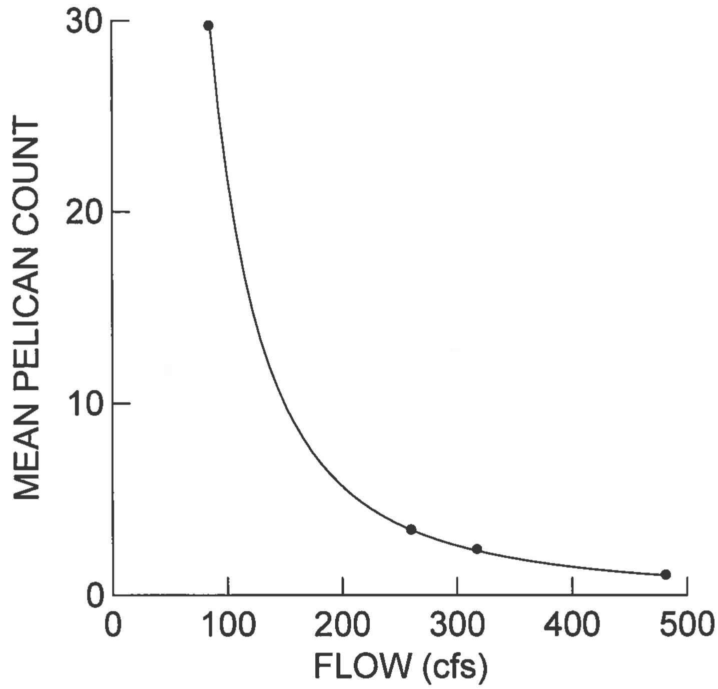

Figure 5. Mean hourly count of AWPE observed in digital photographs plotted as a function of mean spring flows (May-June) on the Blackfoot River. Each data point represents a different year (2007-2010), but the same camera location.

DISCUSSION

There are several limitations to this predation rate study. First, the estimates do not account for total predation, because AWPE likely excrete tags in other locations besides Gull Island. For example, in 2004, about 30% of recovered tags were found on lands other than Gull Island. Unidentified predators may have carried some of those tags out of the river corridor, but it is not possible from our dataset to determine how many were taken by AWPE. Secondly, most AWPE foraging activity observed in the digital images occurred below the fish weir. We captured and tagged YCT at the weir and predation below the weir was not measured; thus we believe the 2004 and 2007 predation rate estimates (14 % and 33%) are much underestimated. Future studies should focus on tagging YCT in the reservoir prior to spring migrations to obtain a total spawning run predation rate. In addition to improving the adult predation estimates, downstream emigrating juvenile salmonids are vulnerable to piscivorous birds (White 1957; Ruggerone 1986; Kennedy and Greer 1988) and should be included in future evaluations.

The use of automated digital images can be a useful tool for monitor AWPE abundance and foraging patterns. The cameras provide a cost-effective assessment tool that measures instantaneous AWPE use of about 3 km of the Blackfoot River. It would be prohibitively time consuming and costly to complete the same level of assessment using field crews. Some of the limitations of the automated photography include equipment failure and weather conditions that obstruct the camera lens (i.e., snow).

In response to the measured predation impacts, IDFG developed a management plan that recommended significant reductions in the AWPE population nesting at the Blackfoot Reservoir (IDFG 2009). Implementation of the plan began in 2010, with the return of badgers and skunks to one of the pelican nesting islands on Blackfoot Reservoir. Those species were removed from the nesting islands in the early 1990s to enhance goose production. The presence of badgers may discourage pelican nesting on the island. A nesting exclusion fence was also tested in 2010. The exclusion fence covered about 50% of a second island used by nesting AWPE. Aerial photographs and ground surveys confirmed that no AWPE nested within the exclosure during the entire nesting season, which suggests that nonlethal methods may exist for controlling AWPE recruitment in the future.

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IDAHO DEPARTMENT OF FISH AND GAME

Edward B. Schriever, Chief
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Acting State Fish Manager