Rifle Gap Reservoir
Final Approved Lake Management Plan

View of Rifle Gap Reservoir looking to the west, April 2004.

Colorado Parks and Wildlife
Northwest Region Aquatic Section
Grand Junction, Colorado
June 5, 2015

Table of Contents

Executive Summary

Rifle Gap Reservoir (approximately 360 surface acres at full capacity) was constructed to the northeast of the Town of Rifle, Colorado (Garfield County) in the early 1960s, primarily for agricultural purposes. The reservoir is owned by the U.S. Bureau of Reclamation, and water is managed by the Silt Water Conservancy District. Colorado Parks and Wildlife (CPW) manages visitor and recreational use at Rifle Gap Reservoir, as well as the fishery. CPW also manages the fisheries downstream in Rifle Creek and the Colorado River. Rifle Gap Reservoir is the main feature of Rifle Gap State Park (981 land acres, 360 water acres), attracting boaters, water-skiers, swimmers, and anglers. The park provides year-round recreation for approximately 300,000 visitors during a typical year. This visitation rate results in more than $500,000 in revenue to the State of Colorado.

Rifle Gap Reservoir is currently managed by CPW for coldwater trout, and cool-warmwater walleye (*Sander vitreus*) and smallmouth bass (*Micropterus dolomieu*). Water from the reservoir (by bottom release or by spillway) flows down Rifle Creek for approximately eight miles until the creek merges with the mainstem Colorado River. Rifle Creek transitions from a coldwater trout fishery just downstream of Rifle Gap Reservoir to a cool-warmwater native fish community at the confluence with the Colorado River. CPW manages lower Rifle Creek and the Colorado River downstream of the town of Rifle for native fish, including listed and non-listed species (bluehead sucker (*Catostomus discobolus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*)). The State of Colorado considers the roundtail chub a Species of Special Concern. The U.S. Fish and Wildlife Service (USFWS) has designated the mouth of Rifle Creek and the mainstem Colorado River immediately downstream of Rifle Creek as critical habitat for two of the four endangered fish species, including the razorback sucker (*Xyrauchen texanus*) and Colorado pikeminnow (*Ptychocheilus lucius*).

Rifle Gap Reservoir is a mixed non-native fishery, containing both coldwater (rainbow (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*)) and cool-warmwater species (walleye, smallmouth bass, yellow perch (*Perca flavescens*), northern pike (*Esox lucius*), and black crappie (*Pomoxis nigromaculatus*)). Occasionally, anglers will report catching largemouth bass (*Micropterus salmoides*), but this species has been absent from CPW fish surveys for more than a decade. Other fish species that are present include golden shiner (*Notemigonus crysoleucas*), green sunfish (*Lepomis cyanellus*), and red shiner (*Cyprinella lutrensis*). The walleye and smallmouth bass fisheries within the reservoir have naturally sustained since a 1972 stocking of 200, 6-inch walleye and 6,325, 3-inch smallmouth bass. No walleye, smallmouth bass, or any other cool-warmwater fish species (non-salmonids) have been stocked by CPW since 1972. CPW believes yellow perch and northern pike were illicitly introduced between 1993 and 1999, while black crappie were illicitly introduced prior to September 1993. Currently, CPW only stocks catchable rainbow trout into Rifle Gap Reservoir, in accordance with a cooperative agreement establishing Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin (Stocking Procedures), signed by the state wildlife agencies of Colorado, Utah, Wyoming, and the USFWS (USFWS 1996 and USFWS 2009, revised). Per these Stocking Procedures, non-salmonids cannot be stocked until this Lake Management Plan (LMP) is approved by these signatories.

In the spring of 2013, CPW completed the construction of an in-stream fish screen in Rifle Creek downstream of Rifle Gap Reservoir's stilling basin. The intent of the screen is to preclude non-native sport fish that may escape from Rifle Gap Reservoir, from negatively impacting native, listed and non-listed fish species downstream in critical habitat of Rifle Creek and the Colorado River. The

Rifle Creek fish screen is designed to accommodate a maximum discharge from the reservoir of 200 cubic feet per second. Aperture of the fish screen is 1.0 millimeter (mm) (0.0393 inches, approximately 1/32 inch), and removes 90% of solids 1.0 mm or greater and 100% of solids 2.0 mm and larger. As of May 16, 2013, the Rifle Creek fish screen is operational and functioning successfully by eliminating the opportunity for non-native sportfish to negatively impact native, non-listed and listed fishes downstream.

Reservoir anglers will also benefit from the screen as CPW will be allowed the opportunity to stock non-salmonid sport fish desired by anglers and not currently stocked (i.e., black crappie, triploid walleye (100% sterile), yellow perch)), pending approval of this LMP by the USFWS and States of Colorado, Utah, and Wyoming. CPW plans to manage Rifle Gap Reservoir for these three species in addition to trout. Black crappie, yellow perch, and rainbow and brown trout are included in the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) "'Compatible' list of non-native aquatic species compatible with recovery/preservation of endangered/native, non-salmonid aquatic species within critical habitat of the upper Colorado River basin (UCRB)" (Martinez et al. 2014). Fertile (diploid) walleye are included within the 'Non-Compatible' list, but use of the triploid and sterile form of walleye (triploid walleye) in the UCRB has been reviewed by the Recovery Program and included within a list of triploid/hybrid sport fishes that could be stocked within the basin (Martinez et al. 2014). Further, this Basin-wide Strategy states that the "stocking of approved sterile fish species in specific locations equipped with screens or otherwise managed to prevent fish escapement would provide redundancy and a more preventive strategy to control the access of these non-native fish species to critical habitat for endangered fishes" (Martinez et al. 2014).

Smallmouth bass, northern pike, and walleye (diploid) are included in the Recovery Program's 'Non-Compatible' list of non-native aquatic species, with further introduction or stocking into waters of the UCRB strongly discouraged (Martinez et al. 2014). CPW will not stock smallmouth bass or northern pike into Rifle Gap Reservoir in the future. CPW will continue to enforce the current special regulations for northern pike, which include bowfishing and spearfishing as additional manners of legal take, and unlimited bag and possession limits for this species. CPW is also committing to additional actions to disadvantage northern pike, fertile (diploid) walleye, and smallmouth bass within Rifle Gap Reservoir as identified in CPW (March 25, 2015) and USFWS (April 27, 2015) correspondence. These CPW actions will include the following:

- removal of the current, special regulations for smallmouth bass at Rifle Gap Reservoir, which include bag, possession, and minimum size limits of two fish, 15 inches in length; and a spawning closure from May 1 through June 15 during which all smallmouth bass caught must be returned to the water alive. CPW will recommend to the Colorado Parks and Wildlife Commission (CPWC) that unlimited bag and possession limits for smallmouth bass at Rifle Gap Reservoir be considered in place of the current special regulations. The CPWC will consider these proposed regulation changes for adoption at the September 2015 CPWC meeting. If adopted, the proposed regulation changes would become effective April 1, 2016.
- removal of gravid, diploid female walleye by netting during the spawning season on an interim basis for the first three years of triploid walleye (100% sterile) stocking. Gravid, female walleye taken may be donated to license-holding anglers, or transported alive to Front Range waters by CPW. If sufficient numbers of gravid females are taken, CPW may elect to operate a small-scale spawn take operation with the intent of inducing 100% triploidy in the eggs followed by restocking of the triploid fry (100% sterile) or triploid fingerlings (100% sterile) into Rifle Gap Reservoir.

- lethal removal of smallmouth bass and northern pike collected during standard CPW sampling procedures in the spring and fall. Fish taken may be donated to license-holding anglers.

CPW, as a partner in the Recovery Program, has prepared this LMP for Rifle Gap Reservoir. The intent of this document is to describe future fish species management within the reservoir in accordance with the Stocking Procedures (USFWS 1996 and USFWS 2009, revised). Final approval and implementation of this LMP for Rifle Gap Reservoir will result in CPW achieving specific objectives of the agency's Strategic Plan and Aquatic Wildlife Management Plan for the Colorado River Basin, while supporting goals of the Recovery Program aimed at recovery/preservation of endangered fishes.

I. Introduction and Background

Agency Mission and Aquatic Objectives of Strategic Plan

Colorado Parks and Wildlife (CPW) was created in 2011 through the merging of the Colorado Division of Wildlife (CDOW) and Colorado State Parks. The mission of the new agency is "to perpetuate the wildlife resources of the state, to provide a quality state parks system, and to provide enjoyable and sustainable outdoor recreation opportunities that educate and inspire current and future generations to serve as active stewards of Colorado's natural resources." The CDOW's Strategic Plan 2010-2020 provides objectives that CPW is implementing to achieve desired outcomes until a Strategic Plan is developed specifically for the CPW. This Rifle Gap Reservoir Lake Management Plan (LMP) addresses six objectives of the CDOW's Strategic Plan: 1) manage proactively to prevent and control fish diseases and introductions of invasive species to protect fish populations; 2) ensure the long-term viability of native fish and strive to maintain the broadest representation of the diversity of native wildlife in suitable habitats across the state; 3) maintain healthy and viable game and sport fish populations sufficient to meet the demand for fishing; 4) provide a variety of fishing opportunities and maintain or increase current levels of angler satisfaction and participation; 5) maintain and enhance fishing recreational opportunities on public lands; and 6) create and enforce regulations necessary to protect fish populations. Achieving these objectives with the approval and implementation of this LMP for Rifle Gap Reservoir will result in: 1) citizens that are satisfied with the diversity and health of the state's native fish, 2) the state retaining primary management authority for Colorado fish species, 3) anglers that are highly satisfied with recreational opportunities for fish, and 4) recreational opportunities that are adequate and well distributed around the state.

Water Management

Rifle Gap Reservoir (approximately 360 surface acres at full capacity) was constructed to the northeast of the Town of Rifle, Colorado (Garfield County) between 1964 and 1967 as part of the Silt Water Project (Figures 1 and 2). The reservoir was designed for agricultural, recreational, and fish and wildlife purposes. The reservoir is owned by the U.S. Bureau of Reclamation (USBOR), and water is managed by the Silt Water Conservancy District (SWCD). The West, Middle, and East forks of Rifle Creek feed the reservoir and their confluences at Rifle Gap Reservoir create mainstem Rifle Creek. The reservoir drainage area is approximately 136 square miles.

Rifle Gap Reservoir provides storage for exchange flows on Rifle Creek. The reservoir has a total capacity of 13,602 acre-feet, an active capacity of 12,168 acre-feet, an inactive capacity of 540 acre-feet, and 894 acre feet of dead capacity. Seventy-six percent (10,384 acre-feet) of the total capacity is allocated to lands owned by shareholders for irrigation. This volume of water is accounted for through SWCD and senior water rights, as well as instream flows. This exchange water provides a full irrigation supply for land that was not previously irrigated, and a

supplemental supply to land previously irrigated with Harvey Gap Reservoir water and Grass Valley Canal diversions.

SWCD can divert water out of priority to the Grass Valley Canal (upstream of the reservoir) and to Davie Ditch (downstream of the reservoir). Water released directly from Rifle Gap Reservoir can: 1) enter Davie Ditch (18 cubic feet/second (cfs) capacity)) to supply irrigation water to 900 acres on Davie Mesa, or 2) enter Rifle Creek. The majority of reservoir releases are replacement flows to senior water right holders downstream on lower Rifle Creek. These releases allow additional diversions from East Rifle Creek upstream from Rifle Gap Reservoir through the Grass Valley Canal (60 cfs capacity). The Grass Valley Canal provides water conveyance to lands in Dry Elk Valley, and for storage in Harvey Gap Reservoir.

Water exchange agreements are in place between the SWCD and downstream water users on Rifle Creek. Irrigation releases from Rifle Gap Reservoir are made to satisfy these rights between April 16 and November 1 of each year under the provisions of these agreements, and to the satisfaction of the State Engineer. Senior water users on lower Rifle Creek must be satisfied before the more junior water right held by the Farmers' Irrigation Company diversion water right to the Grass Valley Canal can be made. SWCD measures flows in West and East Rifle creeks upstream of the diversion structures in order to establish releases from Rifle Gap Reservoir.

Releases from the reservoir must also be made annually, between November 1 and April 16 to satisfy domestic water decrees. The State Engineer requires a 5 cfs flow be released unless the combined inflow in West and East Rifle creeks is less than this amount. The actual inflow will satisfy this requirement if inflows are less than 5 cfs. Instream flow rights (May 7, 1980) provide for the release of 5 cfs between October 1 and April 30, and 9 cfs between May 1 and September 30. These instream flow rights are junior to those water rights of the SWCD and water users on lower Rifle Creek.

Water can also leave Rifle Gap Reservoir over the spillway. The reservoir typically spills when hydrologic conditions are average or wetter than normal. Water has spilled from the reservoir every year between 1993 and 2000 and every year from 2006 through 2012. The spillway is uncontrolled, and water will pass over the spillway at a reservoir elevation of 5,960 feet or higher. Spills are typically in the range of 20-50 cfs and rarely exceed 100 cfs.

The reservoir is primarily operated for agricultural uses, and as such, water levels often fluctuate widely annually, depending on winter snowpack, local weather patterns, and downstream water demand. Pool levels drop during the summer months, impacting recreationists and the reservoir fishery. The USBOR estimates that since the reservoir was constructed, the bottom of the boat ramp has been out of the water more than 11% of the August months. These large fluctuations in surface water levels prove to be challenging to those managing both recreational opportunity and the fishery at Rifle Gap Reservoir.

Rifle Gap State Park Management

While water is managed by the SWCD, CPW manages visitor and recreational use at Rifle Gap Reservoir, as well as the fishery. CPW also manages the fisheries downstream in Rifle Creek and the Colorado River. Rifle Gap Reservoir is the main feature of Rifle Gap State Park (981 land acres, 360 water acres), attracting boaters, water-skiers, swimmers, and anglers. The park has 89 campsites, and can accommodate tent camping as well as use by large motor homes. Rifle Gap State Park provides year-round recreation, including hosting the 16th annual ice fishing tournament in January 2014. During a typical year, the park has approximately 300,000 visitors. In fiscal year 2013 (July 1, 2012 to June 30, 2013), 250,000 people visited the park, resulting in $420,000 in revenue to the State of Colorado. The reduction in visitors during this last fiscal year is attributable primarily to low surface water levels which negatively impacted water-based recreation.

Current Fisheries Management

Rifle Gap Reservoir is currently managed by CPW for coldwater trout, and cool-warmwater walleye (*Sander vitreus*) and smallmouth bass (*Micropterus dolomieu*). Water released from the reservoir flows down Rifle Creek for approximately eight miles until the creek merges with the mainstem Colorado River. Rifle Creek transitions from a coldwater trout fishery just downstream of Rifle Gap Reservoir to a cool-warmwater native fish community at the confluence with the Colorado River. CPW manages lower Rifle Creek and the Colorado River downstream of the town of Rifle for native fish, including listed and non-listed species (bluehead sucker (*Catostomus discobolus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*)). The State of Colorado considers the roundtail chub a Species of Special Concern. The U.S. Fish and Wildlife Service (USFWS) has designated the mouth of Rifle Creek and the mainstem Colorado River immediately downstream of Rifle Creek as critical habitat for two of the four endangered fish species, including the razorback sucker (*Xyrauchen texanus*) and Colorado pikeminnow (*Ptychocheilus lucius*).

Rifle Gap Reservoir is a mixed nonnative fishery, containing both coldwater (rainbow (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*)) and cool-warmwater species (walleye, smallmouth bass, yellow perch (*Perca flavescens*), northern pike (*Esox lucius*), and black crappie (*Pomoxis nigromaculatus*)). Occasionally, anglers will report catching largemouth bass (*Micropterus salmoides*), but this species has been absent from CPW fish surveys for more than a decade. Other fish species that are present include golden shiner (*Notemigonus crysoleucas*), green sunfish (*Lepomis cyanellus*), and red shiner (*Cyprinella lutrensis*). The walleye and smallmouth bass fisheries within the reservoir have naturally sustained since a 1972 stocking of 200, 6-inch walleye and 6,325, 3-inch smallmouth bass. No walleye, smallmouth bass, or any other cool-warmwater fish species (non-salmonids) have been stocked by CPW since 1972. CPW believes yellow perch and northern pike were illicitly introduced between 1993 and 1999, while black crappie were illicitly introduced prior to September 1993. Currently, CPW only stocks catchable rainbow trout into Rifle Gap Reservoir, in accordance with a cooperative agreement establishing Procedures for

Stocking Nonnative Fish Species in the Upper Colorado River Basin (Stocking Procedures), signed by the state wildlife agencies of Colorado, Utah, Wyoming, and the USFWS (USFWS 1996 and USFWS 2009, revised). Per these Stocking Procedures, non-salmonids cannot be stocked until this LMP is approved by these signatories.

In the spring of 2013, CPW completed the construction of an in-stream fish screen in Rifle Creek downstream of Rifle Gap Reservoir's stilling basin (Figures 3 and 4). The intent of the screen is to preclude non-native sport fish that may escape from Rifle Gap Reservoir, from negatively impacting native, listed and non-listed fish species downstream in critical habitat of Rifle Creek and the Colorado River. Reservoir anglers will also benefit from the screen as CPW will be allowed the opportunity to stock non-salmonid sport fish desired by anglers and not currently stocked (i.e., black crappie, triploid walleye (100% sterile), yellow perch)), pending approval of this LMP by the USFWS and States of Colorado, Utah, and Wyoming.

CPW, as a partner in the Upper Colorado River Endangered Fish Recovery Program (Recovery Program), has prepared this LMP for Rifle Gap Reservoir. The intent of this document is to describe future fish species management within the reservoir in accordance with the Stocking Procedures (USFWS 1996 and USFWS 2009, revised). The approval and implementation of this LMP for Rifle Gap Reservoir will result in CPW achieving specific objectives of the agency's Strategic Plan and Aquatic Wildlife Management Plan for the Colorado River Basin, while supporting goals of the Recovery Program aimed at recovery/preservation of endangered fishes.

Management Category and Physical Parameters:

1) Management category: Primary=408, Secondary=509
2) Water code: 69422
3) Drainage: Minor drainage=Rifle Creek, Major drainage=Colorado River
4) Size: 360 surface acres at full pool
5) Elevation: 5,960 feet water surface at full pool
6) Location: Northeast of the Town of Rifle, Colorado (Garfield County), Township 5 South, Range 92 West, Sections 7 and 8
7) Maximum depth: 87 feet
8) Frequency of surface spill and controlling factors: See information provided previously
9) Inlet: West Rifle Creek, Middle Rifle Creek, and East Rifle Creek
10) Dam or berm information: The dam is a zoned earthfill structure, constructed 1964-1967; crest elevation=5,978 feet; structural height=157 feet; width=1,450 feet; currently no plans for expansion; maintenance is performed by USBOR
11) Outlet: Water leaves Rifle Gap Reservoir either over the spillway or via the bottom release (outlet works). The outlet works consist of a concrete intake structure and a 6 foot upstream circular tunnel at the gate chamber with two, 2.25 foot-square high pressure gates. The outlet diverts to a downstream 6 foot flat bottom free flow tunnel that discharges into the

spillway stilling basin. The majority of releases from Rifle Gap Reservoir follow this path and are released into Rifle Creek to meet downstream diversion rights. Additionally, a 7 foot diameter tunnel branches off from the gate chamber and conveys water into a 30 inch pipe. This pipe discharges into the Davie Ditch. An in-stream fish screen is present in Rifle Creek, downstream of the stilling basin.

II. Fish Species and Management

Reservoir Fluctuations

Large fluctuations in average daily surface water elevations of Rifle Gap Reservoir can occur from year to year, as well as within months of the year (Table 1). For example, from 2008 through 2013, the greatest annual change in surface water elevation occurred in 2012 (45.3 feet). The least amount of change in surface water elevation occurred in 2011 (14.7 feet), a wetter water year. Maximum surface water elevations across the seven years occurred as early as March 13 and as late as June 6. Conversely, minimum surface water elevations from 2008 through 2013 occurred typically in the fall months (September through November), with the single exception occurring during the wet year of 2011 (January 1). The lowest surface water elevations for the period of 2008 through 2012 occurred in 2012 and 2013, drier than normal years.

Variations were also observed in the number of occasions the reservoir spilled per year (Table 1). Rifle Gap Reservoir did not spill in 2013, and had the greatest number of spill days in 2011 (62 days). Generally, the reservoir first spills in March continuing through April. Rifle Gap Reservoir has first spilled as early as February 27 and as late as May 30. Occasional operations and routine maintenance require that water be released over the spillway later in the year (i.e., 2011; November 26 through December 9). These fluctuations in surface water elevations between and within years can highly influence the fishery of Rifle Gap Reservoir, and routine fish survey work completed by CPW.

This dynamic system creates a difficult environment for fish species. Water level fluctuations can impact water quality conditions, such as water temperatures and dissolved oxygen concentrations. Changes in surface water levels can also influence the amount and type of habitat available for fish species at different stages of their life cycles. Fish species also rely on phytoplankton and zooplankton for part of their forage base. Plankton densities might also be impacted as a result of fluctuating conditions. All of these factors either individually or coupled can impact individual fish species and/or the entire fish assemblage in Rifle Gap Reservoir.

Development of Lake Management Plan

Managing the fishery in a reservoir with a primary function to store and deliver water for irrigation purposes also presents many challenges to fishery biologists. Identifying and understanding all of the possible ecological ramifications to the Rifle Gap Reservoir fishery may never be attainable due to ever-changing environmental

and anthropogenic conditions. Further, evaluating the responses of anglers (i.e. changes in participation, changes in harvest rates) to these situations can be difficult and costly to assess. Deciphering and differentiating changes in the reservoir fishery solely as a result of changes in fish management (i.e., stocking plans, special regulations) is unrealistic. Therefore, this LMP for Rifle Gap Reservoir has been developed with caution, and with the intent for annual internal review.

CPW utilized as many tools as possible to prepare this LMP, including annual fishery surveys of the reservoir (2008-2013), angler creel surveys during the 1987 and 2009 open water and ice fishing seasons (2009-2010), assistance from Colorado State University in conducting laboratory and quantitative analyses (Johnson et al. 2009), and information from the scientific literature. Modifications related to fish stocking (i.e., species stocking rates, size at stocking, pre-marking techniques, time of stocking) and changes in special regulations (i.e., changes to bag and possession limits, minimum sizes, spawning closures) may be necessary to implement on a more routine basis despite CPW's efforts to develop a comprehensive LMP for Rifle Gap Reservoir.

Historic and Current Fish Assemblage

Anglers have reported Rifle Gap Reservoir as a destination fishery in northwest Colorado for yellow perch, walleye, and smallmouth bass. This reservoir is one of only a handful in western Colorado in which anglers can fish for these three species from a boat. Four fish species (rainbow trout, brown trout, smallmouth bass, and walleye) occupied the reservoir in 1974, and seven additional fish species (black crappie, golden shiner, green sunfish, largemouth bass, northern pike, red shiner, and yellow perch) were illicitly introduced by 2009 (Figure 5). Walleye and smallmouth bass populations have maintained naturally reproducing populations since their initial stockings into the reservoir in 1972. Illicit introductions primarily of yellow perch and northern pike between 1993 and 1999, however, drastically changed the fisheries composition of Rifle Gap Reservoir. Prior to these introductions, the walleye population in 1987 consisted of multiple size classes of fish, indicating walleye were reproducing and recruiting to subsequent size classes (Figure 6). Very few walleye were collected by 2009, and only fish in the 16-20 inch size class. In 1993, walleye comprised 51% of the fishery based upon fall survey methods. By 2002, yellow perch constituted nearly 50% of the fish species composition in Rifle Gap Reservoir. Northern pike relative abundance and catch rate have fluctuated over time (Figures 7 and 8), likely due to low electrofishing capture efficiency, as well as changes in angler actions and fishing regulations. Smallmouth bass and walleye were the only top level predators present in Rifle Gap Reservoir prior to the illicit introduction of northern pike.

Yellow perch continued to dominate the fish assemblage in Rifle Gap Reservoir until 2012 when smallmouth bass became more prevalent in CPW fish surveys when compared to other fish species (Figures 7 and 8). CPW fishery biologists sampled different habitats in the fall of 2012 and 2013 compared to previous years. Surface water elevations in the reservoir ranged from 5,932 feet in October 2010 to 5,950 feet

in October 2011 during standardized fall electrofishing surveys from 2008 through 2011 (Table 1). Fall electrofishing surveys in 2012 and 2013 were completed at water surface elevations of 5,919 feet and 5,918 feet, respectively. This variability in water depth of the reservoir impacted the habitat available to fishery biologists to survey along the shoreline. Submerged aquatic vegetation in the littoral zone was absent in 2012 and 2013, resulting in fewer fish captured. However, habitat along the dam (rip-rap) was still vulnerable to electrofishing techniques despite the low water level. Electrofishing along the dam produced numerous smallmouth bass in the catch in 2012 and 2013. Thus, these differences in habitat availability likely influenced fall sampling results in 2012 and 2013. Angler accounts suggest the yellow perch population has not "crashed" in Rifle Gap Reservoir despite CPW sampling efforts that indicate an increase in smallmouth bass abundance and catch relative to other fish species. It is likely that the majority of yellow perch occupied the limnetic zone in the fall of 2012 and 2013, rendering this species less vulnerable to shoreline electrofishing surveys.

In general, the habitat characteristics of Rifle Gap Reservoir (at full capacity) support all species that currently exist within the reservoir. The inlet areas and some of the shorelines have dense aquatic vegetation, which provide adequate spawning and recruitment habitat for black crappie, northern pike, walleye, and yellow perch. Rip-rap along the dam and boulder/cobble/gravel substrates along the southern shoreline are beneficial to smallmouth bass. Multiple shelves and points in addition to an island area exist, and provide cover and supplemental habitat benefitting black crappie, trout, yellow perch, walleye, and smallmouth bass.

The forage base in Rifle Gap Reservoir fluctuates, and includes both natural and stocked species (trout and illicit bait fish introductions). Martinez (2009) sampled for crustacean zooplankton across June, August, and October 2008, noting the presence of cladocerans and copepods in the reservoir. Moderate densities of *Daphnia* were observed on all dates sampled. Aquatic and terrestrial insects are also present, as well as crayfish. All fish species in the reservoir could potentially serve as forage for each other, at different life stages. CPW does not currently stock any "bait" fish, though anglers have released live golden shiner and red shiner presumably used as bait. Golden shiner have successfully reproduced in the reservoir, and the population varies from year to year. The forage base in Rifle Gap Reservoir could become limited if conditions allow. This limitation in fish forage may be difficult for CPW fishery biologists to predict given the fluctuating environmental conditions, and variations within the reservoir's food web ecology.

Overview of Management Strategies-Historic, Current, and Future (Proposed)

Regulations

Management strategies and regulations for the fishery of Rifle Gap Reservoir have changed over the years in response to changes in the fish assemblage. Statewide fishing regulations were in effect at the reservoir until the 1986-1987 regulation cycle in which a special regulation was set for smallmouth bass. This new regulation

included a slot limit where anglers were required to release alive all smallmouth bass caught between 12 and 15 inches. The statewide bag and possession limits for smallmouth bass and walleye at that time were six fish for each species. The bag and possession limits for trout were eight fish. These statewide regulations also applied to the Rifle Gap fishery, in addition to the special regulation for smallmouth bass. The statewide bag and possession limit for trout would remain in effect at Rifle Gap until 2001 when the bag limit was reduced to four fish and the possession limit remained eight fish. Statewide bag and possession limits for smallmouth bass and walleye were increased from 1990-1992 to 10 fish for each species, and then reduced to five fish for each species from 1993-2000. These statewide limits also applied to Rifle Gap until 2001 when special regulations were implemented for the walleye and smallmouth bass populations.

Statewide fishing regulations in addition to the slot limit for smallmouth bass applied to Rifle Gap Reservoir until 2001 when CDOW fishery biologists and anglers became concerned about the impacts northern pike and yellow perch may have on the smallmouth bass and walleye populations. As a result, the Colorado Wildlife Commission (CWC) approved special regulation changes for walleye and smallmouth bass. The smallmouth bass regulations are still in effect and include: 1) a spawning closure from May 1-June 15 during which all smallmouth bass caught must be released alive; and 2) bag and possession limits of two fish, with a minimum size of 15 inches. Bag and possession limits were reduced for walleye from the statewide limit of five walleye to three walleye, of which only one walleye could be longer than 18 inches.

CDOW fishery biologists remained concerned about the walleye population in Rifle Gap Reservoir, despite the changes in regulations. An "in-lake" walleye spawning operation was attempted across several years in the mid-2000s since alternatives did not exist at the time for stocking walleye into the reservoir (no anti-escapement device in place and no approved LMP). Spawn efforts for walleye proved unsuccessful overall, and the project was abandoned. In 2010, CDOW fishery biologists returned to the CWC seeking approval to further reduce the bag and possession limits for walleye in the reservoir to one fish, with a minimum size of 18 inches. These regulation changes were implemented in 2011 and remain in effect.

Yellow perch and northern pike were illicitly introduced to the reservoir between 1993 and 1999. During this time, statewide bag and possession limits for yellow perch were 20 fish, and limits for northern pike were 10 fish. In 2001, statewide bag and possession limits for northern pike were relaxed, allowing anglers unlimited harvest. Bag and possession limits for yellow perch west of the Continental Divide were relaxed in 2006, allowing anglers unlimited harvest for this species. Since 2011, underwater spearfishing, archery, and gigs have been allowed for take of northern pike at select waters across the state, including Rifle Gap Reservoir.

Currently, bag and possession limits for northern pike remain unlimited in Rifle Gap Reservoir. On April 1, 2015, a special regulation protecting yellow perch became

effective at this reservoir. The previous regulation allowed for unlimited take of yellow perch, while the new regulation allows a bag and possession limit of 20 yellow perch. These new limits will help effectively manage the yellow perch population and protect the species from overfishing.

Other non-salmonid fish species that currently occupy Rifle Gap Reservoir include black crappie, golden shiner, green sunfish, and red shiner. Black crappie were illicitly introduced prior to 1993. Statewide bag and possession limits of 20 fish of each species apply for the centrarchids (black crappie and green sunfish). Cyprinid species (golden and red shiners) were likely introduced by anglers to Rifle Gap Reservoir as bait fish; use of live fish as bait fish in waters west of the Continental Divide, excluding Navajo Reservoir but including Rifle Gap Reservoir, has been prohibited in Colorado since 1986.

Stocking

Rainbow and brown trout are the primary salmonid species present in Rifle Gap Reservoir though several different species of trout have been stocked into the reservoir by CDOW/CPW since 1973. Predominantly, rainbow trout catchables ($\geq$ 8 inches < 14 inches) have been planted over the years (Figure 9), and the reservoir has been managed as a put-and-take fishery. Stocking rates for rainbow catchables has varied, but in general, an average of approximately 100 fish per surface acre have been stocked annually. Catchables have been stocked as early as February, under the ice to replace fish harvested during the annual ice fishing tournament. Most rainbow trout catchables are stocked evenly across the months of May through October. East Rifle and West Rifle creeks drain into Rifle Gap Reservoir. These creeks support a strong brown trout population, which inhabits the reservoir on a year-round basis. Brown trout provide reservoir anglers an unique opportunity for a non-stocked trout species.

Angler Creel Surveys

Angler fishing preferences (species targeted) and behaviors (catch-and-release) have transformed over the years as a result of the ever-changing fish assemblage in Rifle Gap Reservoir, and broader behavioral trends in the angling public (Lischka 2013). The CDOW completed angler creel surveys in 1987 (April-July) and 2009 (May-October) during the open water season, as well as the ice fishing season from December 2009 through February 2010. All surveys followed the agency's standard protocol (Creel Survey Analysis Program (C-SAP)) (Schisler and Bowden 2012). This protocol involves completing angler counts and interviews on two week days and one weekend day per week that are randomly generated by C-SAP. This program generates projections based upon the data collected during the surveys. Angler hours in 2009 decreased 32% from 1987, despite three additional survey months in 2009. Angler catch per hour, however, tripled from 1987 (0.6 fish/hour) to 2009 (1.8 fish/hour). Rainbow trout (30,291 fish) comprised 80% of the total catch in 1987, and only 11% (8,014 fish) in 2009 (Figure 10). In 1987, anglers caught approximately 45% of the 67,298 catchable rainbow trout stocked. Fewer rainbow trout were stocked in 2009 (46,262 fish), of which 17% were caught by anglers.

Yellow perch dominated angler catch in 2009, constituting 82% (61,185 fish) of the total catch. The smaller number of rainbow trout caught in 2009 may be explained by a lower number of rainbow trout stocked that year, and/or by the presence of and abundance of yellow perch which were not available to anglers in 1987. More anglers practiced catch-and-release in 2009 (56% of fish caught were released) than in 1987 (22% of fish caught were released) (Figure 11). Only 8% of rainbow trout caught in 1987 were released compared to 52% in 2009. Yellow perch comprised 86% of the total catch by ice anglers. These anglers also released fewer fish (30% of fish caught were released) in comparison to open water anglers. Nearly one third of the total angler hours in 2009-2010 were attributed to the ice fishing season.

Year-round, warmwater fishing interest has been largely vocalized in western Colorado, particularly in waters on the western slope that offer opportunities for mixed fisheries (cold water and cool-warm water fish species). The desire for "instant fisheries" may have resulted in the increasing number of waters across western Colorado with illicit introductions of cool-warm water fishes (i.e., northern pike, yellow perch, and smallmouth bass). Northern pike and yellow perch are recent invaders to Rifle Gap Reservoir. "Quality" to "trophy" northern pike (21 to 44 inches) and "quality" to "memorable" yellow perch (8 to 12 inches) have created angler demand for these species. Such insistence has led to discord amongst specialized angling groups who target and prefer one species over others (i.e., trout anglers vs. pike anglers vs. walleye anglers, etc.). Anglers surveyed by the CDOW from 2009-2010 at Rifle Gap Reservoir indicated they would prefer primarily to fish for walleye, followed by northern pike, yellow perch, rainbow trout, and black crappie (Figure 12). Anglers also indicated that overall, their fishing experiences at Rifle Gap Reservoir were "above average" to "excellent" (Figure 13).

Fish Species Proposed for Future Management

Balancing changes to the reservoir's fish assemblage, and addressing angler behavior and preferences proved challenging in developing a LMP for Rifle Gap Reservoir. CDOW's Aquatic Wildlife Management Plan for the Colorado River Basin's Rifle Fish Management Unit (2006) calls for CDOW/CPW to "manage walleye and yellow perch populations in Rifle Gap Reservoir to perpetuate self-maintaining fisheries." CPW plans to implement this recommendation by managing Rifle Gap Reservoir for black crappie, trout, yellow perch, and triploid walleye (100% sterile).

Black crappie, yellow perch, and rainbow and brown trout are included in the Recovery Program's "'Compatible' list of non-native aquatic species compatible with recovery/preservation of endangered/native, non-salmonid aquatic species within critical habitat of the upper Colorado River basin (UCRB)" (Martinez et al. 2014). Fertile (diploid) walleye are included within the 'Non-Compatible' list, but use of the triploid and sterile form of walleye (triploid walleye) in the UCRB has been reviewed by the Recovery Program and included within a list of triploid/hybrid sport fishes that could be stocked within the basin (Martinez et al. 2014). Further, this Basin-wide Strategy states that the "stocking of approved sterile fish species in specific locations equipped with screens or otherwise managed to prevent fish escapement would

provide redundancy and a more preventive strategy to control the access of these non-native fish species to critical habitat for endangered fishes" (Martinez et al. 2014).

Smallmouth bass, northern pike, and walleye (diploid) are included in the Recovery Program's 'Non-Compatible' list of non-native aquatic species, with further introduction or stocking into waters of the UCRB strongly discouraged (Martinez et al. 2014). CPW will not stock smallmouth bass or northern pike into Rifle Gap Reservoir in the future. CPW will continue to enforce the current special regulations for northern pike, which include bowfishing and spearfishing as additional manners of legal take, and unlimited bag and possession limits for this species. CPW is also committing to additional actions to disadvantage northern pike, fertile (diploid) walleye, and smallmouth bass within Rifle Gap Reservoir as identified in CPW (March 25, 2015) and USFWS (April 27, 2015) correspondence. These CPW actions will include the following:

- removal of the current, special regulations for smallmouth bass at Rifle Gap Reservoir, which include bag, possession, and minimum size limits of two fish, 15 inches in length; and a spawning closure from May 1 through June 15 during which all smallmouth bass caught must be returned to the water alive. CPW will recommend to the Colorado Parks and Wildlife Commission (CPWC) that unlimited bag and possession limits for smallmouth bass at Rifle Gap Reservoir be considered in place of the current special regulations. The CPWC will consider these proposed regulation changes for adoption at the September 2015 CPWC meeting. If adopted, the proposed regulation changes would become effective April 1, 2016.
- removal of gravid, diploid female walleye by netting during the spawning season on an interim basis for the first three years of triploid walleye (100% sterile) stocking. Gravid, female walleye taken may be donated to license-holding anglers, or transported alive to Front Range waters by CPW. If sufficient numbers of gravid females are taken, CPW may elect to operate a small-scale spawn take operation with the intent of inducing 100% triploidy in the eggs followed by restocking of the triploid fry (100% sterile) or triploid fingerlings (100% sterile) into Rifle Gap Reservoir.
- lethal removal of smallmouth bass and northern pike collected during standard CPW sampling procedures in the spring and fall. Fish taken may be donated to license-holding anglers.

In the spring of 2013, CPW completed the construction of an in-stream fish screen in Rifle Creek downstream of Rifle Gap Reservoir's stilling basin. The intent of the screen is to preclude non-native sport fish that may escape from Rifle Gap Reservoir, from negatively impacting native, listed and non-listed fish species downstream in critical habitat of Rifle Creek and the Colorado River. Reservoir anglers will also benefit from the screen as CPW will be allowed the opportunity to stock non-salmonid sport fish desired by anglers and not currently stocked (i.e., black crappie,

triploid walleye (100% sterile), yellow perch)), pending approval of this LMP by the USFWS and States of Colorado, Utah, and Wyoming.

This LMP for Rifle Gap Reservoir will be evaluated annually by CPW. The schedule for 2014-2015 and beyond involves changes in current management actions for the reservoir, including revision to special regulations, stocking of non-salmonid species (first time since 1972) and first time stocking of a triploid fish, and biennial angler creel surveys. The response of the existing fishery to these actions coupled with the potential impacts of unpredictable environmental conditions is largely unknown. Therefore, CPW may need to adjust the prescribed management actions for certain species accordingly. Further, CPW recognizes that additional research will be necessary to fully understand fish population dynamics and food web structure of the Rifle Gap fishery.

CPW will continue the use of traditional methods to gather fishery and angler creel information to assist in evaluation of the LMP. Fish survey methods will be completed annually by CPW in the spring (April-May-June) and in the fall (September-October). Spring sampling will involve the use of gill nets, modified fyke nets, and shoreline electrofishing. Sampling in the fall will include the same methods used in the spring, in addition to bag seine hauls. Gear description, specifications, and operation related to Rifle Gap Reservoir are provided in Tables 2-5. CPW will also attempt to complete angler creel counts and surveys every other year, beginning in 2014. The open water surveys will commence May 1 and continue through the end of October. Ice anglers will be surveyed once stable ice forms and the ice fishing season begins, usually the beginning of December. Ice fishing surveys will continue through the end of the season, typically the middle to end of February. CPW will follow the agency's C-SAP protocol (Schisler and Bowden 2012) for completing standardized angler creel counts and surveys.

Detailed information describing the general habitat requirements and life histories for black crappie, trout, yellow perch, and walleye is presented in the following sections. Proposed management actions for these specific fish populations as well as the smallmouth bass and northern pike populations within Rifle Gap Reservoir are described below.

Black Crappie

Physical Habitat

The principal requirements of black crappie include clear water absent of noticeable current, and abundant cover in the form of submerged timber or aquatic vegetation (Pflieger 1997). Adult black crappie will typically congregate in shallow water near the upper ends of coves and away from wave action during the spring spawning season. After the spawn, adult black crappie will move into deeper water, commonly occurring at depths of 15 feet or more (Pflieger 1997). Interestingly, Pflieger (1997) also reported that young black crappie can often be found in open water of considerable depth.

Life History

Black crappie typically reach sexual maturity during the second or third summer of life (Pflieger 1997). Black crappie in Colorado begin spawning in the spring, when the water temperature reaches 58 degrees Fahrenheit (F), and spawning peaks at approximately 64 degrees F (Powell 1971). Male black crappie guard and build nests usually in gravel, but they can also nest on mud or plant material that is usually unacceptable to other types of sunfishes (Powell 1971). Female black crappie are highly fecund, producing between 11,000 and 188,000 eggs per year (Hammers and Oakley, undated). Pflieger (1997) reported that in Missouri, black crappie eggs can hatch in approximately three days, and that the fry remain attached to the spawning substrate by an adhesive substance from the egg for several more days. Fry free themselves by vigorous swimming motions, and observations in Missouri (Pflieger 1997) suggest that the fry leave the nest only at night and without schooling. In general, the black crappie is a schooling fish, tending to travel in groups.

Diet of the black crappie can be impacted by multiple factors and differs with locality, season, and age of the black crappie. Generally, young black crappie subsist mainly on zooplankton, crustaceans, and insects, while adults depend more heavily on fish. Adult black crappie can be opportunistic feeders, shifting back to insects when little or no prey fish are available (Hammers and Oakley, undated).

Growth rate of black crappie and other fishes can also be impacted by multiple factors, including water temperature and availability of forage. Powell (1971) notes that black crappie young usually grow two to four inches in the first year, and that in some reservoirs, four-year-old black crappie can be 13 inches long, while black crappie of the same age are only eight inches long in other waters. This fish species typically lives three to four years, with reports that black crappie can live eight years or longer.

Population within Rifle Gap Reservoir

Black crappie were illicitly introduced into Rifle Gap Reservoir sometime prior to 1993. The population of black crappie within the reservoir has fluctuated over the years (Figure 14). This species appears to successfully spawn and recruit to larger size classes. The 2 to 4-inch size class dominated the fish that were collected in 2008, 2010, and 2011 by CDOW/CPW. Fish from this size class should recruit to larger size classes in the subsequent years, becoming available to anglers for harvest. Survey information from 2009, 2010, and 2012 indicate some progression was made from the smaller size classes observed in prior years to larger size classes, 6-inches and greater. Predation by other fish species as well as angler harvest have likely contributed to few, adult fish being collected during standardized fish surveys completed by CDOW/CPW. Such few black crappie were collected in the appropriate size classes that neither Proportional Size Distribution (PSD) (Guy et al. 2007) nor body condition (relative weight, W_r) (Anderson and Neumann 1996) could be evaluated.

Models from angler creel survey data collected by CDOW during the 2009 open water and 2009-2010 ice fishing seasons project 2,694 black crappie were caught during the open water season, compared to only 18 black crappie during the ice fishing season (Figure 15). Less than half (40%) of the black crappie caught during the open water season were harvested, while ice anglers harvested all 18 black crappie caught. The average lengths of black crappie harvested during the open water and ice fishing seasons were 9.4 inches and 10.2 inches, respectively. Anglers released black crappie with an average length of 8.2 inches.

Forage for black crappie during different stages of development may be limited due to changing environmental conditions in Rifle Gap Reservoir, and competition with other fish species for food. Black crappie diets likely include zooplankton, insects, crayfish, and fish. Adult black crappie may feed on larval and juvenile golden shiner, yellow perch, walleye, and smallmouth bass. Piscatorial predators of black crappie in the reservoir may include northern pike, walleye, and yellow perch. On occasion, trout and smallmouth bass may also feed on younger black crappie.

Proposed Management Actions

Stocking Plan

Stock 4 to 6-inch black crappie on the fourth year of a five year stocking schedule, only if natural reproduction and recruitment from the current population is not adequate, and stocking does not negatively impact other fish species managed through this LMP (Table 6). Maximum stocking density will be 50 fish/habitat acre, resulting in a total of 5,000 fish (100 surface acres of available habitat). If only fingerlings (1.5-inch) are available to be stocked, then the fingerling stocking rate will be ten times the 50 fish/habitat acre stocking rate, resulting in 50,000 fish. Fish will be supplied by the CPW hatchery system, state/private aquaculturists approved by the Colorado Department of Agriculture (only if CPW cannot fulfill stocking request), and/or as part of translocation efforts from other nearby waters with existing black crappie populations (Harvey Gap Reservoir, Highline Lake). All fish to be translocated will require CPW disease testing and approval prior to translocation. All black crappie released will be marked to differentiate stocked and naturally produced fish. Black crappie will be stocked in the late summer/early fall, and earlier in the summer if only fingerlings are available.

Regulations

Maintain the current statewide daily bag and possession limits of 20 black crappie each, unless statewide limits change, or black crappie become overpopulated, stunted, and/or negatively impact other fish species to be managed through this LMP. Consider the adoption of appropriate special regulations if the black crappie population becomes out of balance. Statewide daily bag and possession limits will apply unless special regulations for black crappie are implemented.

Measurable Outcomes

Target goals for successful management of black crappie include objectives based on CPW fish survey data and angler creel information (Table 7). These goals are

presented below, and will be evaluated annually. Results from all methods that CPW utilizes during standard fish surveys and angler creel surveys will be compared by season on an annual basis. CPW expects to achieve a minimum of one of the goals tied to fish survey data, a minimum of one year out of every five years. CPW expects to achieve a minimum of one of the goals tied to angler creel survey information, a minimum of one year out of every three years that surveys are completed.

Goals Based on CPW Fish Survey Data
1) Catch per Unit Effort (CPUE): 50 black crappie ≥100 mm (4 inches)/hour
2) Young to Adult Ratio (YAR): 7-10 black crappie <100 mm (4 inches): 1 black crappie ≥100 mm (4 inches)
3) Proportional Size Distribution (PSD): 15-25
4) Relative Size Distribution-Preferred (RSD-P(10 inches)): ≥5

Goals Based on Angler Creel Survey Information
1) Mean Size in Creel: ≥8 inches
2) Annual Harvest: 500
3) Overall Total of All Fish Species Caught/Hour: maintain or improve 1.8 fish/hour
4) Overall Angler Satisfaction: improve from "Above Average" to "Excellent"

Trout

Physical Habitat
Optimal lacustrine habitat for rainbow and brown trout is characterized by clear, cool to cold, deep waters that are typically oligotrophic (Raleigh et al. 1984, 1986). Both species require well-oxygenated water. Rainbow trout generally prefer water temperatures ranging from 50 to 60 degrees F (Burkhard 1971), though they can tolerate short exposure to temperatures as high as 77 degrees F (Raleigh et al. 1984). Favorable water temperatures for brown trout range from 54 to 66 degrees F, with an upper lethal limit near 81 degrees F (Raleigh et al. 1986). Generally, brown trout can tolerate warmer water conditions than rainbow trout. Rainbow and brown trout can occupy both the littoral and pelagic zones of reservoirs, depending on multiple factors.

Life History
Rainbow and brown trout are typically sexually mature during their third year of life. Rainbow trout are spring spawners, while brown trout spawn in the fall. However, hatchery selection has resulted in hatchery-stocked fish spawning in nearly every month of the year, depending on the fish strain. Trout primarily spawn in streams; rainbows and browns occurring within lacustrine habitats generally require tributary streams with riffle areas containing gravel substrate that are free of silt for reproduction to occur. Females construct nests (redds) in riffle areas by lying on their sides and fanning the substrate vigorously with their tail fin. Redds vary in size and are dependent on the size of the spawning fish; some rainbow nests will vary from one to two feet wide and from two to four feet long (Burkhard 1971). One or more male trout join the female in the redd, and fertilize the deposited eggs. The female

trout then disturbs the substrate upstream of the redd, and current carries the substrate to cover the eggs. Rainbow and brown trout eggs are large, with an average female rainbow producing over 1,000 eggs per year (Burkhard 1971), and a female brown producing up to 3,000 eggs per year (Pflieger 1997). Parental care of the eggs is not provided. The eggs are reliant on well-oxygenated water percolating through the gravel. Incubation time of the eggs is highly dependent on temperature, amongst other factors (dissolved oxygen, water velocity, etc). Burkhard (1971) notes that at a water temperature of 50 degrees F, rainbow trout eggs will hatch in approximately 30 days. Raleigh et al. (1986) note several authors who report a decrease in time to hatch brown trout eggs based upon an increase in temperature, i.e., ranging from 148 days at 35 degrees F to 30 to 33 days at 57 degrees F. The young "sac-fry" that hatch from the eggs remain buried in the redd, obtaining nourishment from the yolk sac. Fry emerge through the gravels once the yolk-sac is used and absorbed by the fry. At this life stage, fry prefer shallower and slower water velocity. As the young trout grow, they move to deeper water with increased velocity.

Juvenile and adult rainbow and brown trout are opportunistic feeders, consuming a diversity of food depending on the environmental conditions, season, and size of the fish. Both species focus on zooplankton early on, switching their diets as they grow to include aquatic and terrestrial insects, as well as crustaceans. Several references provided by Raleigh et al. (1984, 1986) in the literature indicate that once trout reach ten inches or greater, rainbows and browns will increase their prey size to include fish.

Growth rates of trout vary, and can be dependent on water quality and availability of forage amongst other aspects. In optimal conditions in Colorado, Burkhard (1971) reported that rainbow trout can reach eight to 10 inches in length during their second summer, and Klein (1971) notes that brown trout can grow to about four inches in one year, doubling this growth in two years of life. Rainbows and browns can live over 10 years, but their general life spans four to six years.

Population within Rifle Gap Reservoir

The population of rainbow trout within Rifle Gap Reservoir is primarily sustained by CPW stocking efforts. Tributaries to the reservoir (West and East Rifle creeks) are the likely sources of the reservoir's brown trout population. These tributaries provide spawning habitat for both rainbow and brown trout that co-exist between the reservoir and streams. Trout information collected during routine CPW fish surveys largely reflects recent stocking events. Larger trout (14 inches and greater) are not uncommon, and are becoming more abundant in the reservoir as angler behavior is shifting more toward catch-and-release and away from harvest.

CDOW models from angler creel survey data collected during the open water seasons in 1987 and 2009 indicate that 56% of fish caught in 2009 were released, while anglers released only 22% of fish caught in 1987 (Figure 11). Specifically, 52% of rainbow trout caught in 2009 were released compared to only 8% in 1987 (Figure 16). Anglers harvested rainbow trout that averaged more than 12 inches in length in 1987.

Anglers released rainbow trout that averaged just less than 12 inches in length during the open water and ice fishing seasons across 2009-2010.

Trout in Rifle Gap Reservoir likely feed on zooplankton, insects, crayfish, and fish. Diets of larger trout may include golden shiner, and larval and juvenile yellow perch and walleye. On occasion, trout may also feed on larval and juvenile smallmouth bass and northern pike. Piscatorial predators of the larger trout in Rifle Gap Reservoir include walleye and northern pike.

Proposed Management Actions

Stocking Plan

Stock catchable trout (rainbow, 10 inches and greater) on an annual basis, unless stocking is determined to negatively impact other fish species managed through this LMP (Table 6). Maximum stocking density will be 100 fish/habitat acre, resulting in a total of 27,000 fish (270 surface acres of available habitat). Subcatchable plants of other trout species (brown trout, recreational cutthroat trout) may be stocked occasionally, but the trout fishery will be managed primarily as a put-and-take fishery. Fish will be supplied by the CPW hatchery system, and/or private aquaculturists approved by the Colorado Department of Agriculture (only if CPW cannot fulfill stocking request). Catchable trout will be stocked across the calendar year, beginning no sooner than June 15 to avoid negative interactions that may occur amongst trout, larval yellow perch, and stocked triploid walleye (100% sterile) fry/fingerlings.

Regulations

Maintain the current statewide daily bag and possession limits of four fish and eight fish, respectively, unless statewide limits change, or trout negatively impact other fish species managed through this LMP. Consider the adoption of appropriate special regulations if the trout population becomes out of balance. Statewide daily bag and possession limits will apply unless special regulations for trout are implemented.

Measurable Outcomes

Target goals for successful management of trout include objectives based on CPW fish survey data and angler creel information (Table 7). These goals are presented below, and will be evaluated annually. Results from all methods that CPW utilizes during standard fish surveys and angler creel surveys will be compared by season on an annual basis. CPW expects to achieve a minimum of one of the goals tied to fish survey data, a minimum of one year out of every five years. CPW expects to achieve a minimum of one of the goals tied to angler creel survey information, a minimum of one year out of every three years that surveys are completed.

Goals Based on CPW Fish Survey Data

1) Catch per Unit Effort (CPUE): 25 trout $\geq$200 mm (8 inches)/hour

Goals Based on Angler Creel Survey Information

1) Mean Size in Creel: $\geq$13 inches

2) Annual Harvest: 5,000
3) Overall Total of All Fish Species Caught/Hour: maintain or improve 1.8 fish/hour
4) Overall Angler Satisfaction: improve from "Above Average" to "Excellent"

Yellow Perch

Physical Habitat
Generally, yellow perch prefer clear lakes with aquatic vegetation, and rocky or sandy bottoms near shore (Cross 1967). Adult yellow perch usually occupy deeper water, while young yellow perch are typically associated with more shallow water. Yellow perch spend the day in deep water, and move inshore to feed in late afternoon or evening (Pflieger 1997). "Generally, yellow perch follow a seasonal migratory pattern that brings them in toward shore in the spring to spawn, out to deeper water as temperatures rise in summer, and into very deep water during the winter" (Mecozzi 2008).

Life History
Yellow perch from Horsetooth Reservoir in Colorado were sexually mature by age three (Goettl 1966), while Wiltzius (1960) observed 98% of yellow perch from Boyd Lake, Colorado were sexually mature before completing their second year of life. Yellow perch begin spawning in Colorado in the spring, when the water temperatures reach 45-52 degrees F (Goettl 1971). Yellow perch observed in seven impoundments in Colorado preferred rough substrate and submerged vegetation for spawning sites (Fajt 1990). However, when preferred spawning habitat was not available, yellow perch selected any substrate, including smooth substrate and/or mud bottoms (Fajt 1990). In fluctuating reservoirs, yellow perch laid eggs directly on the reservoir bottom, and the eggs drifted with water movement (Goettl 1971). Goettl (1971) noted that "this is one of the major adaptive features in the life cycle of the yellow perch, and is a reproductive advantage over other fish in the reservoir environment." Male yellow perch are the first to arrive to and leave the spawning area (Goettl 1971). A single gravid female is followed by 15 to 25 males that fertilize the eggs as they are spawned (Harrington 1947). The eggs are released in long, gelatinous "gobs which extend into accordion-like ribbons from two to seven feet in length" with each strand averaging approximately 23,000 eggs (Goettl 1971). Yellow perch have high fecundity; a 10-inch female yellow perch may lay as many as 50,000 eggs per year. No parental care by yellow perch of the eggs occurs. Yellow perch young hatch and are free from the egg mass in three to four weeks (Goettl 1971). Yellow perch live in large schools (Pflieger 1997), travelling with 50 to 200 fish (Goettl 1971).

Yellow perch are dietary generalists, often consuming what is available at the time. Several studies in Colorado waters have documented shifts in the diets of yellow perch based on different life stages and seasonal differences. Fisk (1953) found that slightly more than half (53%) of the food of young-of-the-year yellow perch consisted of Entomostraca (historical subclass of Crustacea, no longer in technical use) and 45% of insects. Diets of adult yellow perch shifted primarily to fish; adult yellow perch ate 66% fish, 21% insects, and 9% Entomostraca (Fisk 1953). Small fish were the most important food item in the diet of yellow perch collected from Jumbo

Reservoir (Evans 1951). More than 50% of fish in the diet of these yellow perch were identified as young yellow perch. Chironomid larvae and pupae were also important in the diet of yellow perch, while cladocerans, copepods, algae, and higher plants were not significant items within the diets of yellow perch collected from Jumbo Reservoir (Evans 1951). Fisk (1953) and Goettl (1966) also reported that adult yellow perch tend to vary in their selection of food, with Fisk (1953) documenting seasonal differences in the diets of yellow perch. *Daphnia galeata mendotae* was the main source of food for yellow perch in Horsetooth Reservoir as long as the Daphnia density did not drop below three Daphnia per liter (Goettl 1966). Young-of-the-year yellow perch and *Leptodora kindti* were the most important diet items when this situation occurred.

Age and growth of yellow perch in Boyd Lake, Colorado were studied in detail by Wiltzius (1960). Growth in yellow perch was correlated with water level draw downs. Reduction in habitat for spawning purposes and production of fish-food organisms, as well as loss of cover habitat likely weakened the first year growth of yellow perch, while proving beneficial for growth of yellow perch in the second and later years of life through cannibalism. Wiltzius (1960) found differential growth of the sexes with females larger than males at all years of life, in addition to a differential natural mortality rate between male and female yellow perch with an increase in age (females lived longer). Females averaged 1.73 inches longer than males by the end of the sixth year of life. Wiltzius (1960) also observed that the greatest average annual increment of growth occurred during the first year of life. "Growth increments declined rapidly in the second and third years of life, successively increased in the fourth and fifth years of life, and decreased thereafter" (Wiltzius 1960).

Goettl (1971) reported that "the average three-year old yellow perch in Colorado is about seven inches in length." Yellow perch from impoundments located on the eastern slope of Colorado did not reach "quality" size (8 inches) until age six or older (Fajt 1990). The life span of yellow perch is usually less than seven years, with reports of this species living 11 years or longer.

Population within Rifle Gap Reservoir

Yellow perch were illicitly introduced into Rifle Gap Reservoir between 1993 and 1999. The population of yellow perch has fluctuated over the years, with CDOW/CPW fish survey information indicating a strong population across 2008-2011 (Figure 17). The few yellow perch collected in 2012 and 2013 are likely artifacts of poor sampling conditions, and does not accurately represent the most current yellow perch population. Reduced surface water levels in 2012 and 2013 within the reservoir likely impacted yellow perch, but CPW fish biologists have not detected a "crash" of the yellow perch population. Young-of-the-year yellow perch are presumably represented by those fish in the 2 to 3.5-inch size range. This size class was collected across all years, with the exception of 2012. The presumptive young-of-the-year size class in 2008 recruited to the presumptive 5 to 7-inch size class in 2009, and the presumptive 9-inch + size classes in 2010 and 2011.

Yellow perch PSDs (Guy et al. 2007) increased from 2008 to 2010 (9 to 32 to 41). Ninety-five percent confidence values for PSDs from 2008 through 2010 included $\pm$ 6, $\pm$ 9, and $\pm$ 10 respectively, following the methodology of Gustafson (1988). A decrease in PSD was observed for yellow perch collected in 2011 (16 $\pm$ 10) when compared to PSDs from previous years. Few yellow perch within the "quality" (8 inch) and "stock" (5 inch) categories were collected in 2012 and 2013 (presumably attributable to low surface water levels rather than changes in the population), and thus were unable to be analyzed by PSD. Fajt (1990) found a positive relationship between percent composition of crayfish in yellow perch diets and the PSD of the yellow perch population in seven impoundments on the eastern slope of Colorado.

In addition, relative weights (W_r), as measures of body condition, were determined using standard weight values from the literature (Anderson and Neumann 1996). Mean relative weights were calculated by one inch size classes for yellow perch collected from 2008-2012 (Figure 18). Not enough yellow perch were collected in 2013 for evaluation. No consistent patterns in mean relative weights were observed for yellow perch size groups, or for yellow perch collected from year to year during the fall. Mean relative weights for yellow perch ranged from a low of 84 (9.0 to 9.9-inch size group in 2009) to a high of 100 in 2008 within the 4.0 to 4.9-inch size group. In general, yellow perch within Rifle Gap Reservoir appear to be in fair to good condition when compared to the mean relative weight of 93 for other yellow perch populations in North America.

Johnson et al. (2009) completed age and growth analyses for yellow perch collected in the spring and fall of 2008 (Figures 19 and 20). An 8-inch yellow perch was estimated to be four years of age. Otoliths were found to be more reliable than anal fin spines for aging of yellow perch, especially for fish after age three (Johnson et al 2009). Yellow perch growth in the reservoir is somewhat slower than the median of populations reported in Fishbase (2009) (Johnson et al. 2009). It appears that growth of age five and older fish has varied during the past period represented in the samples collected (1998-2003 year classes). This variation in growth may be attributable to variations in reservoir conditions (i.e., surface water level fluctuations associated with drought conditions in the early 2000s) (Johnson et al. 2009).

Models from angler creel survey data collected by CDOW during the 2009 open water and 2009-2010 ice fishing seasons project yellow perch dominated angler catch across both seasons. Yellow perch accounted for 82% of the total catch during the open water season, and 86% of the total catch during the ice fishing season (Figure 21). Ice anglers harvested three out of every four yellow perch caught, while anglers during the open water season kept less than 50% of the yellow perch caught. The average lengths of yellow perch harvested during the open water and ice fishing seasons were 8.9 inches and 8.5 inches, respectively. Open water anglers released yellow perch with an average length of 7.3 inches, while ice anglers released smaller yellow perch (average length of 6 inches).

Forage for yellow perch during different stages of development may be limited due to changing environmental conditions in Rifle Gap Reservoir, and competition with other fish species for food. Yellow perch diets likely include zooplankton, insects, algae, crustaceans, and fish. Adult yellow perch may feed on larval and juvenile golden shiner, black crappie, northern pike, and walleye. Yellow perch have also been documented as a cannibalistic fish species, with larger yellow perch predating on younger yellow perch. Piscatorial predators of yellow perch in Rifle Gap Reservoir may include northern pike, smallmouth bass, and walleye. On occasion, trout may also feed on younger yellow perch.

Proposed Management Actions

Stocking Plan

Currently, CPW has no plans to stock yellow perch (Table 6). However, CPW would like to have the option of stocking yellow perch from nearby waters with existing yellow perch populations (Harvey Gap Reservoir, Ruedi Reservoir, etc.), if this population should crash in Rifle Gap Reservoir. All fish to be translocated will require CPW disease testing and approval prior to translocation. Size of fish to be stocked, stocking density, and stocking schedule (year) and time (month) will need to be determined based upon the overall objectives for the fishery at that time. Any yellow perch to be released will be marked to differentiate stocked and naturally produced fish. Yellow perch will be stocked in the late summer, or early to mid-fall.

Regulations

On April 1, 2015, a special regulation protecting yellow perch became effective at this reservoir. The previous regulation allowed for unlimited take of yellow perch, while the new regulation allows a bag and possession limit of 20 yellow perch. These new limits will help effectively manage the yellow perch population and protect the species from overfishing. Revision to the 2015 special regulation will be considered if yellow perch become overpopulated, stunted, and/or negatively impact other fish species managed through this LMP.

Measurable Outcomes

Target goals for successful management of yellow perch include objectives based on CPW fish survey data and angler creel information (Table 7). These goals are presented below, and will be evaluated annually. Results from all methods that CPW utilizes during standard fish surveys and angler creel surveys will be compared by season on an annual basis. CPW expects to achieve a minimum of one of the goals tied to fish survey data, a minimum of one year out of every five years. CPW expects to achieve a minimum of one of the goals tied to angler creel survey information, a minimum of one year out of every three years that surveys are completed.

Goals Based on CPW Fish Survey Data

1) Catch per Unit Effort (CPUE): 150 yellow perch $\geq$100 mm (4 inches)/hour
2) Young to Adult Ratio (YAR): 2-5 yellow perch <100 mm (4 inches): 1 yellow perch $\geq$100 mm (4 inches)
3) Proportional Size Distribution (PSD): 25-35

4) Relative Size Distribution-Preferred (RSD-P(10 inches)): ≥5

Goals Based on Angler Creel Survey Information
1) Mean Size in Creel: ≥8 inches
2) Annual Harvest: 20,000
3) Overall Total of All Fish Species Caught/Hour: maintain or improve 1.8 fish/hour
4) Overall Angler Satisfaction: improve from "Above Average" to "Excellent"

Walleye

Physical Habitat
Walleye are a coolwater species, occupying both lentic and lotic habitats. In reservoirs, this species typically prefers the open, deeper water. Studies report that recently hatched larvae and fry move into pelagic waters early on (Bozek et al. 2011). Age-0 walleye utilize various habitats including those with high macrophyte abundance in the littoral zone, moving to deeper water as the summer progresses (Bozek et al. 2011). Walleye are mostly nocturnal, moving into shallower areas to feed in the evening, and returning to deeper water after daybreak. The scotopic vision of walleye allows efficient foraging in dim light and high turbidity environments.

Life History
Maturity in Colorado walleye usually occurs in males first (second year of life) followed by females (third year of life) (Taliaferro 1971). Walleye spawn early in the spring, in water temperatures ranging between 45 and 50 degrees F. In Rifle Gap Reservoir, walleye have been on the spawn as early as the middle of March, at water temperatures between 43 and 45 degrees F (B. Elmblad, CDOW retired, personal communication). Walleye generally spawn at night, and occasionally during the day in the peak of the spawning period and/or when light levels are low. Walleye have been observed spawning on numerous substrates ranging from gravel, cobble, and rubble to sand, silt, muck-detritus, vegetation, and root masses (Bozek at al. 2011). Walleye in Rifle Gap Reservoir spawn along the dam in shallow water, eight to 10 feet deep. Ripe walleye of both sexes have also been documented in the east inlet of the reservoir in early April. Walleye have been known to spawn in water so shallow that their backs are exposed (Pflieger 1997). Ripe male walleye arrive first in the spawning areas, and congregate into groups. Female walleye follow, and courtship behaviors occur. "Females release their eggs in bouts, sometimes up to three times per minute," followed by "males releasing milt over the area where eggs are deposited" (Bozek et al. 2011). Multiple studies indicate female walleye are highly fecund, producing small eggs (average of 2 mm in diameter) from 28,000 to 120,000 eggs/kilogram body weight per year (Barton and Barry (2011) and Bozek et al. (2011)). Walleye are broadcast spawners, with no parental care of the eggs or young. Eggs are adhesive, sticking to the spawning substrate until hatching occurs. Barton and Barry (2011) found several studies reported walleye eggs hatching in 14-21 days at temperatures of 46 to 59 degrees F. Elmblad (CDOW retired, personal communication) observed similar results with walleye eggs in Rifle Gap Reservoir having well-developed eyes two to three weeks post-spawn, and presumably hatching

shortly thereafter. Larval walleye, immediately following hatching, remain mostly sedentary among the benthos (Bozek et al. 2011). Walleye often travel in schools, with different age classes of this species travelling together (Bozek et al. 2011).

Multiple studies have documented walleye foraging behavior switching during their first year of life, from zooplankton to invertebrates to fish (Bozek et al. 2011). Walleye are specialist piscivores, focusing their diets on preferred fish species available, including their own species. Chipps and Graeb (2011) noted that although adult walleye consume a variety of fish species, studies also indicate that adult walleye will supplement their diet with invertebrates, as well.

Growth of walleye can be affected by both abiotic (i.e. water temperature) and biotic factors (i.e. competition with other species for forage and habitat). Temperature conditions during the spring and summer, and competition with other species for shared food resources may constrain growth rate, and consequently vulnerability to predation (Bozek et al. 2011). The juvenile life stage in walleye is a period of relatively rapid growth, with male and female walleyes usually growing at the same rate (Bozek et al. 2011). Female walleye sustain higher growth rates than their male counterparts, but this typically does not occur until after sexual maturation (on average, 350 mm (13.8 inches) in males and 450 mm (17.7 inches) in females) (Bozek et al. 2011).

In Colorado, Taliaferro (1971) reported that although walleye length varies considerably in different waters, generally first year walleyes can reach six to eight inches, while two year old fish are usually over 12 inches. Bozek et al. (2011) compiled data from multiple populations indicating that walleye longevity spans four to 32 years.

Population within Rifle Gap Reservoir

Walleye in Rifle Gap Reservoir have maintained a naturally reproducing population since their initial stocking by the CDOW in 1972. The ever-changing fishery within the reservoir has resulted in the decline of the walleye fishery over time (Figures 5 and 6). Specifically, CDOW annual fall electrofishing and gill net surveys in 1987, 1993, and 1999 indicate younger walleye (6 to 15 inches) were present prior to the introduction of northern pike and yellow perch (sometime between 1993 and 1999). Since 2002, only 12 walleye less than 15 inches in length have been collected using similar methodologies and sampling stations comparable to those in previous years. Further, sampling efforts have decreased over time as the density of yellow perch has increased such that over-night gill nets are not effective for catching walleye. Overall, number of walleye collected has decreased over time, with a handful of fish captured across the past six years (Figure 22). Such few walleye were collected from 2008 through 2013 that neither PSDs (Guy et al. 2007) nor relative weights (W_r) (Anderson and Neumann 1996) could be evaluated.

Johnson et al. (2009) completed age and growth analyses for walleye collected in the spring and fall of 2008 (Figures 23 and 24). Otoliths were found to be more reliable

than spines from the dorsal fin for aging of walleye (Johnson et al. 2009). The dorsal spine section was aged to 10 years and the otolith section showed 13 clear annuli, suggesting that the dorsal spine section underestimated the age of the fish by three years. Johnson et al. (2009) found walleye growth in Rifle Gap Reservoir to be slower than "typical" for the species, based on the median of populations recorded in Fishbase (2009). However, age and growth analyses were based primarily upon dorsal spines, which were more easily collected using non-lethal methods than otoliths (lethal collection). Spines are known to be biased low at older ages, and do not provide very reliable age estimates for walleye age seven and older. Thus, these analyses likely resulted in overestimation of walleye growth in Rifle Gap Reservoir (Johnson et al. 2009).

CDOW models from angler creel survey data collected during the open water seasons project 38% more walleye were caught by anglers in 1987 when compared to 2009 (267 fish) (Figure 25). Almost half of the 431 walleye caught in 1987 were harvested by anglers, and the average size of walleye kept was 13.3 inches. Less than 14% of the walleye caught in 2009 were harvested; the average length of walleye harvested was 19.3 inches compared to 16.2 inches, the average size of walleye released. Special harvest regulations for walleye were in place in 2009 compared to statewide regulations for the species in 1987. The bag and possession limits of one walleye at a minimum size of 18 inches likely affected the catch and release actions of anglers from 2009-2010. Fifteen walleye were projected to be caught by anglers during the 2009-2010 ice fishing season. None of these fish were reported as harvested, and the average length of walleye released by ice anglers was 16.9 inches.

Forage for walleye during different stages of development may be limited due to changing environmental conditions in Rifle Gap Reservoir, and competition with other fish species for food. Walleye diets likely include zooplankton, insects, crustaceans, and fish. Adult walleye may feed on larval and juvenile golden shiner, black crappie, yellow perch, smallmouth bass, northern pike, and trout. Walleye have also been documented as a cannibalistic fish species, with larger walleye predating on younger walleye. Piscatorial predators of walleye in Rifle Gap Reservoir may include yellow perch, northern pike, smallmouth bass, and walleye. On occasion, black crappie and trout may also feed on larval and juvenile walleye.

Proposed Management Actions

CPW is committing to additional actions to disadvantage fertile (diploid) walleye within Rifle Gap Reservoir as identified in CPW (March 25, 2015) and USFWS (April 27, 2015) correspondence. Gravid, diploid female walleye will be removed by netting during the spawning season on an interim basis for the first three years of triploid walleye (100% sterile) stocking. Gravid, female walleye taken may be donated to license-holding anglers, or transported alive to Front Range waters by CPW. If sufficient numbers of gravid females are taken, CPW may elect to operate a small-scale spawn take operation with the intent of inducing 100% triploidy in the eggs followed by restocking of the triploid fry (100% sterile) or triploid fingerlings (100% sterile) into Rifle Gap Reservoir.

Stocking Plan

Stock triploid walleye (100% sterile) fingerlings (1.3-inch) for the first three years of a five-year stocking schedule (Table 6). Stocking in year three may be delayed if the first two years of stocking prove successful. Stocking density will be 150 fish/habitat acre, resulting in a total of 36,000 fish (240 surface acres of available habitat). The fry stocking rate will be ten times the fingerling stocking rate if only fry (0.2-inch) are available to be stocked, resulting in a total of 360,000 fish. Fish will be supplied by the CPW hatchery system or other state/private aquaculturists approved by the Colorado Department of Agriculture (only if CPW cannot fulfill stocking request). Fingerling walleye will be stocked in late May/early June, and walleye fry will be stocked in April if only fry are available.

Walleye lots within the CPW hatchery system must reach 100%% triploidy to be stocked into Rifle Gap Reservoir. CPW hatchery personnel will follow CPW protocol to pressure treat diploid walleye eggs, thereby creating triploid walleye eggs (D. Harris, CPW, personal communication). This protocol has been tested for several years, and successfully utilized in Colorado since 2012. The state of Montana is also utilizing similar protocols to achieve successful triploidy in walleye. Once the triploidy process is complete in the CPW hatchery system, ploidy certification will be validated by Dr. Bonnie Brown of Virginia Commonwealth University utilizing flow cytometric ploidy assessment (Schultz et al. 2001).

Regulations

Maintain the current special regulations for walleye of one fish in bag and possession, with a minimum size of 18 inches. Revision to this special regulation will be considered if the walleye population grows as a result of actions taken in this LMP, and the population can safely handle additional harvest.

Measurable Outcomes

Target goals for successful management of walleye include objectives based on CPW fish survey data and angler creel information (Table 7). These goals are presented below, and will be evaluated annually. Results from all methods that CPW utilizes during standard fish surveys and angler creel surveys will be compared by season on an annual basis. CPW expects to achieve a minimum of one of the goals tied to fish survey data, a minimum of one year out of every five years. CPW expects to achieve a minimum of one of the goals tied to angler creel survey information, a minimum of one year out of every three years that surveys are completed.

Goals Based on CPW Fish Survey Data

1) Catch per Unit Effort (CPUE): 25 walleye $\geq$200 mm (8 inches)/hour
2) Young to Adult Ratio (YAR): 1-3 walleye <200 mm (8 inches): 1 walleye $\geq$200 mm
3) Proportional Size Distribution (PSD): 30-40
4) Relative Size Distribution-Preferred (RSD-P(20 inches)): $\geq$5

Goals Based on Angler Creel Survey Information
1) Mean Size in Creel: ≥18 inches
2) Annual Harvest: 100
3) Overall Total of All Fish Species Caught/Hour: maintain or improve 1.8 fish/hour
4) Overall Angler Satisfaction: improve from "Above Average" to "Excellent"

Smallmouth Bass

Population within Rifle Gap Reservoir
Smallmouth bass in Rifle Gap Reservoir have maintained a naturally reproducing population since their initial stocking by the CDOW in 1972. The population of smallmouth bass has fluctuated over the years, with CPW fish survey information indicating a strong population in 2012 and 2013 (Figure 26). The 2012 and 2013 surveys highlighted the smallmouth bass population that was present along the rip-rap shoreline of the dam. Generally, structured habitat to survey in the reservoir was limited to the dam area in 2012 and 2013 due to low reservoir water levels. Very few smallmouth bass were collected in 2008, 2009, and 2011. Presumptive young-of-the-year (<4 inches in length) smallmouth bass were captured in three of the six years sampled, including 2008, 2011, and 2013. Smallmouth bass collected in 2010 ranged from 5.5 inches to 14.2 inches in length. Smallmouth bass across the 4 to 12-inch size range were collected in 2012 and 2013. Presumptive young-of-the-year and smallmouth bass greater than 12 inches were also collected in 2013.

Smallmouth bass PSDs (Guy et al. 2007) were determined in 2010, 2012, and 2013. Few smallmouth bass within the "quality" (11-inch) and "stock" (7-inch) categories were collected in 2008, 2009, and 2011, and so PSD could not be evaluated. The highest PSDs were in 2013 (30) and 2010 (26). The lowest PSD was 7 from the smallmouth bass population surveyed in 2012. Ninety-five percent confidence values for PSDs from 2010, 2012, and 2013 included ± 15, ± 9, and ± 16 respectively, following the methodology of Gustafson (1988).

In addition, mean relative weights (W_r) (Anderson and Neumann 1996) were calculated by one-inch size classes for smallmouth bass collected from 2010, 2012 and 2013 (Figure 27). Unfortunately, not enough smallmouth bass were collected in 2008, 2009, or 2011 to be evaluated. The lowest mean relative weights for all size groups of smallmouth bass occurred in 2013. Overall, the highest and lowest mean relative weights for smallmouth bass were 97 and 83, values for fish collected in 2012 and 2013, respectively, within the 11.0 to 11.9-inch size group. In general, smallmouth bass within Rifle Gap Reservoir appear to be in fair to average condition when compared to the mean relative weight of 93 for other smallmouth bass populations in North America.

Johnson et al. (2009) completed age and growth analyses for smallmouth bass collected in the spring and fall of 2008 (Figures 28 and 29). A 7-inch smallmouth bass was estimated to be four years of age. Smallmouth bass growth in the reservoir is similar to the median of populations reported in Fishbase (2009) (Johnson et al.

2009). Otoliths from larger smallmouth bass (≥ 300 mm) are needed to determine growth later in life as smallmouth approach the minimum size limit of 15 inches (381 mm).

CDOW models from angler creel survey data collected during the open water seasons project 90% more smallmouth bass were caught by anglers in 1987 when compared to 2009 (692 fish) (Figure 30). Less than a quarter of the 7,021 smallmouth bass caught in 1987 were harvested by anglers, and the average size of smallmouth bass kept was 10.2 inches. Less than 3% of the smallmouth bass caught in 2009 were harvested; the average length of smallmouth bass harvested was 15.0 inches compared to 8.8 inches, the average size of smallmouth bass released. Special harvest regulations for smallmouth bass were in place in 2009 compared to statewide regulations for the species in 1987. The bag and possession limits of two smallmouth bass at a minimum size of 15 inches likely affected the catch and release actions of anglers in 2009.

Forage for smallmouth bass during different stages of development may be limited due to changing environmental conditions in Rifle Gap Reservoir, and competition with other fish species for food. Smallmouth bass diets likely include zooplankton, insects, crayfish, and fish. Adult smallmouth bass may feed on larval and juvenile golden shiner, black crappie, yellow perch, walleye, and northern pike. Piscatorial predators of smallmouth bass in Rifle Gap Reservoir may include northern pike and walleye. On occasion, yellow perch may also feed on younger smallmouth bass.

Proposed Management Actions

CPW is committing to additional actions to disadvantage smallmouth bass within Rifle Gap Reservoir as identified in CPW (March 25, 2015) and USFWS (April 27, 2015) correspondence. CPW will encourage anglers to legally harvest smallmouth bass so that other fish species in the reservoir may flourish. CPW is in the process of removing the current, special regulations for smallmouth bass at Rifle Gap Reservoir, which include bag, possession, and minimum size limits of two fish, 15 inches in length; and a spawning closure from May 1 through June 15 during which all smallmouth bass caught must be returned to the water alive. CPW will recommend to the CPWC that unlimited bag and possession limits for smallmouth bass at Rifle Gap Reservoir be considered in place of the current special regulations. The CPWC will consider these proposed regulation changes for adoption at the September 2015 CPWC meeting. If adopted, the proposed regulation changes would become effective April 1, 2016.

CPW also will not augment the existing smallmouth bass population through stocking. CPW may consider stocking and managing for largemouth bass as a replacement species in the future. CPW will also lethally remove smallmouth bass collected during standard CPW sampling procedures in the spring and fall. Fish taken may be donated to license-holding anglers.

Northern Pike

Population within Rifle Gap Reservoir

Northern pike were illicitly introduced into Rifle Gap Reservoir between 1993 and 1999. This introduction has created conflict amongst different angling groups who frequent the reservoir. Some anglers covet northern pike and the opportunity to catch a "trophy-sized" fish in western Colorado. Anglers fishing for smallmouth bass, walleye, yellow perch, and trout are adamantly opposed to CPW managing Rifle Gap Reservoir for northern pike. These different viewpoints have created management challenges for CPW.

The northern pike population in Rifle Gap Reservoir is similar to other fish populations resident in the reservoir, fluctuating year to year (Figure 31). Juvenile fish were collected every year except 2012 and 2013. Larger, adult fish were collected every year except 2010. Northern pike collected in 2008 and 2009 had the greatest diversity in size classes, with fish ranging from just under nine inches to over 32 inches in 2008, and from just over 10 inches to more than 36 inches in 2009. Accurate abundance and size classes of northern pike in Rifle Gap Reservoir are likely underestimated by CPW fish surveys, especially in 2012 and 2013. Northern pike can be difficult to capture by electrofishing, and this reality coupled with changing water levels likely influenced collection of northern pike across all years of sampling. Such few northern pike were collected from 2008-2013 that PSDs (Guy et al. 2007) could not be evaluated.

In addition, mean relative weights (W_r) (Anderson and Neumann 1996) were calculated by one-inch size classes for northern pike collected from 2008-2013 (Figure 32). Several size classes across the years had fewer than two fish present. Thus, mean relative weights were determined for northern pike 23 inches and smaller ($\leq$584 mm), and northern pike greater than 23 inches (>584 mm). Body condition of the larger fish was greater (mean W_r=104) than body condition of the smaller fish (mean W_r=91). This improved body condition is likely due to the ability of larger northern pike to exploit catchable rainbow trout as prey (Johnson et al. 2009). Johnson et al. (2009) also documented that northern pike in Rifle Gap Reservoir age five through age ten were 132% heavier than the median of populations reported in Fishbase (2009).

Johnson et al. (2009) completed age and growth analyses utilizing cleithra collected in the spring and fall of 2006, 2007 and 2008 (Figure 33). Northern pike growth in the reservoir is rapid, with age five through age ten fish averaging 24% larger in length than the median of 39 populations reported in Fishbase (2009) (Johnson et al. 2009).

Models from angler creel survey data collected by CDOW during the 2009 open water and 2009-2010 ice fishing seasons project 1,524 and 137 northern pike were caught, respectively (Figure 34). Ice anglers harvested 42% of the northern pike caught, while anglers during the open water season only kept 272 northern pike

(18%). The average lengths of northern pike harvested during the open water and ice fishing seasons were 17.9 inches and 22.5 inches, respectively. Ice anglers released larger northern pike (average length of 18.9 inches), when compared to open water anglers who released northern pike with an average length of 13.9 inches.

Forage for northern pike during different stages of development may be limited to changing environmental conditions in Rifle Gap Reservoir, and competition with other fish species for food. Northern pike diets likely include zooplankton, insects, crustaceans, and fish. Adult northern pike may feed on golden shiner, black crappie, yellow perch, smallmouth bass, walleye, and trout. Northern pike have also been documented as a cannibalistic fish species, with larger northern pike predating on younger northern pike. This fish species will consume other fishes up to 50% of their own body length. Piscatorial predators of northern pike in Rifle Gap Reservoir may include yellow perch, northern pike, smallmouth bass, and walleye. On occasion, black crappie and trout may also feed on larval and juvenile northern pike.

Johnson et al. (2009) estimated consumptive demand of northern pike in the reservoir per age, per year (Figure 35) based on data collected by CDOW from 2007-2009. Estimated consumption of yellow perch was greater than consumption of rainbow trout. Estimated consumptive demand of northern pike per capita increased steadily from age-three for yellow perch and from age-four for rainbow trout (Johnson et al. 2009). An age-four northern pike was predicted to eat 26 catchable rainbow trout and 47 yellow perch per year, while an age-ten northern pike was predicted to consume 79 rainbow trout and 144 yellow perch per year. This trend was reversed at the population level with the age-four cohort of northern pike consuming the most yellow perch and rainbow trout and the age ten cohort consuming the least amount of prey (Figure 36). This relationship is a result of the age-four cohort being the most abundant age class in the population based upon the CDOW survey data utilized for the analysis.

Proposed Management Actions

CPW will continue to encourage anglers to legally harvest northern pike in Rifle Gap Reservoir so that other fish species in the reservoir may flourish. CPW will not augment the existing northern pike population through stocking. CPW will continue to enforce the special regulations currently in place for northern pike. Bowfishing and spearfishing regulations allowing legal take of northern pike will remain in effect, as will unlimited bag and possession limits for this species.

CPW is also committing to additional actions to disadvantage northern pike within Rifle Gap Reservoir as identified in CPW (March 25, 2015) and USFWS (April 27, 2015) correspondence. CPW will also lethally remove northern pike collected during standard CPW sampling procedures in the spring and fall. Fish taken may be donated to license-holding anglers.

III. Fish Escapement

Fish can escape from Rifle Gap Reservoir via the spillway or through the bottom release. The reservoir typically spills at least once a year (Table 1), though low snowpack and drought conditions prohibited the reservoir from spilling in 2013. Rifle Creek originates at the Rifle Gap Reservoir dam, and is a perennial stream. A 5 cfs domestic water right for Rifle Creek downstream of the reservoir is in place year-round. This water right can be met annually through the bottom release, when spills cannot occur.

In the spring of 2013, CPW completed the construction of an in-stream fish screen in Rifle Creek downstream of Rifle Gap Reservoir's stilling basin (Figures 3 and 4). The intent of the screen is to preclude non-native sport fish that may escape from Rifle Gap Reservoir, from negatively impacting native, listed and non-listed fish species downstream in critical habitat of Rifle Creek and the Colorado River. The Rifle Creek fish screen is designed to accommodate a maximum discharge of 200 cfs from the reservoir. Aperture of the fish screen is 1.0 millimeter (mm) (0.0393 inches, approximately 1/32 inch), and removes 90% of solids 1.0 mm or greater and 100% of solids 2.0 mm and larger. As of May 16, 2013, the Rifle Creek fish screen is operational and functioning successfully by eliminating the opportunity for non-native sport fish to negatively impact native, non-listed and listed fishes downstream.

CPW personnel, in coordination with the USBOR, recently completed an Operations and Maintenance Plan for the fish screen. This plan assists all stakeholders involved with the screen project by:
1) identifying the roles and responsibilities of personnel implementing operations and maintenance of the fish screen,
2) establishing the protocol for routine inspection and cleaning of the fish screen, and
3) establishing the process for long-term maintenance of the fish screen, as needed.
Implementation of this plan began in July, 2013.

Routine cleaning/inspection of the fish screen involves CPW personnel visually inspecting the screen a minimum of twice a week, to insure that the screen is operating as designed, as mandated by CPW's Operation and Maintenance Plan. Cleaning of the screen can occur simultaneously with these inspections, and occurs a minimum of once per week. Routine inspection of the fish screen has varied from every day to every two or three days per week. Cleaning of the screen has also varied on these occasions from 20 minutes to 90 minutes. Maintenance of the fish screen has been minimal to this date.

CPW personnel have documented seven fish species collected in the troughs of the fish screen from May through October, 2013 (Figure 37). These species include black crappie, brown trout, northern pike, rainbow trout, smallmouth bass, walleye, and yellow perch. The smallest fish collected thus far have included black crappie and yellow perch that were 15 mm (0.6 inch) and 31 mm (1.2 inches) in total length, respectively (Figure 38). Larger fish, including trout (320 mm; 12.6 inches) and

northern pike (525 mm; 21 inches) have also been captured by the screen, and observed in the collection troughs (Figure 38). Non-salmonid fish are lethally removed, while salmonids are returned alive into Rifle Creek downstream of the fish screen. Overall, a minimum of 184 fish have been captured by the fish screen through October 2013.

CPW personnel initiated an annual fish monitoring program in the fall of 2011 within Rifle Creek (Figure 39), prior to the construction of the Rifle Creek fish screen. The intent of the electrofishing is to survey three sites during low flow conditions (one site upstream of the fish screen and three sites downstream of the fish screen) to monitor changes in the fish species assemblage. A fourth site, located immediately downstream of the fish screen, was added in the fall of 2013. Results of this annual, fall monitoring program are provided in Table 8. CPW will continue monitoring the fish community in Rifle Creek upstream and downstream of the Rifle Creek fish screen, once releases from the reservoir have decreased to a discharge suitable for instream electrofishing.

This LMP identifies three species and one fish family (Salmonidae) that CPW will manage for in Rifle Gap Reservoir. Black crappie, yellow perch, and rainbow and brown trout are included in the Recovery Program's "'Compatible' list of non-native aquatic species compatible with recovery/preservation of endangered/native, non-salmonid aquatic species within critical habitat of the upper Colorado River basin (UCRB)" (Martinez et al. 2014). Fertile (diploid) walleye are included within the 'Non-Compatible' list, but use of the triploid and sterile form of walleye (triploid walleye) in the UCRB has been reviewed by the Recovery Program and included within a list of triploid/hybrid sport fishes that could be stocked within the basin (Martinez et al. 2014). Further, this Basin-wide Strategy states that the "stocking of approved sterile fish species in specific locations equipped with screens or otherwise managed to prevent fish escapement would provide redundancy and a more preventive strategy to control the access of these non-native fish species to critical habitat for endangered fishes" (Martinez et al. 2014).

All of these fish species in addition to smallmouth bass and northern pike, exist in habitat downstream of Rifle Gap Reservoir. Trout, black crappie, yellow perch, smallmouth bass, northern pike, and walleye have been collected by the USFWS and CDOW/CPW during lethal removal efforts for centrarchids in the Colorado River downstream of the confluence with Rifle Creek. This section of the Colorado River supports a popular, recreational trout fishery. Catch rates and abundance of black crappie collected within the Colorado River from Silt (7.2 river miles upstream of Rifle Creek) to Debeque (31.1 river miles downstream of Rifle Creek) have been minimal over recent years (Table 9). Yellow perch were first collected within this stretch in 2013. Juvenile and adult smallmouth bass were collected across the last six years, and catch rates have ranged from a low of 0.09 fish/hour in 2012 to a high of 1.21 fish/hour in 2010. A total of 26 northern pike were collected from 2008-2013. Only one walleye (total length = 593 mm) was collected in six years of sampling (2008), while a handful of adult fish have been captured downstream by the USFWS

over the last 20 years (B. Burdick and T. Francis, USFWS, personal communication). Recently, Wolff et al. (2012) used strontium isotopes in otoliths to verify that seven walleye captured in the Colorado River prior to 2008 originated from Rifle Gap Reservoir. Prior to the construction of the Rifle Creek fish screen, smallmouth bass and walleye within Rifle Gap Reservoir had access to Rifle Creek and the Colorado River for more than 40 years.

Survivability of these fish species within the Colorado River near the town of Rifle varies from one species to another. Trout survive and reproduce in the Colorado River, and are most abundant in colder sections of the mainstem Colorado River upstream of Rifle. Black crappie and yellow perch seem to survive in the Colorado River, but less is known regarding these species' abilities to spawn and recruit to larger size classes. Both juvenile and adult black crappie and yellow perch have been collected in backwater/slackwater habitats within the mainstem river. However, it is unknown whether these species originated in the river or escaped from floodplain ponds with connectivity to the river. Black crappie and yellow perch utilize shallow and deep water habitats during their life cycles. For example, young black crappie tend to leave littoral habitat for the deeper, limnetic zone. Nesler (2002) notes that "there is no surrogate for deepwater lentic habitat in the Colorado River; the lotic and fluctuating backwater habitat of the Colorado River likely promote high mortality for black crappie and their progeny." The lack of lentic habitat available in the Colorado River likely also affects the survivability of the Percidae. Only walleye adults have been collected in the Colorado River within the State of Colorado. The same can also be said for northern pike. In Colorado, evidence of reproduction within the mainstem Colorado River has not been documented for either walleye or northern pike. Relative abundance and catch rates for black crappie, yellow perch, and walleye (Table 9) coupled with lack of suitable habitat support these species as a minor component of the Colorado River fish community downstream of Rifle Gap Reservoir.

Smallmouth bass, in contrast to black crappie, yellow perch, and walleye, seem to do quite well in stretches of the Colorado River near the town of Grand Junction (downstream of Rifle Gap Reservoir). Rifle Gap Reservoir is the suspected, original source of the smallmouth bass population in this area of the Colorado River. This irrigation reservoir was drawn-down below normal levels for an extended period of time in 2002 as a result of drought conditions. Smallmouth bass may have escaped the reservoir unimpeded, eventually making their way to the Colorado River. Increased abundance of smallmouth bass in lower sections of the river within and downstream of the Grand Junction area prompted the USFWS to initiate an annual centrarchid removal program in 2004. Catch rates and total numbers of smallmouth bass collected from 2004 through 2013 have been the highest for those sections of the Colorado near and downstream of Grand Junction (Grand Valley reaches), including the lower 2.3 miles of the Gunnison River (Table 10). Catch of age-0 (<100mm) smallmouth bass in the upper section of the Colorado River near Rifle has been less than the catch of this age class in the Grand Valley reaches throughout the 10 year project. These data suggest that spawning success of smallmouth bass in the upper

reaches of the Colorado River may not be as successful as that in the Grand Valley reaches (Francis and Ryden 2013). Warmer water conditions and habitat more suitable for smallmouth bass persistence may exist in sections of the Colorado River in and downstream of the Grand Junction area.

Multiple studies in the Colorado River Basin have documented the detrimental impacts that non-native fishes pose to native fishes (i.e., Hawkins and Nesler 1991; Tyus and Saunders 1996). Interactions between non-native and native fishes can occur at the trophic level (i.e., predation and competition for food resources), as well as spatially (i.e., competition for habitat). As primarily piscivores, smallmouth bass, northern pike, and walleye are likely the most concern to downstream native fishes. Arena et al. (2012) hypothesized that smallmouth bass in the wild "will be able to consume ..... young roundtail chub, their presumptive trophic competitors," based on the researchers' laboratory trials evaluating prey capture behavior of smallmouth bass and roundtail chub. Tyus and Beard (1990) collected walleye and Colorado squawfish (pikeminnow) in similar shoreline habitats in the Green River, noting that resource sharing between the species could be problematic during periods of limited availability. Negative impacts of yellow perch and black crappie to native fishes are likely less significant than those of predatory fish species; though black crappie have been documented as predators of larval and juvenile Colorado pikeminnow in riverside ponds of the Colorado River (Osmundson 1987). Trout are not typically associated with or considered a threat to native fishes "because upper basin endangered fishes are not usually found in sympatry with coldwater fishes" (Hawkins and Nesler 1991). Rainbow and brown trout of the Colorado River extend downstream of the town of Rifle into critical habitat for native fishes. However, the abundance of trout declines in a downstream direction as the thermal gradient becomes intolerable for both rainbows and browns.

Multiple measures can be taken by CPW to remedy the negative impacts of non-native sport fishes on native fishes of the Colorado River, should fish originating from Rifle Gap Reservoir be proven problematic. Fish that have escaped from Rifle Gap Reservoir will be captured in the Rifle Creek fish screen. Therefore, fish escapees from Rifle Gap Reservoir should never have the opportunity to interact with native fishes of the Colorado River, unless the screen fails due to a situation beyond human control. CPW will immediately cease the stocking of black crappie, yellow perch, and triploid walleye (100% sterile), should this situation occur. Statewide and special regulations as well as manner of take will be relaxed, allowing for unlimited harvest of the problematic species in Rifle Gap Reservoir. CPW will also utilize passive and active sampling gears within the reservoir, as well as Rifle Creek and the Colorado River to target and remove the fish species in question. Annual monitoring by CPW electrofishing crews within Rifle Creek and the Colorado River near the town of Rifle will continue into the future. This monitoring involves the lethal removal of all non-native, non-salmonid fishes collected. All of these measures are feasible in remedying the detrimental impacts that fish escapees from Rifle Gap Reservoir may have on native fishes downstream.

IV. Prepared by:

Northwest Region Area Aquatic Biologist	Date

V. Approvals:

A. Northwest Region Senior Aquatic Biologist	Date
B. State Aquatic Wildlife Manager	Date

Appendix A.

Literature Cited

Anderson, R.O. and R.M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B.R. Murphy and D.W. Willis, editors. Fisheries techniques, second edition. American Fisheries Society, Bethesda, Maryland.

Arena, A., L.A. Ferry, A.C. Gibb. 2012. Prey capture behavior of native vs. nonnative fishes: a case study from the Colorado River drainage basin (USA). Journal of Experimental Zoology Part A: Ecological Genetics & Physiology 317(2): 103-116.

Barton, B.A. and T.P. Barry. 2011. Reproduction and environmental biology. Pages 199-231 *in* B.A. Barton, editor. Biology, management, and culture of walleye and sauger. American Fisheries Society, Bethesda, Maryland.

Bozek, M.A., D.A. Baccante, and N.P. Lester. 2011. Walleye and sauger life history. Pages 233-301 *in* B.A. Barton, editor. Biology, management, and culture of walleye and sauger. American Fisheries Society, Bethesda, Maryland.

Burkhard, W.T. 1971. Rainbow trout. Pages 30-31 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Chipps, S.R. and B.D. Graeb. 2011. Feeding ecology and energetics. Pages 303-319 *in* B.A. Barton, editor. Biology, management, and culture of walleye and sauger. American Fisheries Society, Bethesda, Maryland.

Colorado Division of Wildlife. 2006. Colorado River Basin Aquatic Wildlife Management Plan. Colorado Division of Wildlife, Denver, Colorado.

Colorado Parks and Wildlife. March 25, 2015. Letter to U.S. Fish and Wildlife Service describing proposed revisions to the Rifle Gap Reservoir Lake Management Plan.

Cross, F.B. 1967. Handbook of fishes of Kansas. University of Kansas Museum of Natural History, Lawrence, Kansas. 357 pages.

Edwards, E.A., G. Gebhart, and O.E. Maughan. 1983. Habitat suitability information: smallmouth bass. U.S. Fish and Wildlife Service FWS/OBS-82/10.36. 47 pages.

Evans, R.L. 1951. Food and growth of the major game fishes in Jumbo Reservoir. (Master of Science thesis), Colorado State University, Fort Collins, Colorado. 111 pages.

Fajt, J.R. 1990. A comparison of seven yellow perch populations in central Colorado. (Master of Science thesis), Colorado State University, Fort Collins, Colorado. 85 pages.

Fishbase. 2009. *Esox lucius* northern pike from http://www.fishbase.org/Summary/SpeciesSummary.php?id=258 website (January 2009), World Fish Center.

Fisk, L.O. 1953. Food habits of yellow perch in two northern Colorado reservoirs. (Master of Science thesis), Colorado State University, Fort Collins, Colorado. 79 pages.

Francis, T. and D. Ryden. 2013. Removal of smallmouth bass in the upper Colorado River between Price-Stubb dam near Palisade, Colorado and Westwater, Utah. Annual project report prepared for the Upper Colorado River Endangered Fish Recovery Program, Project Numbers 126a and 126b. U.S. Fish and Wildlife Service, Colorado River Fishery Project, Grand Junction, Colorado. 40 pages.

Goettl, J.P. 1966. The vertical-distribution, food and feeding habits of yellow perch in Horsetooth Reservoir, Colorado. (Master of Science thesis), Colorado State University, Fort Collins, Colorado. 41 pages.

Goettl, J.P. 1971. Yellow perch. Pages 70-71 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Gustafson, K.A. 1988. Approximating confidence intervals for indices of fish population size structure. North American Journal of Fisheries Management 8(1): 139-141.

Guy, C.S., R.M. Neumann, D.W. Willis, and R.O. Anderson. 2007. Proportional size distribution (PSD): a further refinement of population size structure index terminology. Fisheries 32(7): 348.

Hammers, B.E. and N.C. Oakley. Undated. Black and white crappie: North Carolina wildlife profiles from http://www.ncwildlife.org/portals/0/Fishing/documents/crappie.pdf website (January 2014), North Carolina Wildlife Resource Commission, Raleigh, North Carolina.

Harrington, R.W., Jr. 1947. Observations on the breeding habits of the yellow perch, *Perca flavescens* (Mitchell). Copeia 3: 199-200.

Hawkins, J.A. and T.P. Nesler. 1991. Nonnative fishes of the Upper Colorado River Basin: an issue paper. Final report. Colorado State University and Colorado Division of Wildlife, Fort Collins, Colorado. 72 pages.

Johnson, B.M, A. Abeyta, K. Bentley, M. Brandt, M. Burton, J. Charles, C. Cross, J. Fike, A. Graham, W. Hibbs, M. Kuti, J. Mangels, T. Martyn, W. Pate, J. Restad, R. Santistevan, R. Schmidt, and K. Stockton. 2009. Rifle Gap Reservoir fishery investigation. Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, Colorado. 26 pages.

Klein, W.D. 1971. Brown trout. Pages 27-28 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Lischka, S.A. 2013. 2012 Colorado angler survey report. Colorado Parks and Wildlife, Fort Collins, Colorado. 64 pages.

Martinez, P.J. 2009. Coldwater reservoir ecology. Federal Aid Project F-242-R16. Colorado Division of Wildlife, Fort Collins, Colorado. 83 pages.

Martinez, P.J. and A.L. Kolz. 2013. Performance of four boat electrofishers with measured electrode resistances for electrofishing boats and rafts. North American Journal of Fisheries Management 33(1): 32-43.

Mecozzi, M. 2008. Yellow perch (Perca flavescens). Publication FM-710 08. Bureau of Fisheries Management, Wisconsin Department of Natural Resources, Madison, Wisconsin. 5 pages.

Nesler, T.P. 2002. Interactions between endangered fishes and introduced gamefishes in the Colorado River, Colorado. Colorado River Recovery Implementation Program Project No. 91-29, Federal Aid Project SE-3. Colorado Division of Wildlife, Fort Collins, Colorado. 53 pages.

Osmundson, D.B. 1987. Growth and survival of Colorado squawfish (*Ptychocheilus lucius*) stocked in riverside ponds, with reference to predation by largemouth bass (*Micropterus salmoides*). (Master of Science thesis), Utah State University, Logan, Utah. 358 pages.

Pflieger, W.L. 1997. The fishes of Missouri, revised edition. Conservation Commission of the State of Missouri, Jefferson City, Missouri. 372 pages.

Pope, K.L., R.M. Neumann, and S.D. Bryan. 2009. Warmwater fish in small standing waters. Pages 13-27 *in* S.A. Bonar, W.A. Hubert, and D.W. Willis, editors. Standard methods for sampling North American freshwater fishes. American Fisheries Society, Bethesda, Maryland.

Powell, T. 1971. Black crappie. Page 63 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Raleigh, R.F., T.Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish and Wildlife Service FWS/OBS-82/10.60. 64 pages.

Raleigh, R. F., L. D. Zuckerman, and P. C. Nelson. 1986. Habitat suitability index models and instream flow suitability curves: Brown trout, revised. U.S. Fish and Wildlife Service FWS/OBS-82/10.124. 65 pages.

Schisler, G.J. and D. Bowden. 2012. Creel survey analysis program: creel survey design and analysis manual. Colorado Parks and Wildlife, Fort Collins, Colorado. 43 pages.

Schultz, S.L.W., E.L. Steinkoenig, B.L. Brown. 2001. Ploidy of feral grass carp in the Chesapeake Bay watershed. North American Journal of Fisheries Management 21(1): 96-101.

Taliaferro, R. 1971. Black crappie. Pages 69-70 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Tyus, H.M. and J.M. Beard. 1990. *Esox lucius* (Esocidae), and *Stizostedion vitreum* (Percidae) in the Green River basin, Colorado and Utah. Great Basin Naturalist 50(1): 33-39.

Tyus, H.M. and J.F. Saunders, III. 1996. Nonnative fishes in the upper Colorado River basin and a strategic plan for their control. Final report for the Recovery Implementation Program for Endangered fish species in the upper Colorado River basin, Cooperative Agreement No. 14-48-0006-95-923. U.S. Fish and Wildlife Service, Denver, Colorado. 103 pages.

Martinez, P., K. Wilson, P. Cavalli, H. Crockett, D. Speas, M. Trammell, B. Albrecht, and D. Ryden. 2014. Upper Colorado River basin nonnative and invasive aquatic species prevention and control strategy. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. 125 pages.

U.S. Fish and Wildlife Service. 1996. Procedures for stocking nonnative fish species in the Upper Colorado River Basin. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. 25 pages.

U.S. Fish and Wildlife Service. 2009, revised. Procedures for stocking nonnative fish species in the Upper Colorado River Basin. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado. 15 pages.

U.S. Fish and Wildlife Service. April 27, 2015. Letter to Colorado Parks and Wildlife describing proposed revisions to the Rifle Gap Reservoir Lake Management Plan.

Weber, D. 1971. Smallmouth bass. Page 61 *in* W.H. Everhart and W.R. Seaman. Fishes of Colorado. Colorado Game, Fish, and Parks Division, Denver, Colorado.

Wiltzius, W. J. 1960. Age and growth of the yellow perch in a northern Colorado reservoir. (Master of Science thesis), Colorado State University, Fort Collins, Colorado. 106 pages.

Wolff, B.A., B.M. Johnson, A.R. Breton, P.J. Martinez, D.L. Winkelman. 2012. Origins of invasive piscivores determined from the strontium isotope ratio ($^{87}Sr/^{86}Sr$) of otoliths. Canadian Journal of Fisheries and Aquatic Sciences 69: 724-739.

Appendix B.

Figure 1. Location of Rifle Gap Reservoir in the State of Colorado. Map courtesy of the website located at http://mapoftheunitedstates.wordpress.com/2008/03/09/map-of-colorado/

Figure 2. Aerial photograph of Rifle Gap Reservoir. Image provided by Google Earth.

Figure 3. Rifle Creek fish screen. Structure is not "angled" as combined photographs suggest from side-view.

Figure 4. Rifle Creek fish screen looking upstream through structure.

Figure 5. Relative abundance of fish species in Rifle Gap Reservoir in 1974 (rainbow trout=RBT, smallmouth bass=SMB, walleye=WAL, brown trout=LOC) and 2009 (June-October sampling all methods combined), after the illicit introductions of black crappie=BCR, golden shiner=GSH, green sunfish=SNF, northern pike=NPK, red shiner=RDS, green sunfish=SNF, and yellow perch=YPE. Data collected by the Colorado Division of Wildlife.

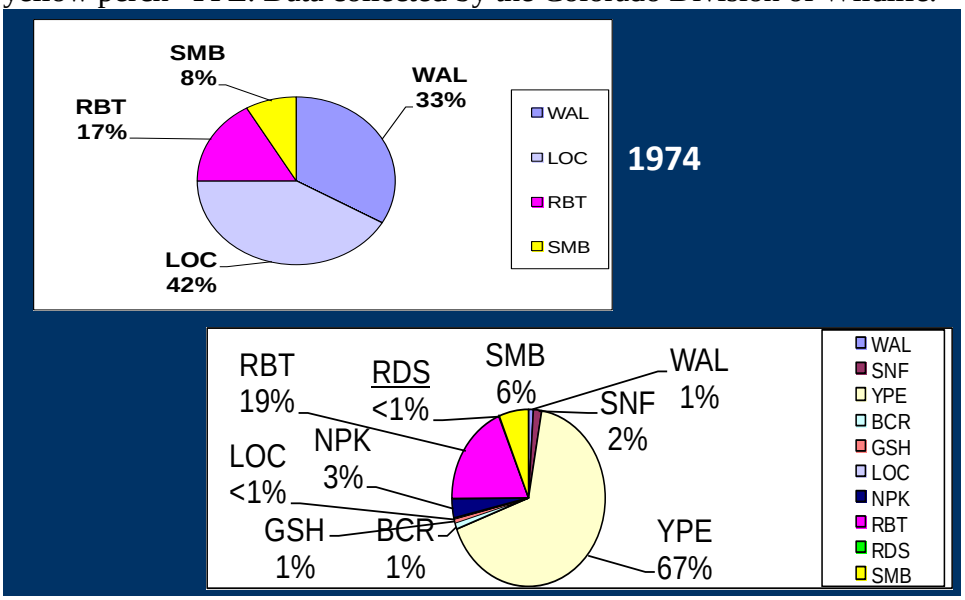


Figure 6. Walleye (WAL) population size structure in Rifle Gap Reservoir in 1987 and 2009 (fall sampling, all methods combined). Data collected by the Colorado Division of Wildlife.

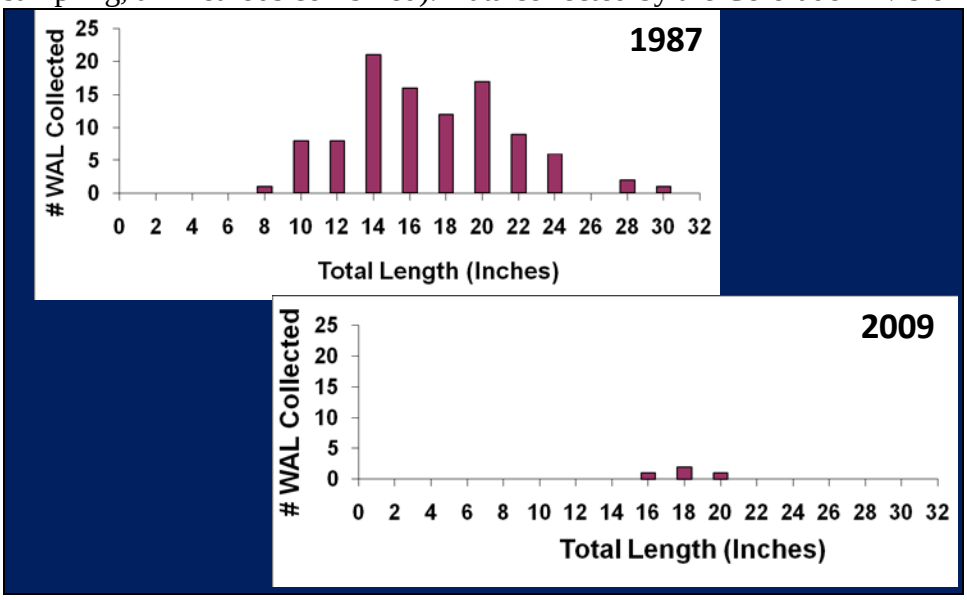


Figure 7. Fish species relative abundance based upon boat electrofishing the same two stations on Rifle Gap Reservoir during the fall season from 2008-2013. Electrofishing station locations were located from the boat ramp to the west inlet, and from the west inlet east across the face of the dam toward the southeast shoreline. Fish species codes: black crappie=BCR, bluegill=BGL, golden shiner=GSH, brown trout=LOC, northern pike=NPK, rainbow trout=RBT, smallmouth bass=SMB, green sunfish=SNF, walleye=WAL, and yellow perch=YPE. Data collected by the Colorado Division of Wildlife/Colorado Parks and Wildlife.

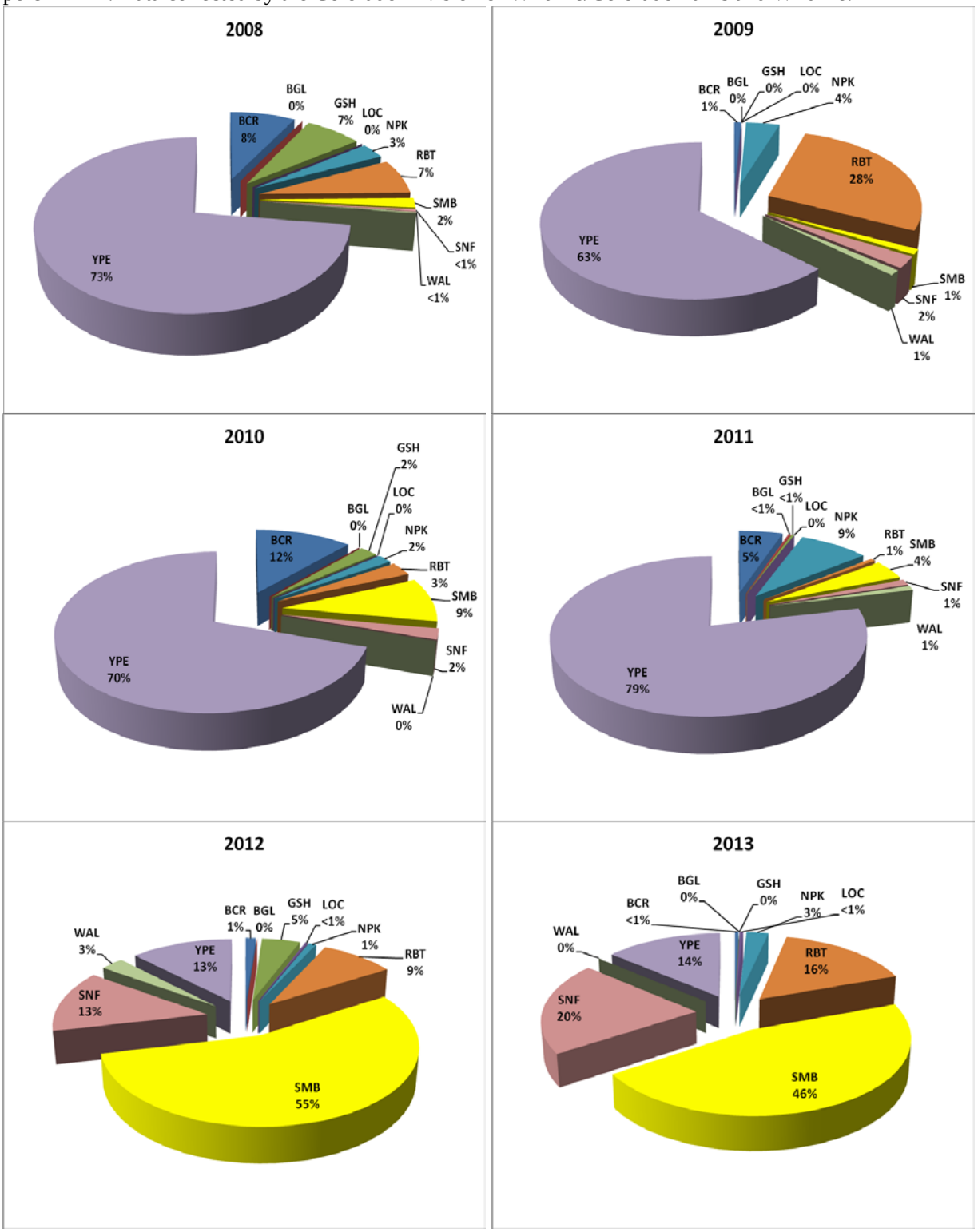


Figure 8. Fish species catch per hour based upon boat electrofishing the same two stations on Rifle Gap Reservoir during the fall season from 2008-2013. Electrofishing station locations were located from the boat ramp to the west inlet, and from the west inlet east across the face of the dam toward the southeast shoreline. Fish species codes: black crappie=BCR, bluegill=BGL, golden shiner=GSH, brown trout=LOC, northern pike=NPK, rainbow trout=RBT, smallmouth bass=SMB, green sunfish=SNF, walleye=WAL, and yellow perch=YPE. Data collected by the Colorado Division of Wildlife/Colorado Parks and Wildlife.

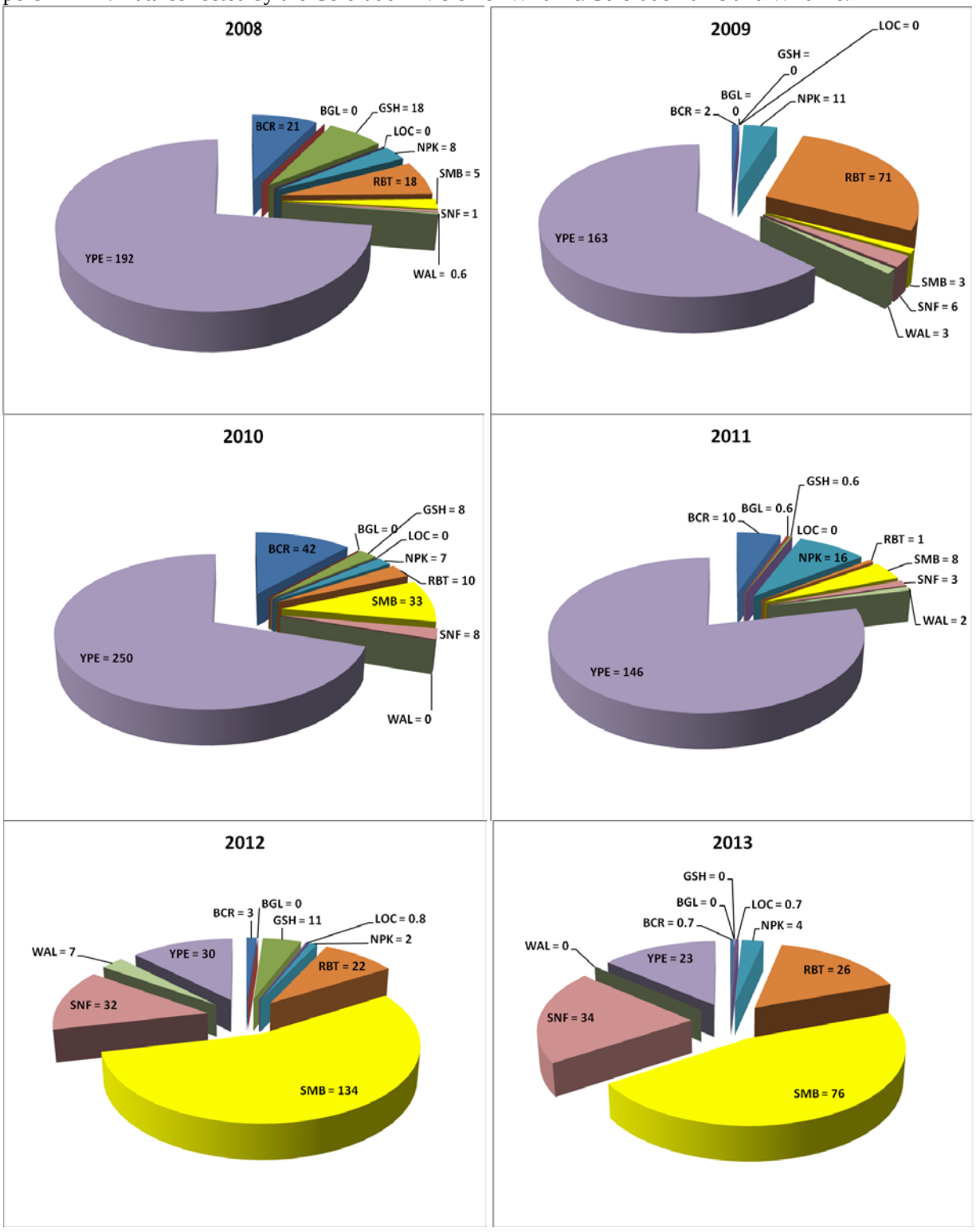


Figure 9. Rainbow trout catchables (≥8 and <14 inches) stocked into Rifle Gap Reservoir from 1973 through 2013. Only larger fish (<14 inches) were stocked in 2000, and thus no data are presented for that year. Yellow bars designate the years the Colorado Division of Wildlife/Colorado Parks and Wildlife completed angler creel surveys, and the red bars designate the years bracketing the illicit introductions of northern pike and yellow perch. Black crappie were illicitly introduced prior to 1993.

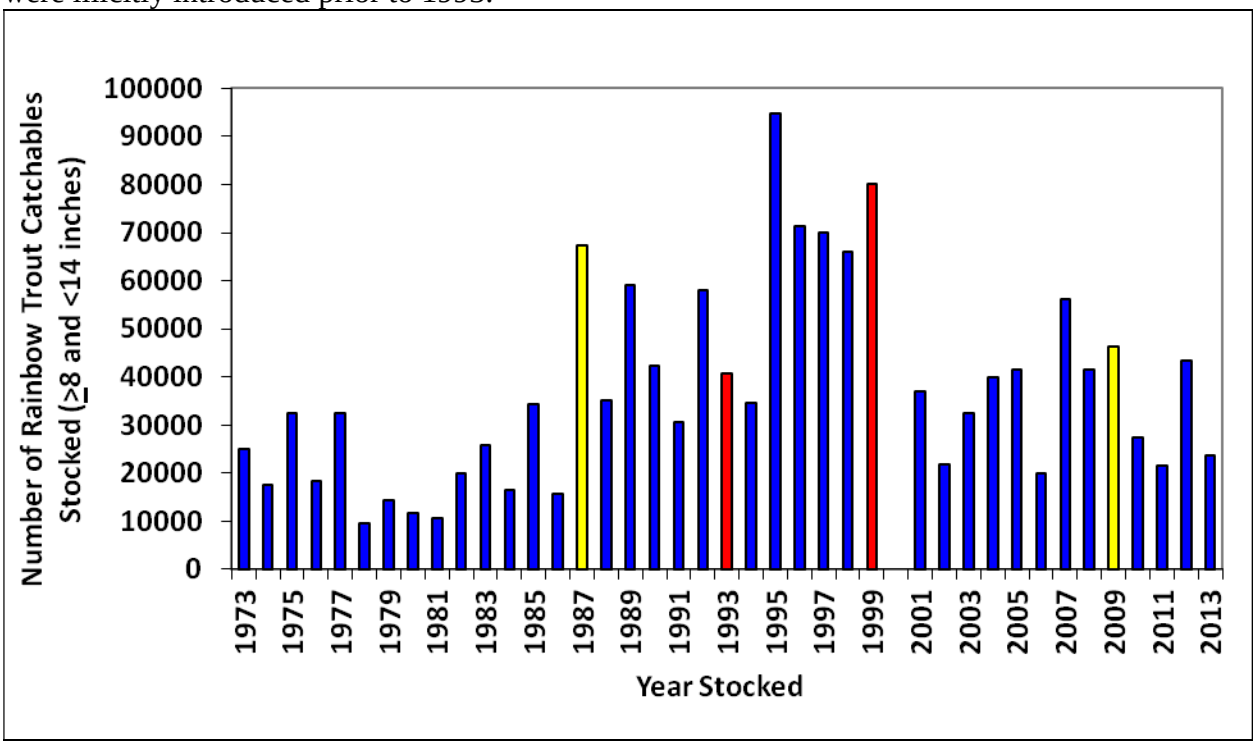


Figure 10. Percentages of angler total catch by fish species for Rifle Gap Reservoir in 1987 and 2009 as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season. Fish species codes: black crappie=BCR, bluegill=BGL, brown trout=LOC, northern pike=NPK, rainbow trout=RBT, smallmouth bass=SMB, largemouth bass=LMB, green sunfish=SNF, walleye=WAL, and yellow perch=YPE.

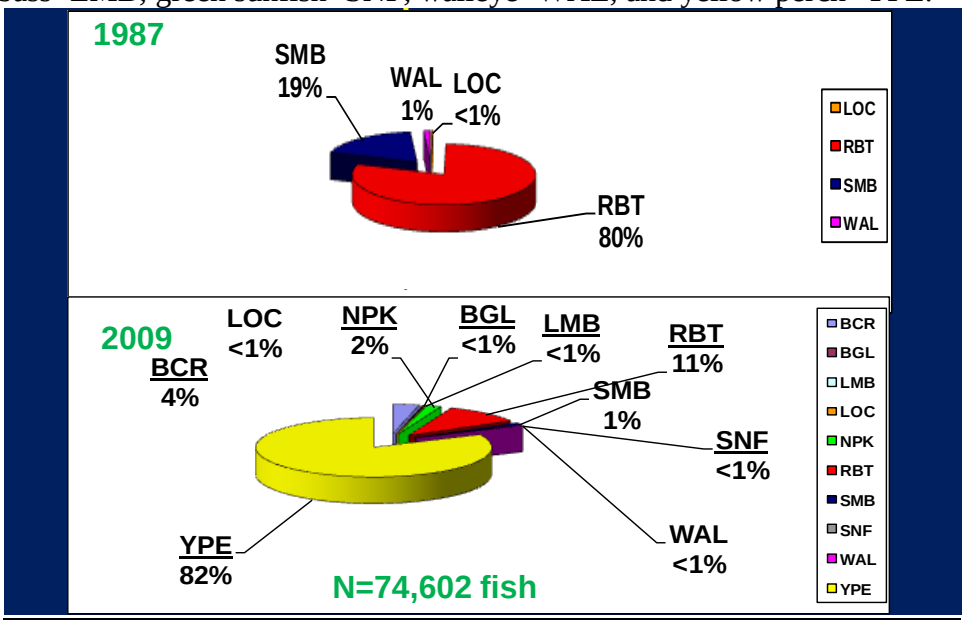


Figure 11. Angler total fish caught and total fish kept for Rifle Gap Reservoir in 1987 and 2009 as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season. 95% confidence intervals are included for each data set.

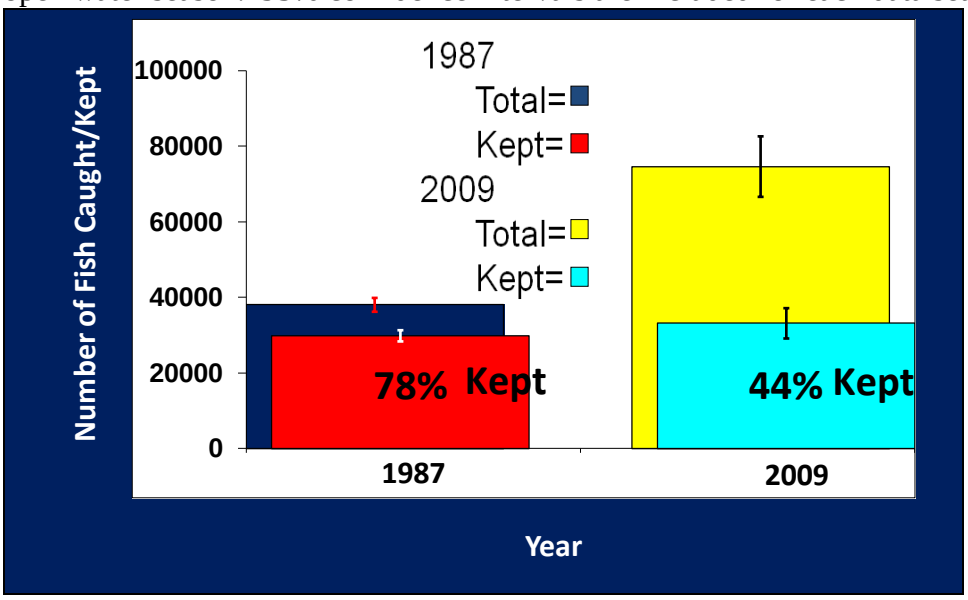


Figure 12. Angler fish species preference for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season (May - October 2009) and ice fishing season (December 2009 - February 2010). Fish species codes: walleye=WAL, northern pike=NPK, yellow perch=YPE, rainbow trout=RBT, black crappie=BCR, smallmouth bass=SMB, brown trout=LOC, channel catfish=CCF, largemouth bass=LMB, bluegill=BGL, TROUT=generally all trout species, BASS=generally all bass species.

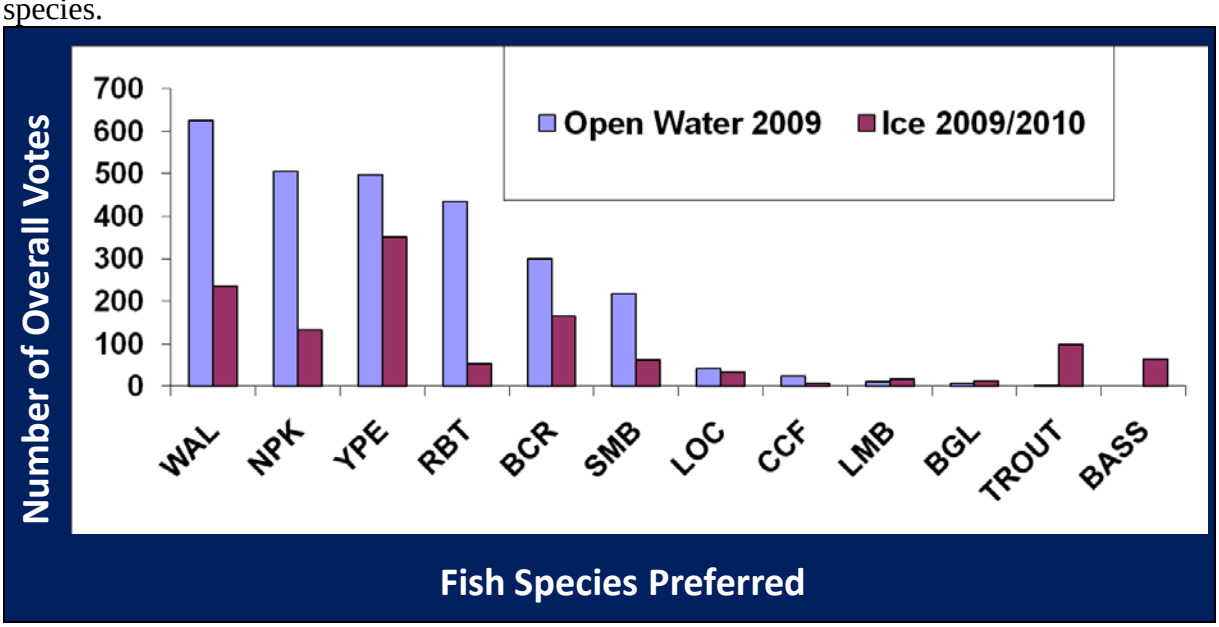


Figure 13. Angler ratings (by percentage) of fishing experiences at Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season (May - October 2009) and ice fishing season (December 2009 - February 2010).

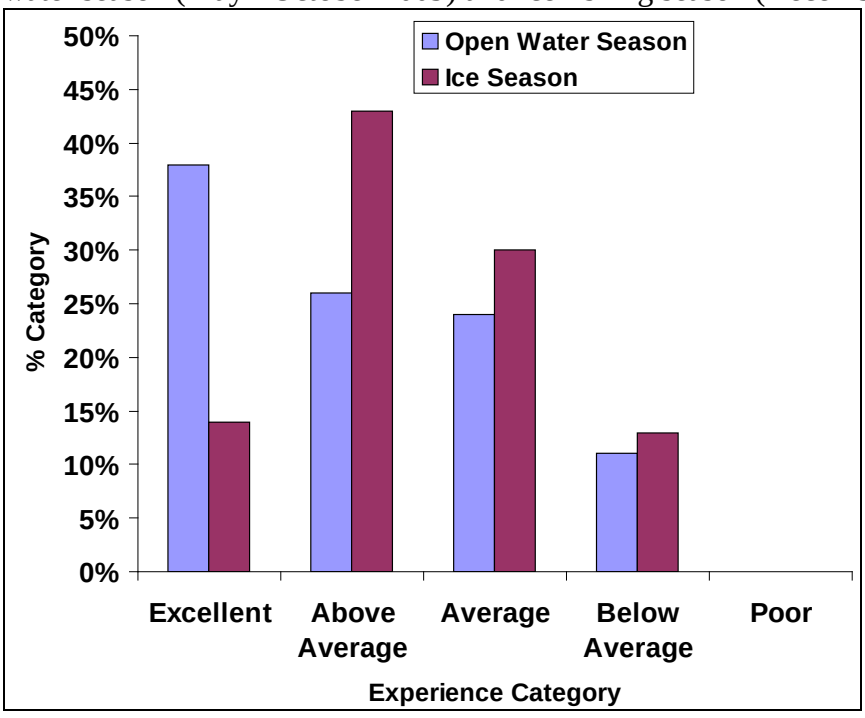


Figure 14. Size structure of the black crappie population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013.

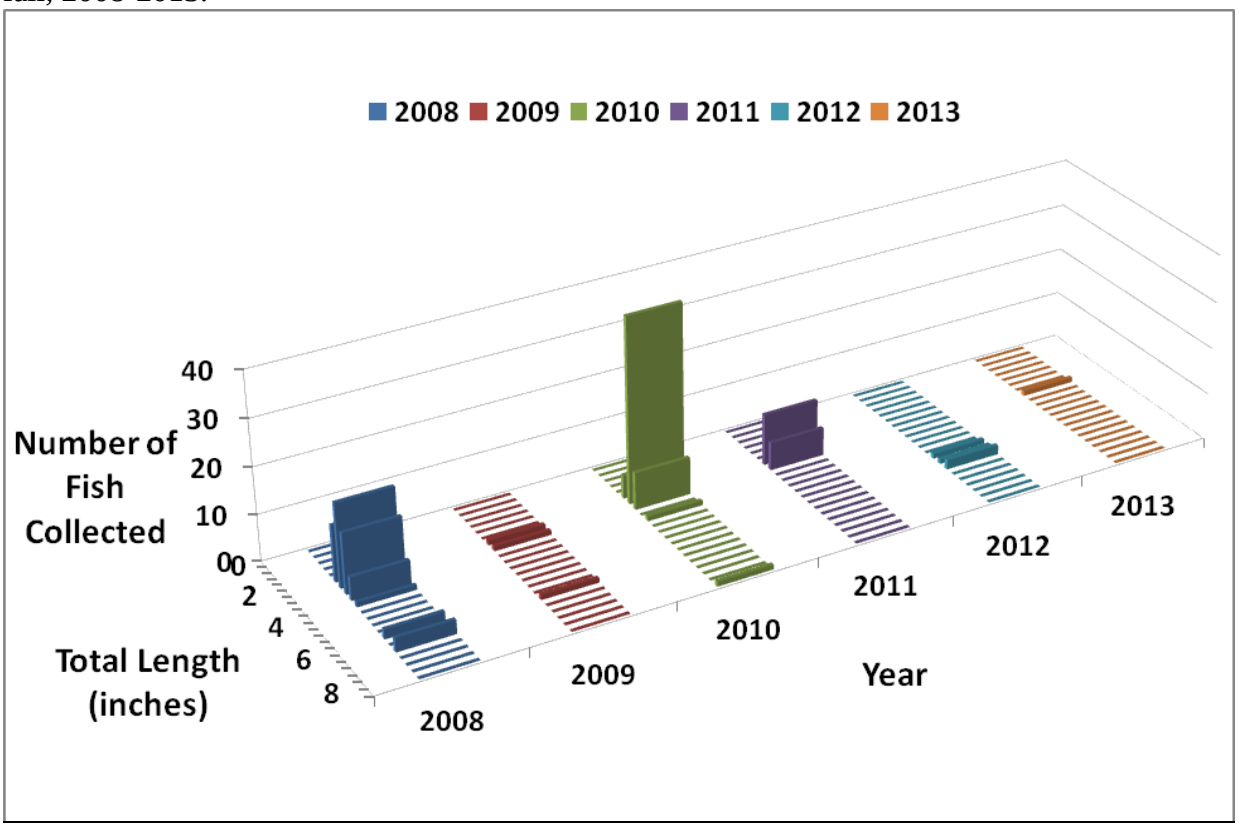


Figure 15. Black crappie (BCR) total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season (May - October 2009) and ice fishing season (December 2009 - February 2010). Black crappie were not present in the 1987 season. Average lengths of black crappie kept and released are also provided. Data were not applicable=NA for the ice fishing season in 2009-2010.

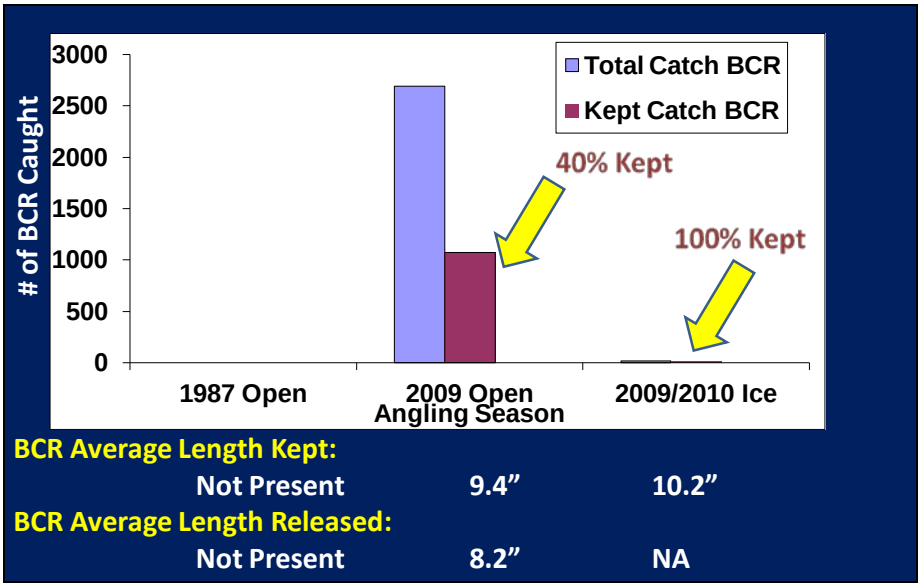


Figure 16. Rainbow trout (RBT) total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water seasons (May - October 2009 and April - July 1987) and ice fishing season (December 2009 - February 2010). Average lengths of rainbow trout kept and released are also provided. Data were not available=NA for 1987.

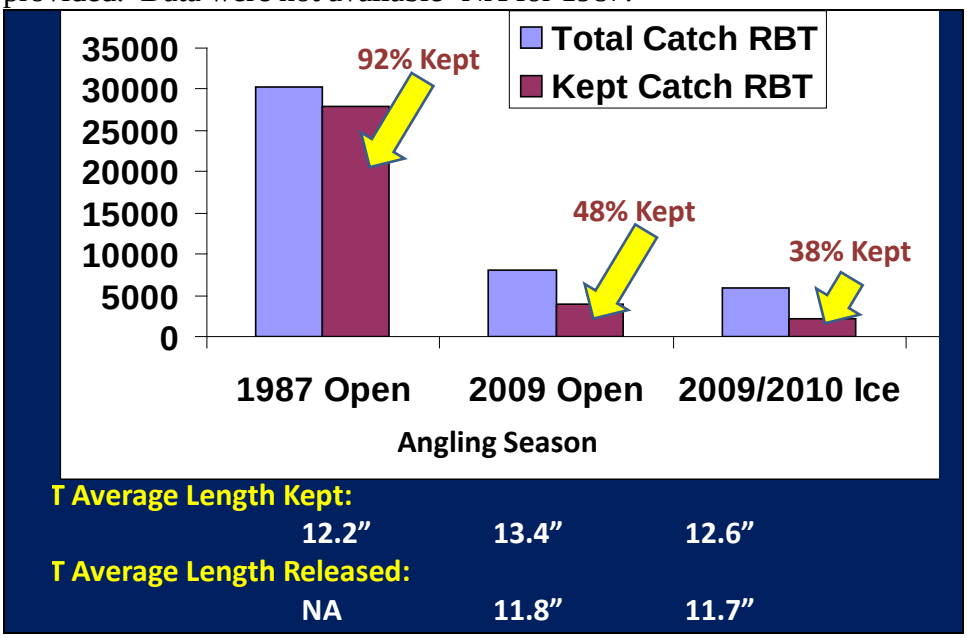


Figure 17. Size structure of the yellow perch population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013.

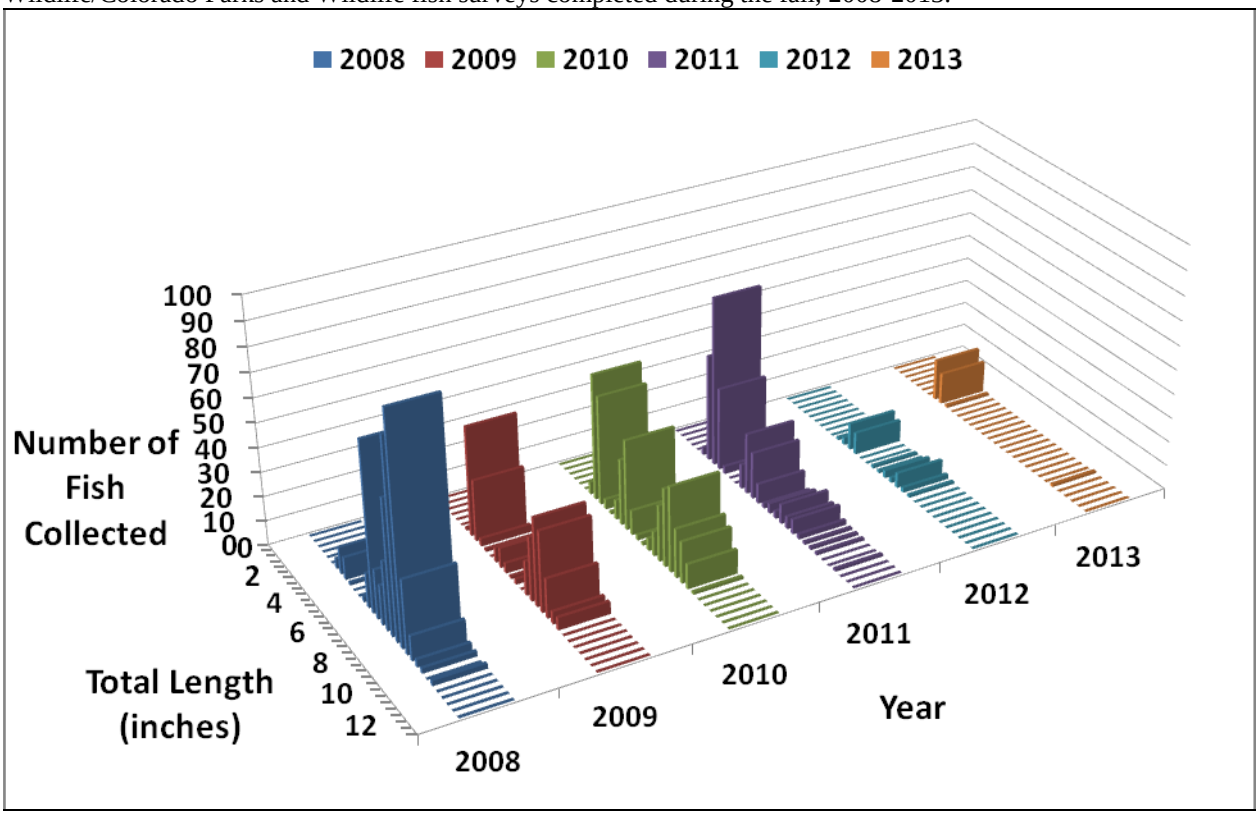


Figure 18. Mean relative weight (W_r) percentages by size class (one inch size groups) of the yellow perch population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2012. Not enough yellow perch were collected in 2013 to be considered for the analysis. The 2012 value for the 5.0-5.9 inch size group reflects data from only one fish. So, the relative weight percentage is not representative of a true mean.

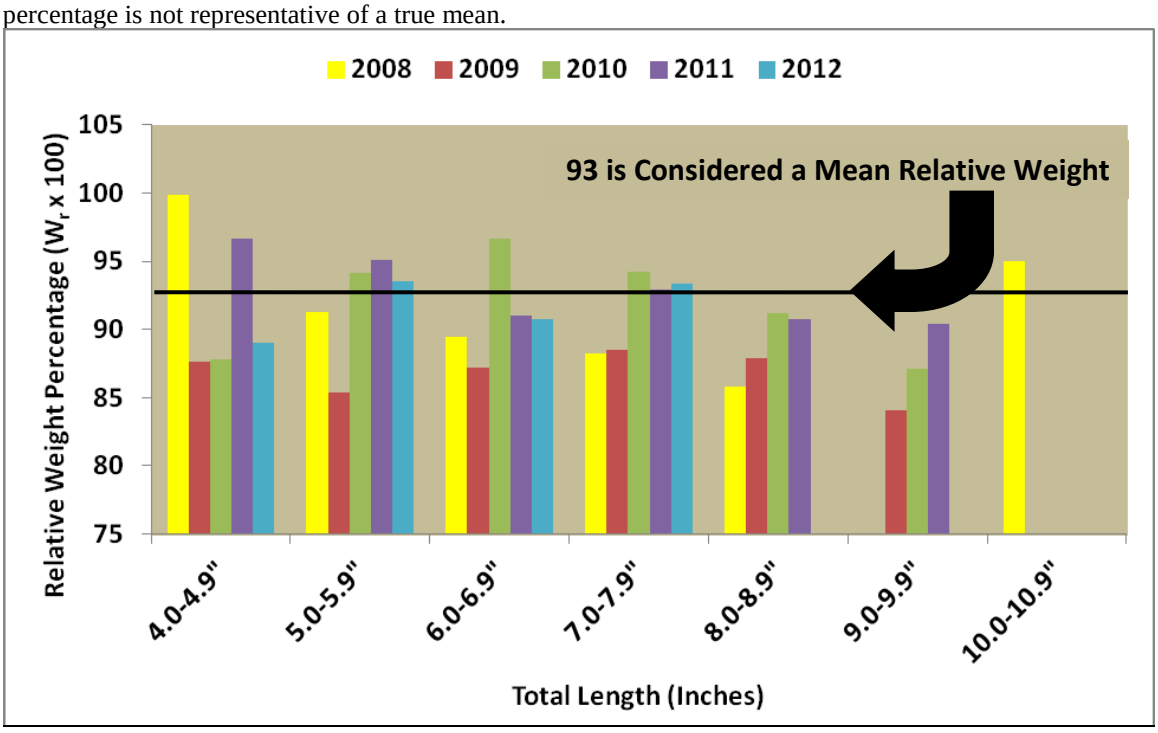


Figure 19. Example of a saggital otolith section from a Rifle Gap Reservoir yellow perch collected by the Colorado Division of Wildlife in the fall of 2008 (Johnson et al. 2009). This fish was 206 mm (millimeters) (8 inches) in total length (TL) and estimated to be four years of age.

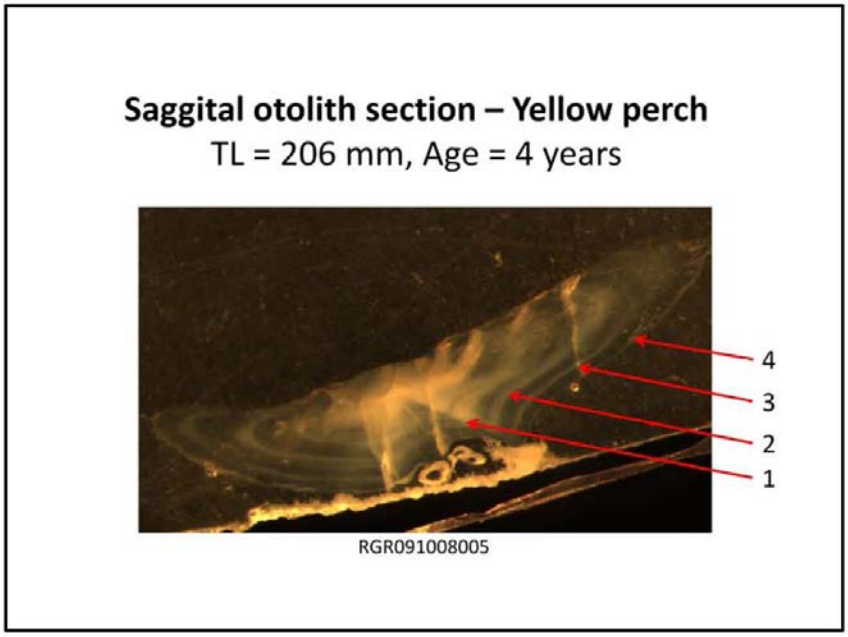


Figure 20. Yellow perch growth in Rifle Gap Reservoir (based upon samples collected by the Colorado Division of Wildlife in the spring and fall of 2008) is somewhat slower than the median growth of yellow perch populations reported in Fishbase (2009) (Johnson et al. 2009). Parameters of the von Bertalanffy growth equation for median yellow perch growth are shown in the upper left corner.

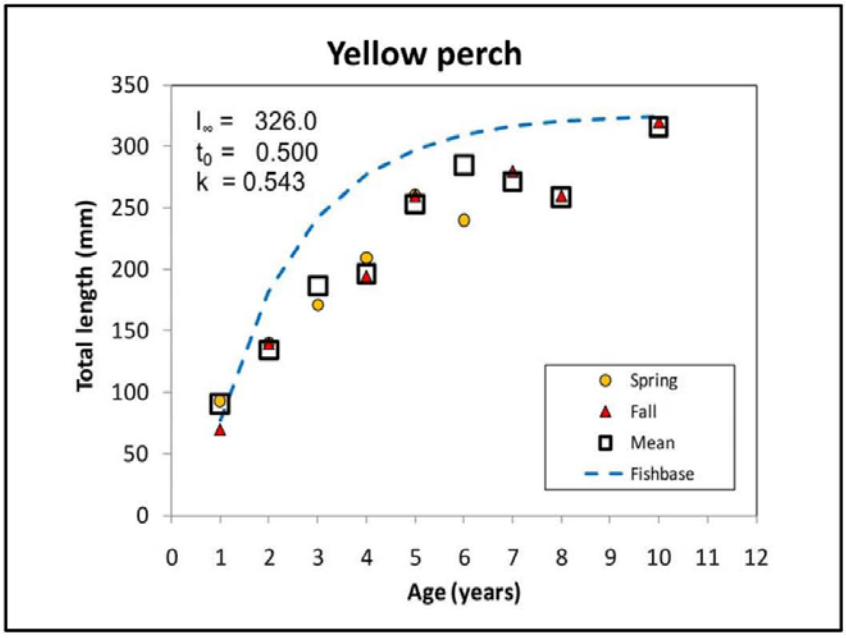


Figure 21. Yellow (YPE) perch total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season (May - October 2009) and ice fishing season (December 2009 - February 2010). Yellow perch were not present in the reservoir during the 1987 season. Average lengths of yellow perch kept and released are also provided.

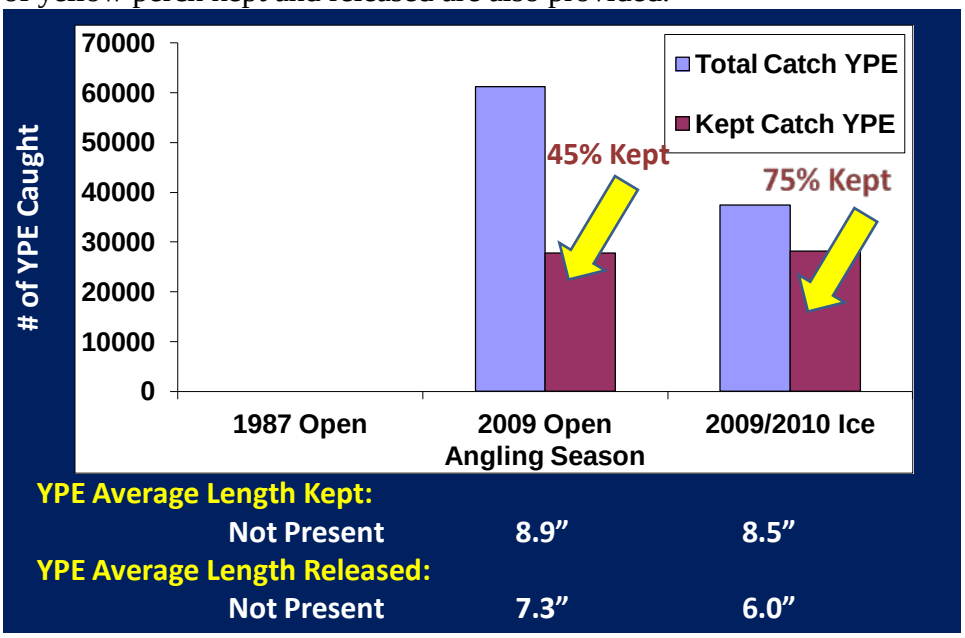


Figure 22. Size structure of the walleye population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013. No walleye were collected in 2010 or 2013.

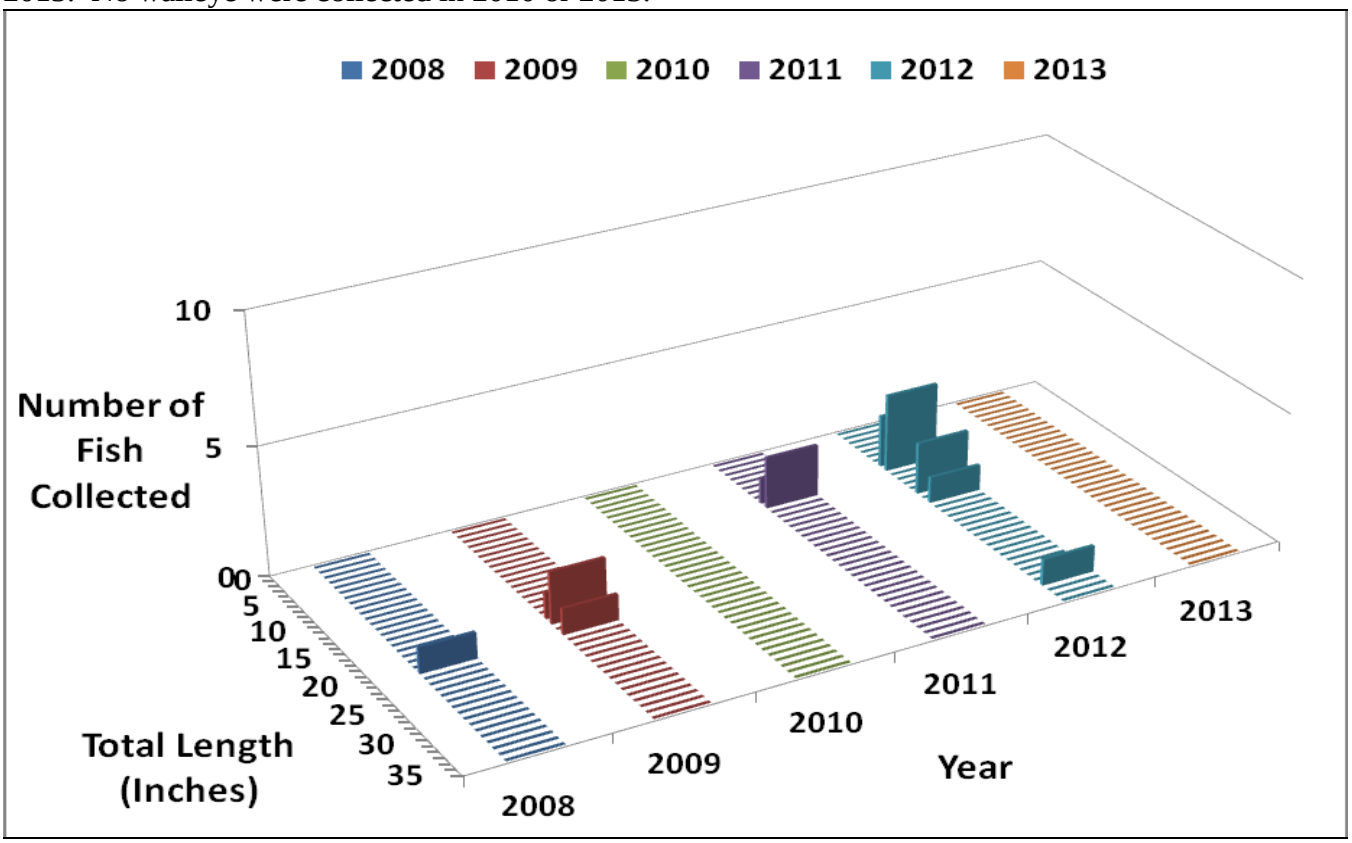


Figure 23. Example of a dorsal spine section and saggital otolith section from a Rifle Gap Reservoir walleye collected by the Colorado Division of Wildlife in June of 2008 (Johnson et al. 2009). This fish was 525 mm (millimeters) (21 inches) in total length (TL) and estimated to be 10 years of age by the dorsal spine and 13 years of age by the otolith.

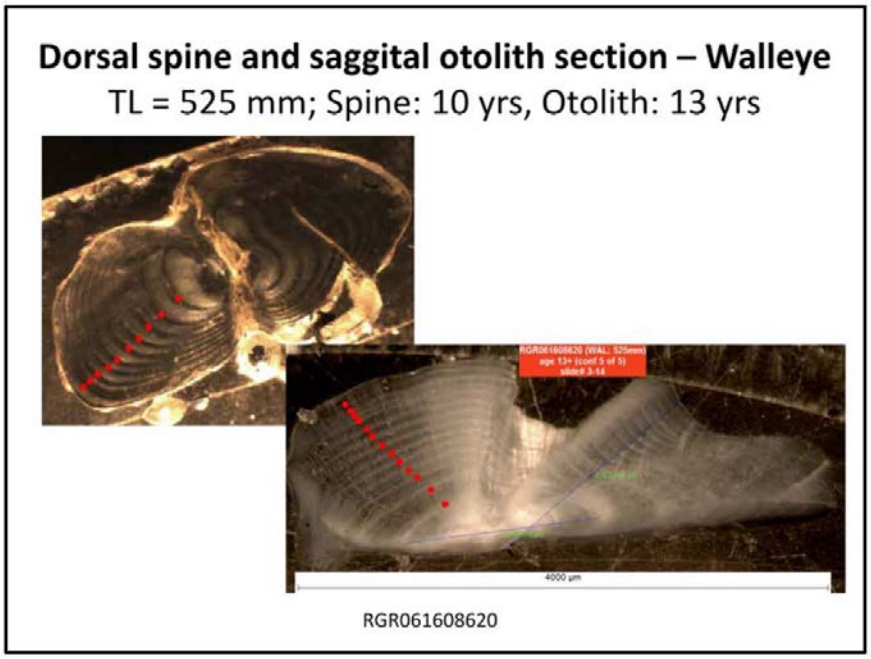


Figure 24. Walleye growth in Rifle Gap Reservoir (based upon samples collected by the Colorado Division of Wildlife in the spring and fall of 2008) is slower than the based on the median growth of walleye populations reported in Fishbase (2009) (Johnson et al. 2009). Parameters of the von Bertalanffy growth equation for median walleye growth are shown in the upper left.

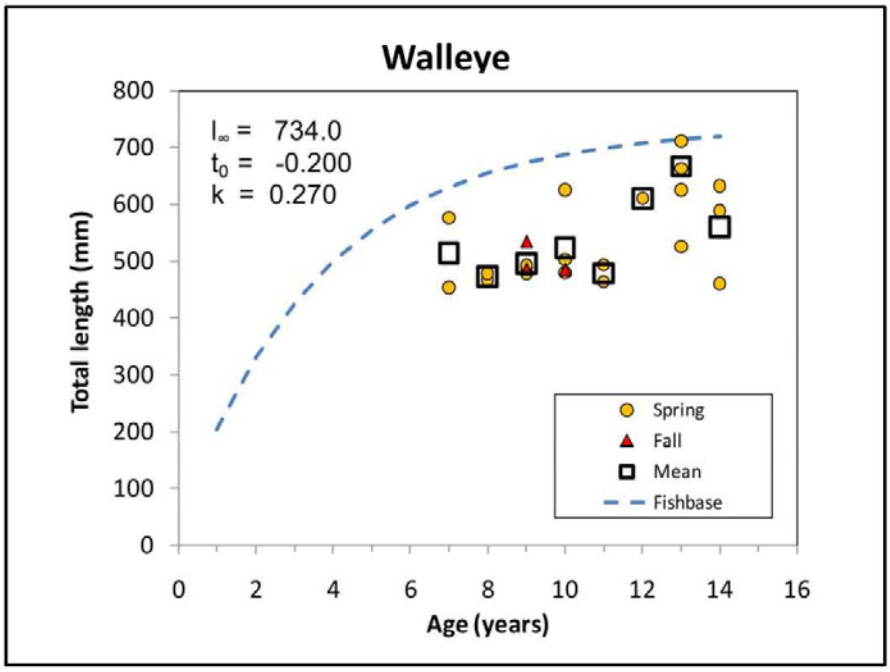


Figure 25. Walleye (WAL) total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water seasons (May - October 2009 and April - July 1987) and ice fishing season (December 2009 - February 2010). Average lengths of walleye kept and released are also provided. Data were not available=NA for 1987, and not applicable=NA for the ice fishing season in 2009-2010.

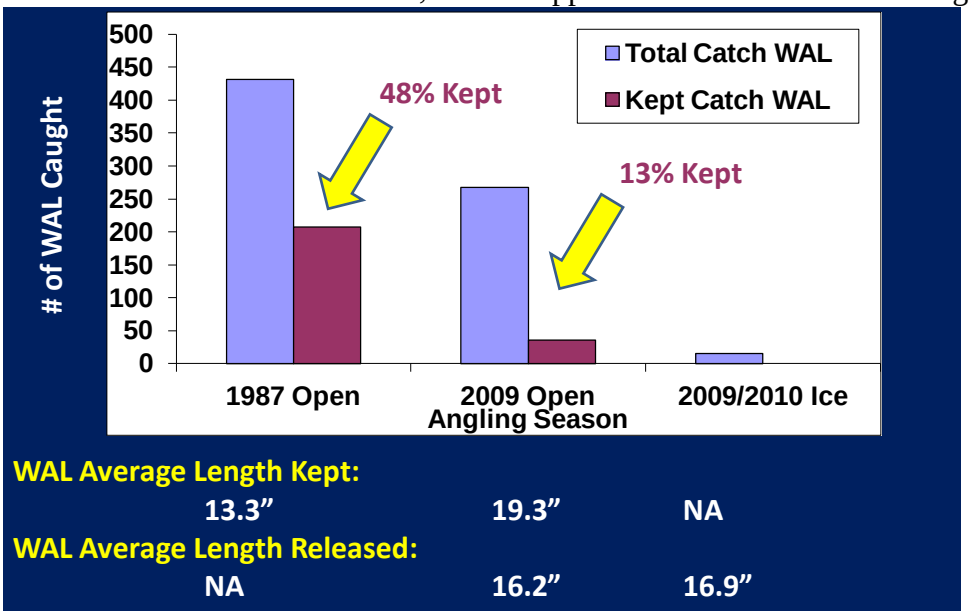


Figure 26. Size structure of the smallmouth bass population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013.

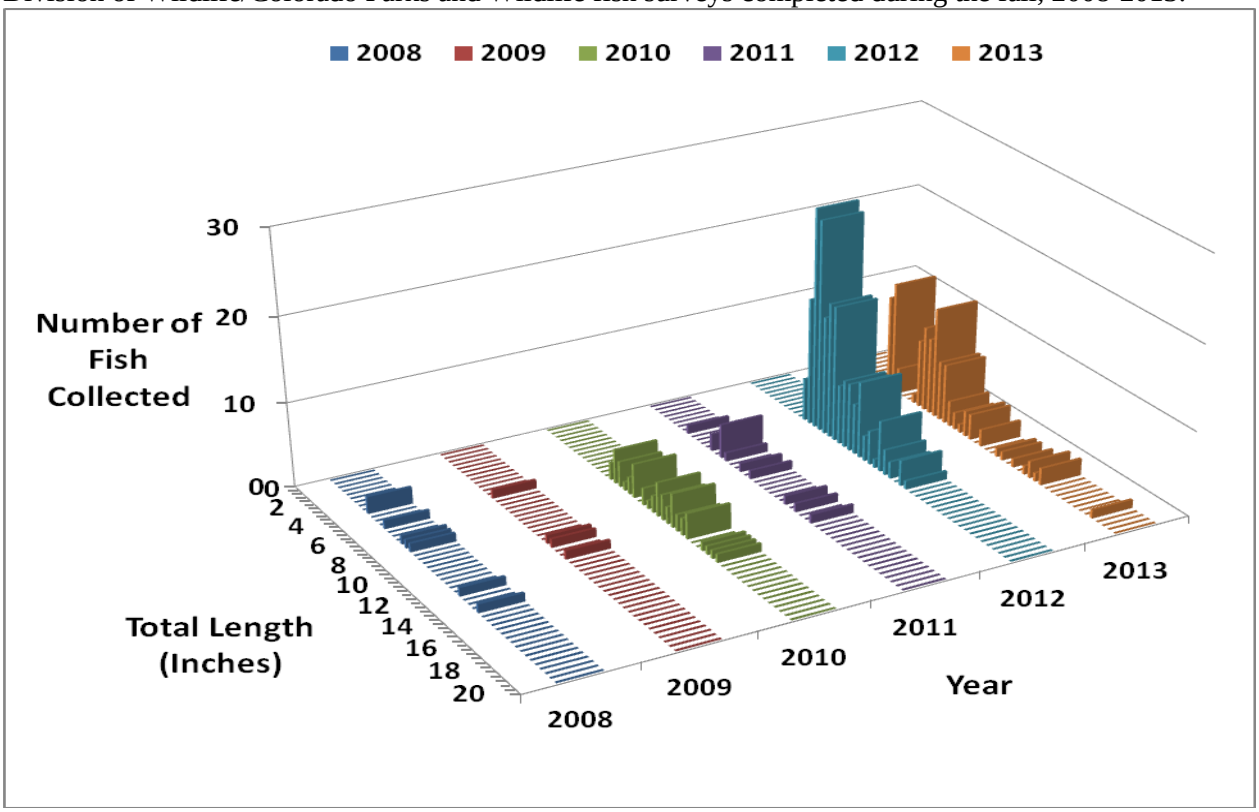


Figure 27. Mean relative weight (Wr) percentages by size class (one inch size groups) of the smallmouth bass population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall of 2010, 2012, and 2013. Not enough smallmouth bass were collected in 2008, 2009, or 2011 to be considered for the analysis. All three values for the 12.0-12.9 inch size group reflect data from only one fish. So, in this case, the relative weight percentages are not representative of true means.

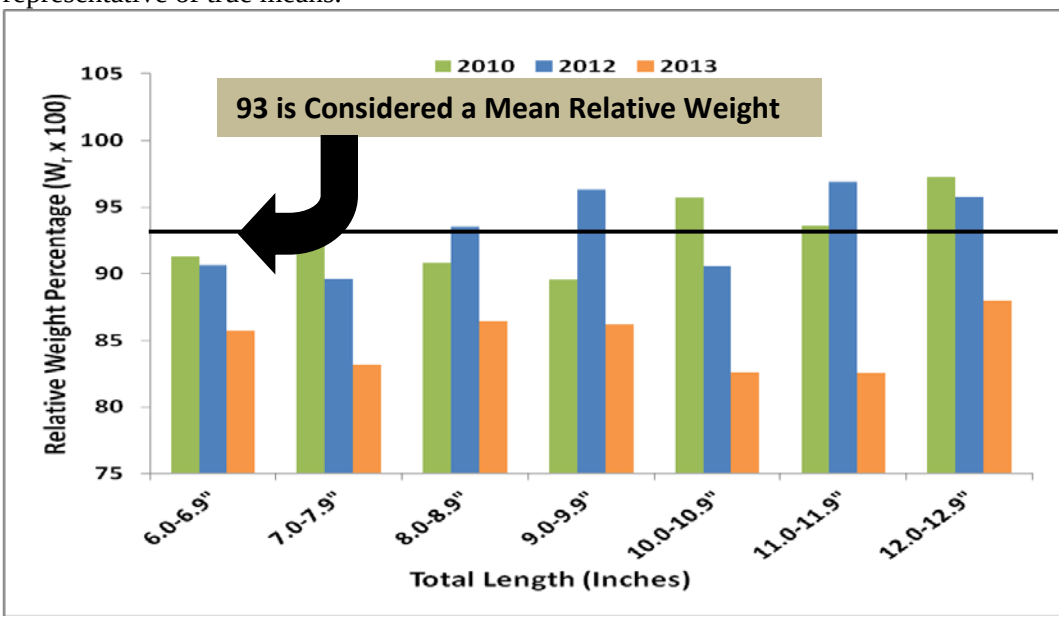


Figure 28. Example of a saggital otolith section from a Rifle Gap Reservoir smallmouth bass collected by the Colorado Division of Wildlife in the fall of 2008 (Johnson et al. 2009). This fish was 183 mm (millimeters) (7 inches) in total length (TL) and estimated to be four years of age.

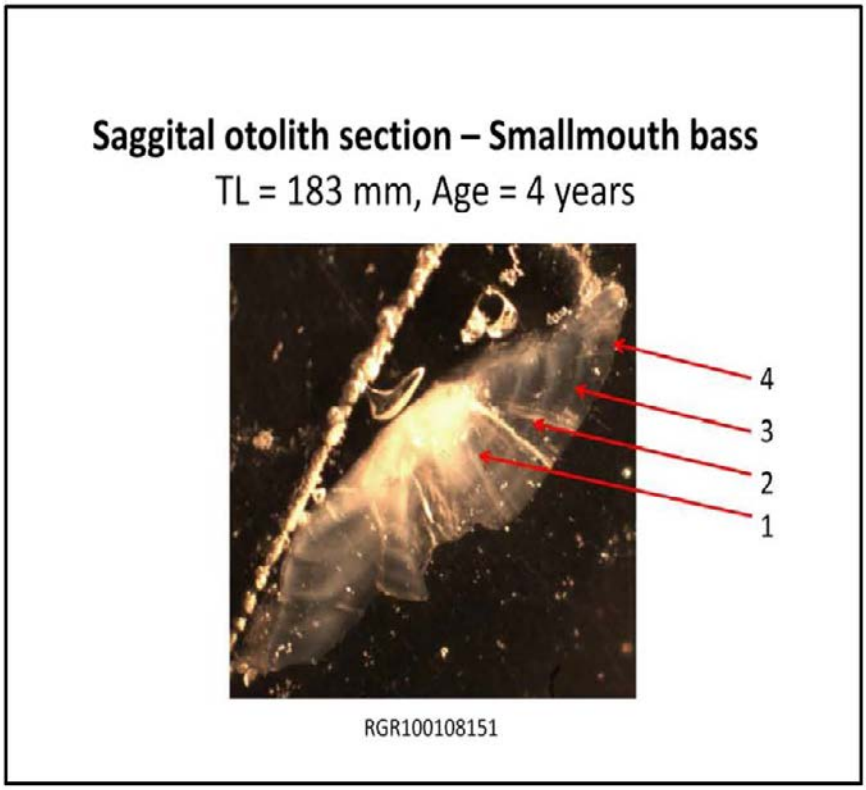


Figure 29. Smallmouth bass growth in Rifle Gap Reservoir (based upon samples collected by the Colorado Division of Wildlife in the spring and fall of 2008) is similar to the median growth of smallmouth bass populations reported in Fishbase (2009) (Johnson et al. 2009). Parameters of the von Bertalanffy growth equation for median smallmouth bass growth are shown in the upper left.

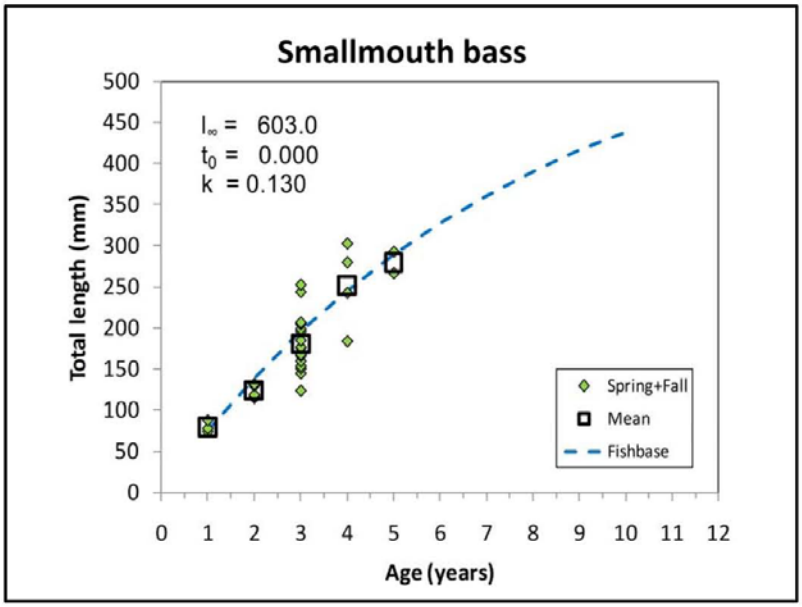


Figure 30. Smallmouth bass (SMB) total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water seasons (May - October 2009 and April - July 1987) and ice fishing season (December 2009 - February 2010). Average lengths of smallmouth bass kept and released are also provided. Only 17 smallmouth bass were caught and kept during the 2009 open water season which is why the bar representing this data point is difficult to see. Data were not available=NA for 1987, and not applicable=NA for the ice fishing season in 2009-2010.

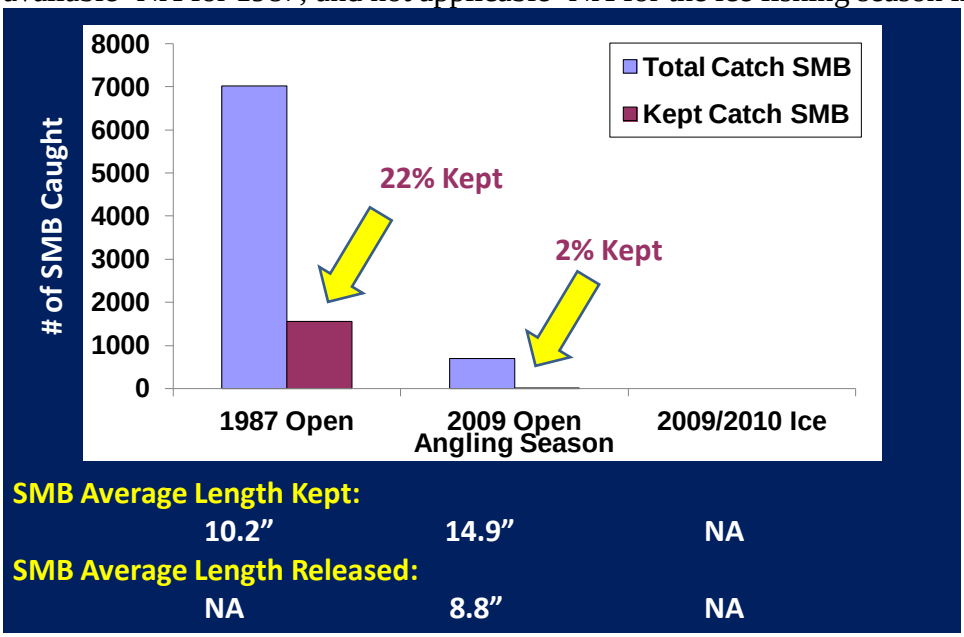


Figure 31. Size structure of the northern pike population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013.

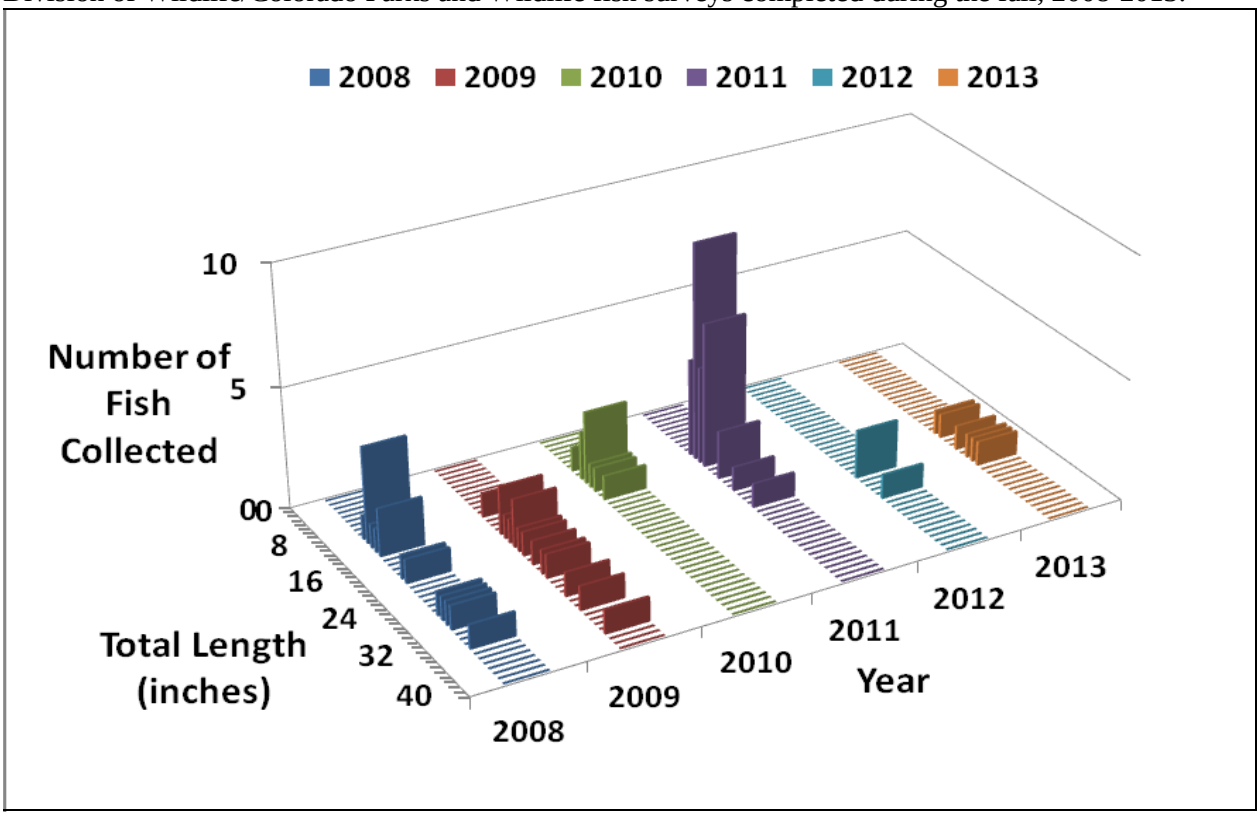


Figure 32. Mean relative weight (W_r) percentages by size class (one inch size groups) of the northern pike population in Rifle Gap Reservoir as a result of Colorado Division of Wildlife/Colorado Parks and Wildlife fish surveys completed during the fall, 2008-2013. More than several of the values across all years for certain size groups reflect data from only one fish. So, in some cases, the relative weight percentages are not representative of true means.

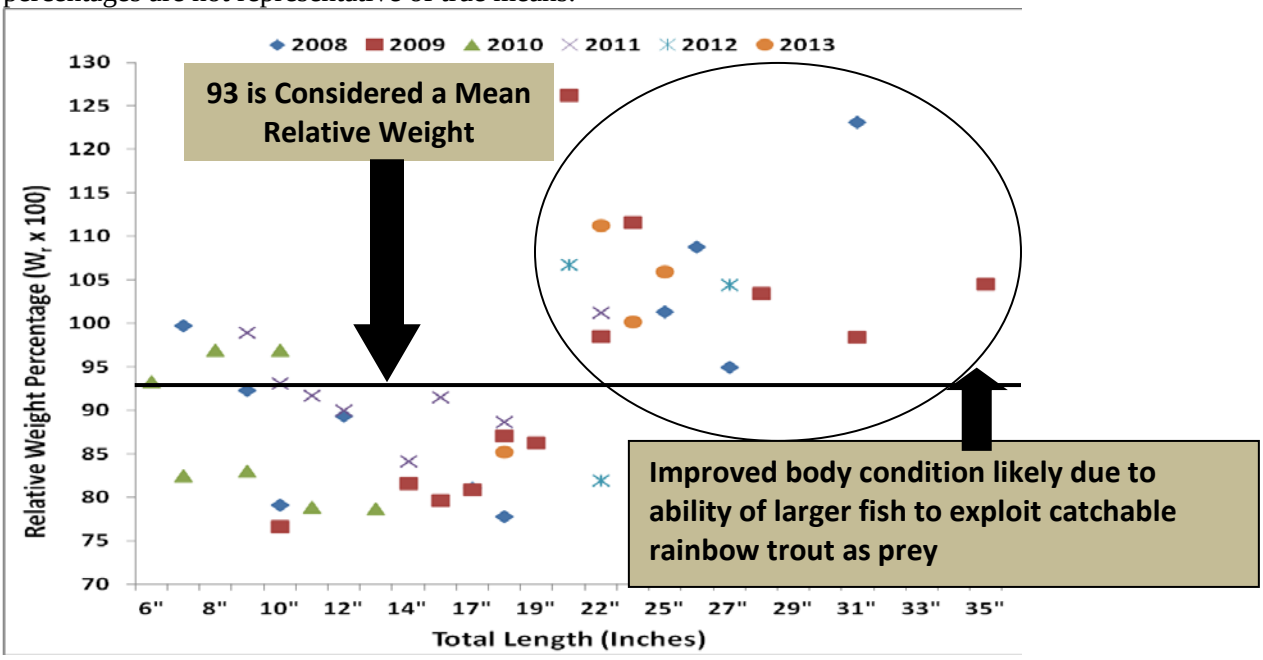


Figure 33. Northern pike growth in Rifle Gap Reservoir (based upon samples collected by the Colorado Division of Wildlife in the spring and fall of 2006, 2007, 2008) is rapid with age-5 through age-10 fish averaging 24% larger in total length (TL) than the median growth of northern pike populations reported in Fishbase (2009) (Johnson et al. 2009). Parameters of the von Bertalanffy growth equation for median northern pike growth are shown in the upper left.

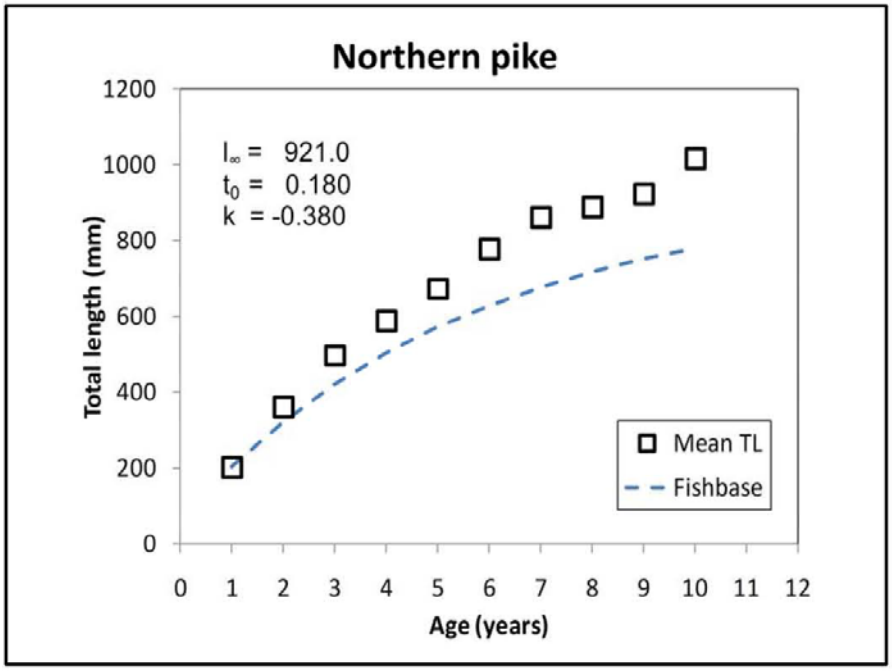


Figure 34. Northern pike (NPK) total catch and total kept catch (harvest) for Rifle Gap Reservoir as a result of angler creel surveys completed by the Colorado Division of Wildlife during the open water season (May - October 2009) and ice fishing season (December 2009 - February 2010). Northern pike were not present in the reservoir during the 1987 season. Average lengths of northern pike kept and released are also provided.

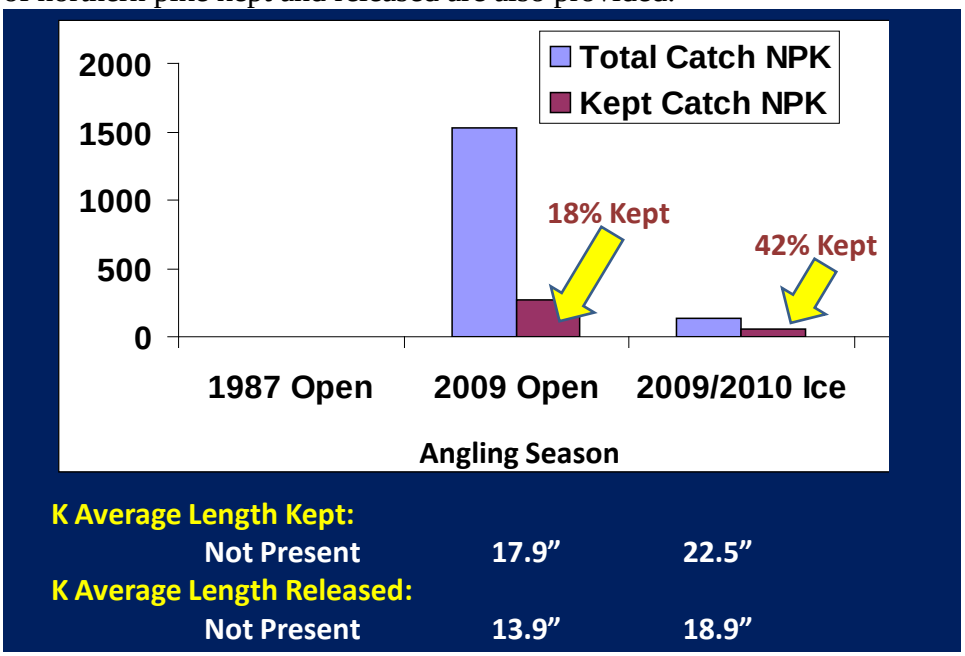
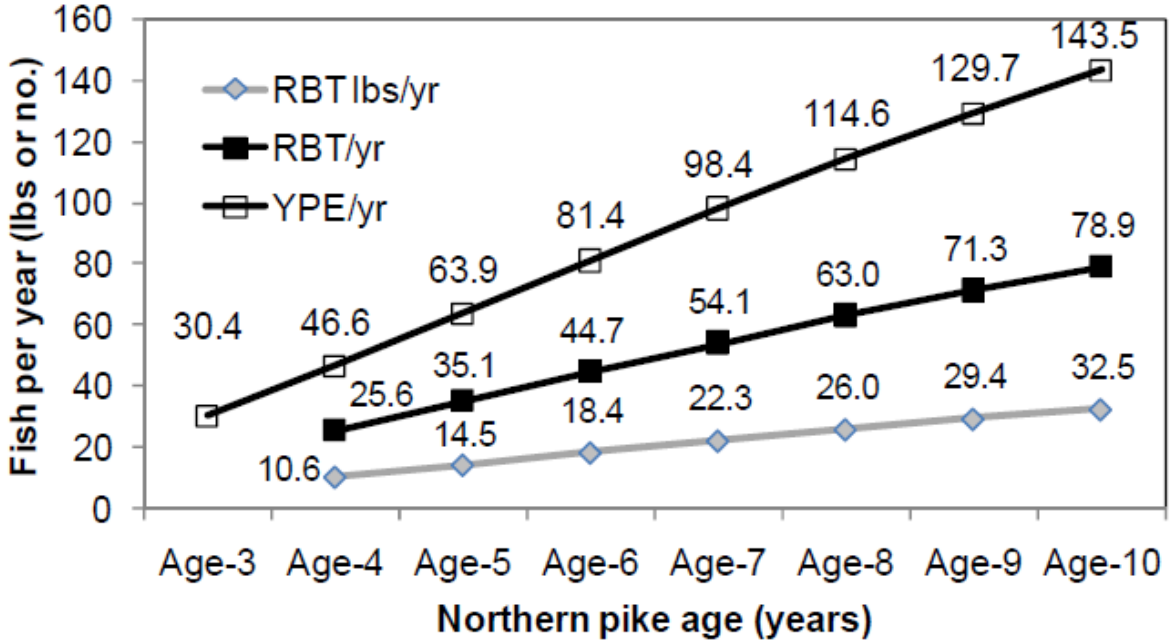
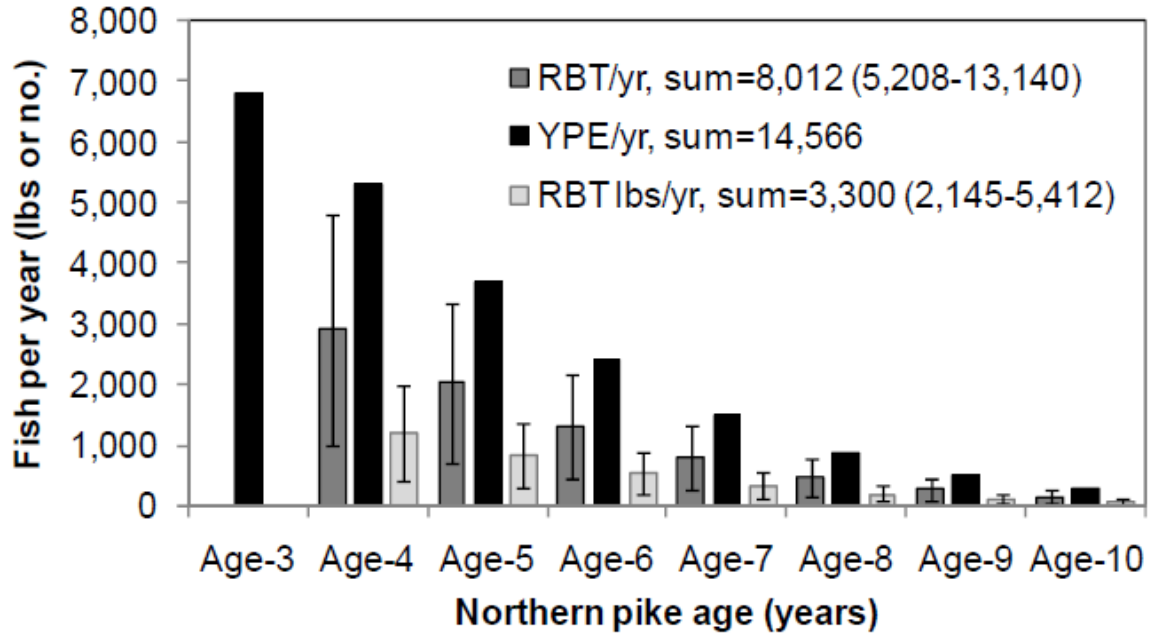


Figure 35. Annual per capita consumptive demand of northern pike in Rifle Gap Reservoir based upon bioenergetic simulations from samples collected by the Colorado Division of Wildlife in the spring and fall of 2006, 2007, 2008 (Johnson et al. 2009). Demand is expressed as number of rainbow trout (RBT) and yellow perch (YPE) and pounds of rainbow trout consumed per year for northern pike of seven or eight age classes. The actual numbers and pounds consumed are shown above each point.



ure 9. Per capita consumptive demand expressed as number (black line) and
ass (gray line) of fish consumed per pike per year of seven age-classes of NPK in
e Gap Reservoir. The actual numbers and bounds consumed are shown above

Figure 36. Annual number and biomass of rainbow trout (RBT) and yellow perch (YPE) consumed by seven or eight age classes of northern pike in Rifle Gap Reservoir based upon bioenergetic simulations from samples collected by the Colorado Division of Wildlife in the spring and fall of 2006, 2007, and 2008 (Johnson et al. 2009). Confidence intervals are based on errors associated with the northern pike abundance estimate; confidence intervals are omitted from the yellow perch consumption estimate so as not to obscure the rainbow trout data.



ure 10. Annual number and biomass of fish consumed by seven or eight age-
sses of northern pike in Rifle Gap Reservoir, based on bioenergetics simulations.
or bars are based on errors associated with abundance estimate; bars are omitted
n the YPE consumption estimate so as not to obscure the RBT data.

Figure 37. Fish composition and relative abundance for fish species excluded and collected by the Rifle Creek fish screen, May - October, 2013. At least 184 fish have been collected. Non-salmonids are lethally removed.

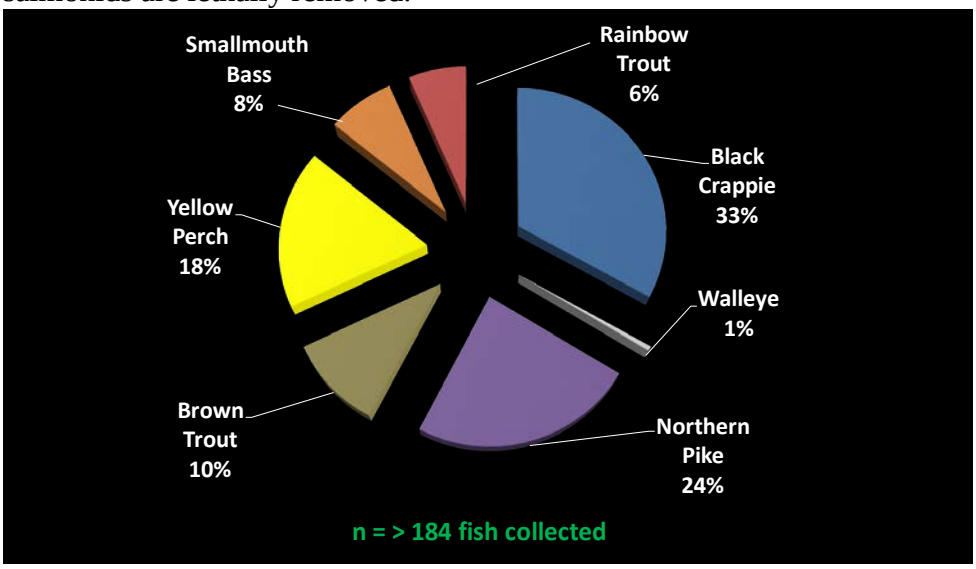


Figure 38. Photographs of fish excluded and collected by the Rifle Creek fish screen in 2013.

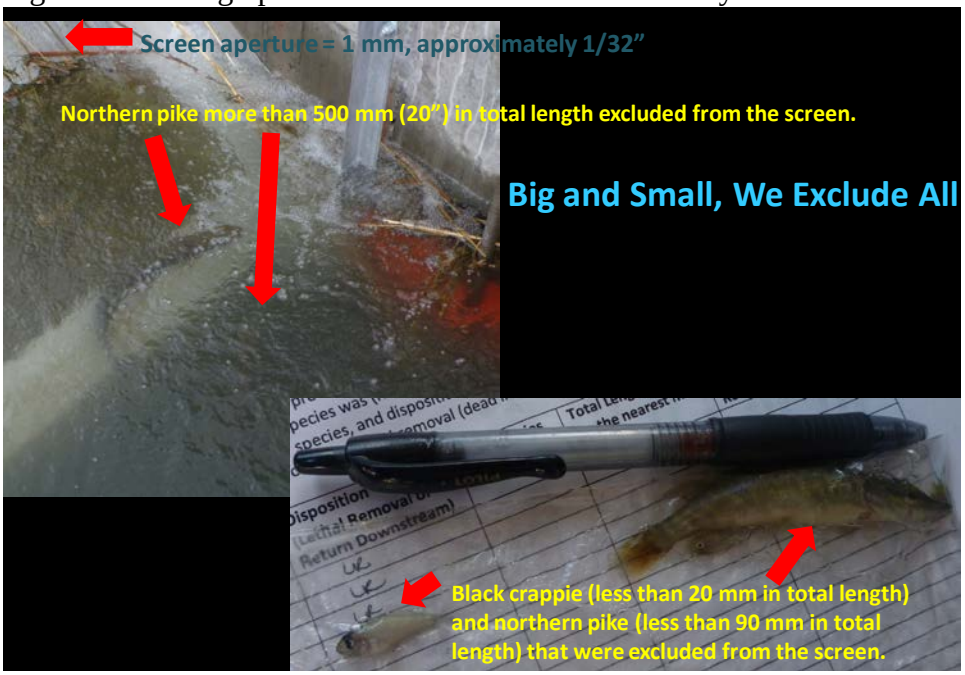
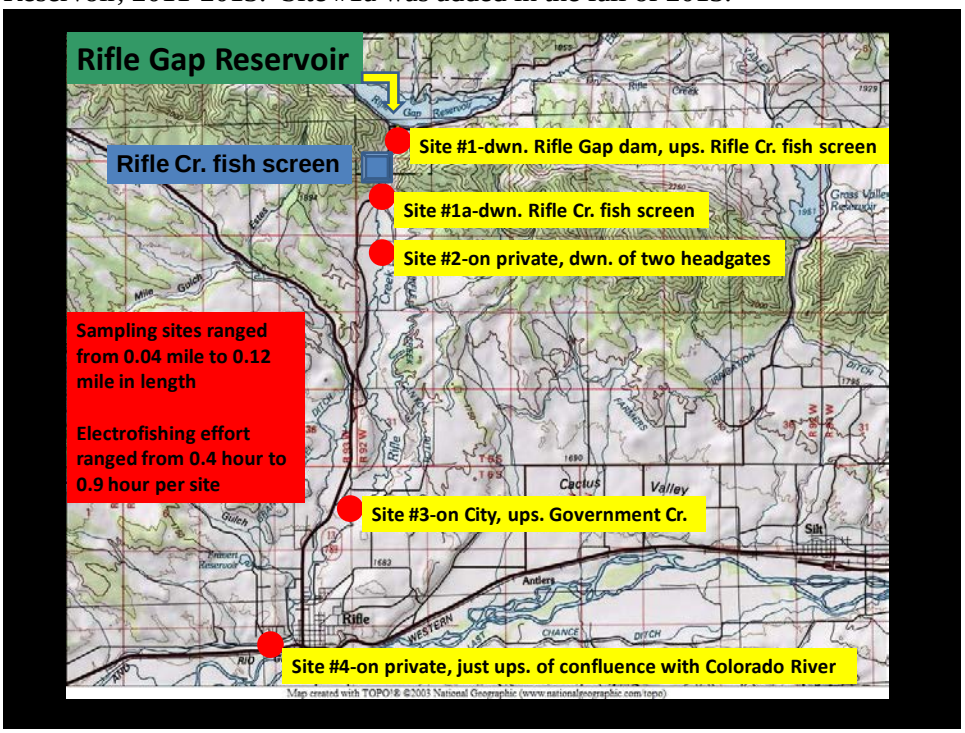


Figure 39. Locations of Colorado Parks and Wildlife electrofishing sites downstream of Rifle Gap Reservoir, 2011-2013. Site #1a was added in the fall of 2013.



Appendix C.

Table 1. Summary of Rifle Gap Reservoir water fluctuations from 2008 through 2013. Average daily water elevations for the reservoir were used to determine the maximum and minimum water elevations, as well as the greatest difference in water elevation. Minimum and maximum water elevations were based upon values that were maintained across more than one day (i.e., a drastic water level change across one day was not included as the high or low). Water elevations that corresponded with fish surveys were rounded to the nearest foot. Reservoir spill elevation is 5,960 feet. Data provided by Colorado Division of Water Resources website at http://www.dwr.state.co.us/SurfaceWater/data/

Year	Maximum Water Elevation (feet) and Date	Minimum Water Elevation (feet) and Date	Water Elevation Difference (feet) Within Year	Number of Spills and Range of Spill Dates	Water Elevation (feet) on Fish Survey Date
2008	5,960.7' on 6/6	5,938.2' on 11/10	22.5'	22 days; 5/29 to 6/18	5,945' on 9/10; 5,944' on 10/1
2009	5,960.4' on 4/8	5,937.9' on 10/8	22.5'	50 days; 2/27 to 4/24	5,938' on 10/12
2010	5,960.3' on 4/2	5,930.5' on 10/13	29.8'	32 days; 3/22 to 4/22	5,932' on 10/4
2011	5,961.1' on 6/4	5,946.4' on 1/1	14.7'	62 days; 4/22 to 5/4; 5/30 to 7/2; 11/26 to 12/9	5,950' on 10/10
2012	5,960.4' on 3/13	5,915.1' on 10/9	45.3'	38 days; 3/7 to 4/13	5,919' on 9/25
2013	5,947.7' on 4/30	5,918.4' on 9/27	29.3'	Did not spill	5,918' on 9/30

Table 2. Standardized bag seine description, operation, and effort planned for Rifle Gap Reservoir. Information adapted from Pope et al. (2009). Abbreviations: millimeter=mm, meter=m, foot=ft, inch=in, pounds=lbs

Feature	Description
Length and depth	9.1 x 1.8 m (30 x 6 ft)
Mesh bar size	6.4 mm ($^1/_4$ in) Delta
Brailes	1.8-2.5 m (6-8 ft) long (polyvinyl chloride tubing or wood)
Float and leadlines	29.5 kg (75 lbs) lead core bottom line and floatline with floats evenly spaced on the top line
Bag dimensions	The bag [1.8 x 1.8 x 1.8 m (6 x 6 x 6 ft)] is incorporated in the center of the seine. The seine contains 3.7 m (12 ft) wings on each side of the bag.
Operation	Fully extend seine perpendicular from shore then pivot around the entry (anchor) point. Seine haul will cover an area equal to a 0.25 circle with a radius of 9.1 m (30 ft), which is known as a quarter haul or quarter arc. After net is fully extended, pull into water and sweep in a 180-degree arc downstream.
Effort	Minimum of three seine hauls per habitat substrate across five areas of shoreline (swim beach, island, northeast shoreline, southwest shoreline, southeast shoreline). Stratified random sampling design will be followed.

Table 3. Standardized core gill net description, operation, and effort planned for Rifle Gap Reservoir. Information adapted from Pope et al. (2009). Abbreviations: millimeter=mm, meter=m, foot=ft, inch=in

Feature	Description
Net type; length and depth	Monofilament, 8 panel, sinking 24.8 x 1.8 m (81 x 6 ft)
Panel sizes	3.1 m (10 ft) long x 1.8 m (6 ft) deep (benthic)
Mesh bar size	19, 25, 32, 38, 44, 51, 57, 64 mm (0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50 in)
Monofilament diameters corresponding to mesh sizes above	0.28, 0.28, 0.28, 0.33, 0.33, 0.33, 0.40, 0.40 mm (0.011, 0.011, 0.011, 0.013, 0.013, 0.013, 0.016, 0.016 in)
Mesh order	38, 57, 25, 44, 19, 64, 32, 51 mm (1.50, 2.25, 1.00, 1.75, 0.75, 2.50, 1.25, 2.00 in)
Hanging ratio	0.5
Soak time	Up to 2 hour sets during daylight (early morning or late afternoon)
Effort	Minimum of six net sets across six areas of shoreline (swim beach, island, northeast shoreline, southwest shoreline, dam, and southeast shoreline). Stratified random sampling design will be followed. Nets will be set perpendicular to the shore on the bottom of the reservoir in 1.8 to 5.0 m (6 to 16 ft) of water. Two nets may be used together to increase the length sampled. In these cases, the 38 mm mesh panel on one net end will be joined with the 51 mm mesh panel on the other net end. The net end set closest to shore will be randomly determined for each net set.

Table 4. Standardized modified fyke net description, operation, and effort planned for Rifle Gap Reservoir. Information adapted from Pope et al. (2009). Abbreviations: millimeter=mm, meter=m, foot=ft, inch=in

Feature	Description
Net type	Modified fyke net consisting of a sinking trap and a lead; all netting 13 mm ($^1/_2$ in) bar knot-less nylon, with a black asphalt-type coating
Lead	One, 15-30 m (50-100 ft) long, shorten in steep stations; 0.9 m (3 ft) high
Hanging ratio	0.33
Trap	Two 0.9 x 1.8 m (3 x 6 ft) rectangular frames each with a center brace; frames 0.6 m (24 in) apart with inward mesh trap that tapers from the first frame to the second ending in a 102 mm (4 in) diameter opening; behind frames, four 0.77 m (30 in) diameter hoops, 0.6 m (24 in) apart, with mesh funnel between first and third hoops; cod end with purse string closure
Soak time	Set late afternoon and retrieve following morning
Effort	Minimum of five net sets across five areas of shoreline (swim beach, northeast shoreline, east inlet, southeast shoreline, and west inlet). Stratified random sampling design will be followed. Nets will be set perpendicular to the shore on the bottom of the reservoir in 1.0 to 5.0 m (3 to 16 ft) of water.

Table 5. Standardized electrofishing boat description, operation, and effort planned for Rifle Gap Reservoir. Information adapted from Pope et al. (2009) and Martinez and Kolz (2013). Abbreviations: centimeter=cm, meter=m, foot=ft, inch=in, voltage alternating current=VAC, hertz=Hz, kilowatt=kW, watt=W, direct current=DC, microsiemens=uS

Feature	Description
Boat	Aluminum hull (to serve as cathode), flat-bottom John boat, 5.3 m long (17-18 ft), 2.4 m (8.0 ft) wide
Outboard motor	Need to access shallow water and cruise shore at low speed with power requirements to navigate long distances; must be in electrical continuity with the boat hull
Power generator	220-240 VAC, single phase, 55-65 Hz, alternator supplied with power rating of 5.5 kW; in electrical continuity with the boat hull
Control unit	Capable of 60 Hz pulsed DC output, high voltage; with adjustable voltage, amperage, duty cycle, and frequency output; includes amperage and voltage meter, and a timer to track "on-time"
Booms	Fiberglass poles extending 2.3 m (7.5 ft) from the boat bow; positioned 2.0 m (6.5 ft) apart
Anodes	23 cm (9 in) diameter stainless steel spheres
Cathode	Hull of aluminum boat
Power output	Up to 4,800 W pulsed DC in water conductivities ranging from 100 to 1,500 uS/cm
Frequency	30-60 Hz pulsed DC
Boat operation	Night-time, shoreline (< 3.0 m) electrofishing of a minimum of five stations across five areas of shoreline (west inlet and swim beach, northeast shoreline and east inlet, southeast shoreline, dam, and southwest shoreline). Each station will be electrofished for 15 continuous minutes. Stratified random sampling design will be followed.
Dip nets	6.4 mm ($^1/_4$ in) mesh, 30-46 cm (12-18 in) deep bags attached to fiberglass handles sufficiently long to allow netters to retrieve fish

Table 6. Specifics regarding fish species to be stocked in Rifle Gap Reservoir per the Rifle Gap Reservoir Lake Management Plan.

Species to be Stocked	Fish Stocking Density	Size of Fish to be Stocked	Stocking Schedule
Black Crappie	50 /habitat acre = 5,000 fish; 500 fingerlings/habitat acre = 50,00 fish	4 to 6-inch 1.5-inch	4th year of 5 year cycle; late summer/early fall; early summer for fingerling
Rainbow Trout	100 fish/habitat acre = 27,000 fish	≥8-inch (catchables)	Annual; June (2,500 fish), July and August (8,750 fish each month), September (5,000 fish), October and November (1,000 each month)
Yellow Perch	Unknown at this time	Unknown at this time	Only if current population crashes
Triploid Walleye (100% sterile)	150 fingerlings/habitat acre = 36,000 fish; 1,500 fry/habitat acre = 360,000 fish	1.3-inch 0.2-inch	1st, 2nd, and 3rd years of 5 year cycle-3rd year may not be necessary; late May/early June; April for fry

Table 7. Measurable outcomes by fish species to be managed per the Rifle Gap Reservoir Lake Management Plan. We also hope that our anglers achieve our goal of maintaining or improving 1.8 fish caught/hour for all fish species combined.

Species	Catch per Unit Effort (catch/hour)	Young to Adult Ratio	Proportional Size Distribution (PSD)	Relative Size Distribution-Preferred (RSD-P)	Mean Size in Angler Creel (inches)	Annual Angler Harvest (# of fish)
Black Crappie	50 fish ≥100mm	7-10 fish <100mm : 1 fish ≥100mm	15-25	≥5	≥8"	500
Trout	25 fish ≥200mm	---	---	---	≥13"	5,000
Yellow Perch	150 fish ≥100mm	2-5 fish <100mm : 1 fish ≥100mm	25-35	≥5	≥8"	20,000
Walleye	25 fish ≥200mm	1-3 fish <200mm : 1 fish ≥200mm	30-40	≥5	≥18"	100

Table 8. Numbers of fish and total length ranges (millimeter=mm) by species for fish collected by Colorado Parks and Wildlife in Rifle Creek, 2011-2013. Site #1a was added in 2013. *The two northern pike collected at Site #1a (downstream of the screen) were presumed to be present in Rifle Creek prior to the screen being built, rather than as a function of screen failure. Fish species codes: black bullhead=BBH, BCR=black crappie, BHS=bluehead sucker, common carp=CPP, creek chub=CRC, flannelmouth sucker=FMS, fathead minnow=FMW, longnose sucker=LGS, brown trout=LOC, mottled sculpin=MTS, mountain whitefish=MWF, northern pike=NPK, rainbow trout=RBT, roundtail chub=RTC, smallmouth bass=SMB, green sunfish=SNF, speckled dace=SPD, white sucker=WHS, white sucker hybrid=WHSX, yellow perch=YPE

	Sampling Location				
Year	**Site #1**	**Site #1a**	**Site #2**	**Site #3**	**Site #4**
2011	50 LOC (90-538 mm); 25 RBT (298-440 mm); 1 NPK (180 mm); 4 SNF (134-154 mm); 5 YPE (87-160 mm)	Not applicable	21 LOC (107-307 mm)	1 BBH (107 mm); 91 CRC (35-132 mm); 23 LOC (119-404 mm); 1 SNF (87 mm); 5 SPD (79-110 mm); 71 WHS (32-386 mm)	1 BHS (107 mm); 5 CRC (58-91 mm); 31 LOC (76-450 mm); 1 MTS (48 mm); 35 MWF (128-163 mm); 1 RBT (123 mm); 2 SNF (82-115 mm); 1 SPD (94 mm); 5 WHS (179-244 mm)
2012	1 BCR (51 mm); 30 LOC (108-454 mm); 10 RBT (324-419 mm); 3 SNF (47-99 mm); 13 YPE (86-150 mm)	Not applicable	75 LOC (97-404 mm); 3 SPD (43-73 mm)	56 CRC (75-152 mm); 54 LOC (81-405 mm); 2 SPD (49-81 mm); 59 WHS/WHSX (47-332 mm)	15 CRC (54-195 mm); 2 FMS (77-103 mm); 1 FMW (59 mm); 12 LOC (112-404 mm); 3 MWF (136-157 mm); 21 RBT (98-177 mm); 9 RTC (37-70 mm); 4 SNF (79-111 mm); 1 SPD (42 mm); 22 WHS (49-202 mm)
2013	31 LOC (92-418 mm); 5 RBT (361-413 mm); 20 NPK (173-279 mm); 2 SMB (78-85 mm); 1 SNF (112 mm); 69 YPE (62-239 mm)	130 LOC (94-365 mm); *2 NPK (228-248 mm) 18 RBT (217-321 mm);	15 CRC (43-152 mm); 62 LOC (93-410 mm); 51 WHS/WHSX (58-344 mm)	116 LOC (82-329 mm)	1 BHS (83 mm); 1 CPP (97 mm); 15 CRC (49-150 mm); 12 FMS (44-149 mm); 6 FMW (37-75 mm); 1 LGS (137 mm); 29 LOC (72-424 mm); 9 RBT (52-85 mm); 44 RTC (45-124 mm); 16 SNF (49-137 mm); 19 SPD (34-82 mm); 52 WHS/WHSX (53-198 mm)

Table 9. Number of fish collected and their respective catch rates (fish/hour) for fish species lethally removed from the Colorado River between Silt, Colorado and the Beavertail Mountain tunnel (just downstream of Debeque, Colorado) by Colorado Parks and Wildlife and the U.S. Fish and Wildlife Service, 2008-2013. The entire river reach from Silt to Beavertail Mountain was not sampled every year: 2008=River Mile (RM) 248.0 to RM 195.7 sampled (Silt to Beavertail); 2009 and 2010=RM 240.4 to RM 195.7 sampled (Rifle to Beavertail); 2011=RM 240.4 to RM 236.6, RM 229.0 to RM 222.5, and backwaters/side channels at/from RM 233.7 to RM 233.0 and RM 231.4 sampled (Rifle to Parachute); 2012 and 2013=RM 248.0 to RM 222.2 and RM 209.7 to RM 195.7 sampled (Silt to Parachute and Debeque to Beavertail Mountain). Fish species codes: black bullhead=BBH, black crappie=BCR, bluegill=BGL, green sunfish=SNF, largemouth bass=LMB, northern pike=NPK, smallmouth bass=SMB, walleye=WAL, and yellow perch=YPE

	Fish Species								
Year	**BBH**	**BCR**	**BGL**	**SNF**	**LMB**	**NPK**	**SMB**	**WAL**	**YPE**
2008	0; 0.00	2; 0.02	72; 0.81	1,683; 18.86	596; 6.93	0; 0.00	82; 0.95	1; 0.01	0; 0.00
2009	0; 0.00	1; 0.02	27; 0.43	466; 7.49	70; 1.12	0; 0.00	15; 0.24	0; 0.00	0; 0.00
2010	0; 0.00	0; 0.00	27; 0.34	957; 12.11	68; 0.85	0; 0.00	96; 1.21	0; 0.00	0; 0.00
2011	0; 0.00	0; 0.00	0; 0.00	0; 0.00	27; 2.14	9; 0.71	11; 0.49	0; 0.00	0; 0.00
2012	7; 0.12	5; 0.09	2; 0.04	310; 5.49	72; 1.27	16; 0.28	5; 0.09	0; 0.00	0; 0.00
2013	6; 0.10	50; 0.84	4; 0.07	807; 13.50	300; 5.02	1; 0.02	34; 0.57	0; 0.00	21; 0.35

Table 10. Number of smallmouth bass collected by size groups (total length <100 millimeters (mm)=age-0, 100-199 mm=juveniles and, >200 mm=adults) and their respective catch rates (fish/hour) for fish removed from reaches of the "upper" Colorado River (Silt to Beavertail Mountain, just downstream of Debeque: River Miles (RM) 248.0-195.7), and reaches of the "lower" Colorado and Gunnison rivers (Colorado from Government Highline Dam near Palisade (RM 193.7) to Westwater, Utah (RM 127.6); Gunnison from Redlands Diversion Dam (RM 3.0) to the Colorado River confluence in Grand Junction (RM 0.7)) by Colorado Parks and Wildlife and the U.S. Fish and Wildlife Service, 2004-2013. The entire upper and lower reaches were not sampled every year, and some sections were added from year to year: Silt (RM 248.0) to Rifle (RM 240.4) sampled only during 2007, 2008, 2012, and 2013; Government Highline Dam (RM 193.7) to Cameo Bridge (RM 189.8) added in 2009; in 2011, a portion of the upper Colorado reach was sampled, Rifle (RM 240.4) to Parachute (RM 222.2); in 2011, reaches in the lower Colorado not sampled included Government Highline Dam (RM 193.7) to Cameo Bridge (RM 189.8) and Black Rocks (136.8) to Westwater, Utah (RM 127.6); in 2012 and 2013, Parachute (RM 222.2) to Debeque (RM 209.7) not sampled; in 2012, reaches in the lower Colorado not sampled included Government Highline Dam (RM 193.7) to GVIC (RM 185.4) and the lower Gunnison river from the Redlands Diversion Dam (RM 3.0) to the Colorado River confluence (RM 0.7). Table extrapolated from Francis and Ryden (2013).

River Reaches and Fish Size Classes	**Year**									
Upper Colorado	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
<100 mm	3; 0.15	58; 1.46	36; 0.96	17; 0.20	21; 0.25	0; 0.00	57; 0.72	0; 0.00	1; 0.02	4; 0.07
100-199 mm	4; 0.20	54; 1.36	2; 0.05	28; 0.32	29; 0.34	3; 0.05	0; 0.00	6; 0.48	1; 0.02	29; 0.53
>200 mm	14; 0.71	118; 2.96	41; 1.09	45; 0.52	32; 0.37	12; 0.19	39; 0.49	5; 0.01	3; 0.05	1; 0.02
Lower Colorado/Lower Gunnison										
<100 mm	93; 0.55	254; 1.46	261; 1.61	1,358; 4.15	185; 0.63	191; 0.55	2,054; 5.82	226; 0.55	761; 2.62	1,213; 3.33
100-199 mm	618; 3.66	345; 1.98	54; 0.33	250; 0.76	214; 0.73	137; 0.39	159; 0.45	611; 1.47	316; 1.09	1,281; 3.52
>200 mm	456; 2.70	768; 4.39	449; 2.77	429; 1.31	135; 0.46	177; 0.51	188; 0.53	147; 0.35	423; 1.46	754; 2.07