FISHERY RESEARCH

SUMMARY OF 15 YEARS OF IDFG DINGELL-JOHNSON RESEARCH, 1988-2003

Grant # F-73-R-26

Report Period July 1, 2004 to June 30, 2005

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Project 1: Fishery Research Supervision

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TABLE OF CONTENTS

Page

LIST OF TABLES

ANNUAL PERFORMANCE REPORT
PROJECT #1: FISHERY RESEARCH SUPERVISION

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ABSTRACT

In 1984 the Federal Aid in Sport Fish Restoration Act, or Dingell-Johnson (D-J) Act, was amended by the enactment of the Wallup-Breaux amendment. This amendment expanded the sources of revenue from taxes and increased the state appropriations, including in Idaho. Prior to this period, fisheries research funded by D-J dollars within the Idaho Department of Fish and Game (IDFG) primarily concentrated on water specific research questions across the state. At the 1985 fishery managers meeting, a group decision was made to create regional fish biologists with the additional D-J money received and focus the D-J research projects on questions with statewide implications. By 1988, this transition was begun. Research projects were then initiated with statewide perspectives and begun by investigating the quality of Idaho fisheries and potential for improvements. In the early 1990s, research began to evaluate our hatchery fish relative to strain evaluations, rearing conditions, stocking rates, and later, on sterilization techniques and performance evaluations. Statewide D-J research on wild trout began in 1990 and focused on statewide comparisons of productivity, regulation modifications, hooking and electrofishing mortality, and impacts from whirling disease. Some recent studies have focused on Endangered Species Act issues regarding status assessments and angler harvest compliance. This report is an attempt to summarize this research in a format useful to IDFG staff for both historical perspective and as a handy reference source for any findings of interest to biologists. The basic structure of the report includes a one-paragraph summary of findings for various projects or subprojects, along with the appropriate literature citations. In addition, a second section lists a number of additional efforts and products conducted at the request of IDFG fishery managers or headquarters staff. Many of these products (e.g., anadromous fish whitepapers conducted by resident staff during the early 1990s) may not appear in actual D-J reports, and their existence is in danger of being lost to the institutional knowledge base. It is hoped that their mention here will reduce such information loss.

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INTRODUCTION

In 1984 the Federal Aid in Sport Fish Restoration Act, or Dingell-Johnson (D-J) Act, was amended by the enactment of the Wallup-Breaux amendment. This amendment expanded the sources of revenue from taxes attributable to motorboat and small engine fuel use and on sport fishing equipment, as well as import duties on additional fishing equipment, yachts, and pleasure craft. Wallop-Breaux also created two separate accounts—one for boating safety funds and another for sport fish monies—and authorized the transfer of all but $1 million of motorboat fuel taxes to the new trust fund.

The result of this expansion of the original Sport Fish Restoration Act was an increase in money received by each state for management, conservation, and restoration of fishery resources. Prior to this period, fisheries research funded by D-J dollars within the Idaho Department of Fish and Game (IDFG) primarily concentrated on water specific research questions across the state. At the 1985 IDFG fishery managers meeting, a group decision was made to create regional fish biologists with the additional D-J money received, and focus the D-J research projects on questions with statewide implications. By 1988, this transition was begun.

Research projects were initiated with more of a statewide perspective and begun by investigating the quality of Idaho fisheries and potential for improvements. In the early 1990s, research began to evaluate our hatchery fish relative to strain evaluations, rearing conditions, stocking rates, and later, on sterilization techniques and performance evaluations. Statewide D-J research on wild trout began in 1990 and focused on statewide comparisons of productivity, regulation modifications, hooking and electrofishing mortality, and impacts from whirling disease. Some recent studies have focused on Endangered Species Act issues regarding status assessments and angler harvest compliance. Other research projects have focused on a variety of topics, including largemouth and smallmouth growth, kokanee production and population dynamics, predator forage, irrigation diversion fish loss, and hydroacoustic population estimates.

This report is an attempt to summarize this research in a format useful to IDFG staff for historical perspective, and as a reference source for particular studies, reports, research briefs, or publications. It is organized into sections covering 1) research projects and findings, including report and publication citations, and 2) management support, including creel surveys and other management assistance projects outside the scope of annual reports. The literature cited section contains all known reports and publications produced by research staff, even those that are not cited in any specific topic of research within this report.

RESEARCH PROJECTS AND FINDINGS

Bass and Forage Fish Projects (Dillon – 1990-1991)

Statewide Study (30 waters) of limiting factors for largemouth bass

This project determined that bass growth was not being limited by available forage, so forage introductions would not be helpful in improving populations. Temperature was determined to be the main limiting factor influencing largemouth bass growth in Idaho. Because managers have no ability to influence temperature, bass populations will sometimes be

composed of smaller fish than some of the angling public may prefer. Results could be used by managers when presenting bass management options to the public.
Tool = Warmwater fisheries management; research brief
Citations = Dillon 1990, 1991a, 1995a (brief), 1996b (brief)

Smallmouth bass investigations on 12 Idaho waters

The project identified the impacts that physical habitat, productivity, temperature, and forage species have on growth. Most populations were determined to be limited by water temperature but several appeared to be forage limited, including Brownlee Reservoir. Results could be used by managers when presenting bass management options to the public.
Tool = Warmwater fisheries management; research brief
Citations = Dillon 1991b, 1992, 1996a (brief), 1996c (brief)

Forage development and evaluation on Brownlee Reservoir

A literature review was conducted on emerald shiners and American shad regarding their potential use as forage enhancement in Brownlee Reservoir. Either species would be expected to have substantial benefits in stimulating smallmouth bass growth, but impacts on anadromous species immediately downstream could occur. Because of this, it was recommended introductions not be carried out.
Tool = Forage fish management
Citations = Dillon and Myers 1990

Forage development and evaluation on Priest Lake

A literature review was conducted on deepwater sculpin and lake whitefish regarding their potential use as forage enhancement in Priest Lake. Either species could potentially enhance the lake trout fishery, but negative interactions from whitefish introductions could occur. Deepwater sculpin appeared to be the better introduction candidate if a disease free source could be found.
Tool = Forage fish management
Citations = Dillon and Taki 1990

Alternative species for lake and reservoir fisheries

This project investigated species composition in Salmon Falls Creek Reservoir to evaluate the effect of past walleye introductions. Declines were documented in forage fish species, and an increase in kokanee population was also detected.
Tool = Fishery enhancement potential
Citations = Partridge 1988

Status and analysis of salmonid fisheries (Rieman – 1990-1992)

Kokanee population dynamics

This research project determined that kokanee became vulnerable to anglers at about 180 mm, and that vulnerability increased with length. Exploitation may increase dramatically in populations with densities of age-3+ fish at low densities and could collapse the fishery. Unusually large kokanee should serve as a danger signal of such collapse for managers. Age-at-maturity had a large influence on predicted weight of fish harvested and was more important than fish density. Research on methods to delay age-at-maturity (including sterilization) may be a way to dramatically improve some kokanee fisheries. In lakes without natural reproduction, initial kokanee stocking rates should be 100 to 500 fry per hectare with the higher numbers for more productive lakes.

Tool = Stocking guidelines; fishery enhancement potential
Citations = Rieman 1989, 1991, 1992; Rieman and Myers 1990; Rieman and Maiolie 1995

Benefits and risks of salmonid predators

An investigation into predators and kokanee populations determined that Chinook salmon should produce the best yields in lakes where kokanee are the dominant or only forage. Lake trout should provide the best yields where a diversity of forage is available. However, lake trout represent a greater risk of collapsing a kokanee population. The channeling of kokanee production through an additional trophic level is high risk in unproductive lakes unless the kokanee fishery is of little value. Stocking rates for lake trout and Chinook salmon should be less than 7 fish/hectare. Past stocking rates in Idaho have been much higher and may explain the collapse of some kokanee populations and the failure of some predator introductions.
Tool = Stocking guidelines; fishery enhancement potential
Citations = Rieman 1991

Kokanee monitoring guidelines

Data from 12 years of routine monitoring on eight lakes were used to describe density-dependant changes in kokanee populations and to develop stocking guidelines. Benefits from stocking programs will be maximized at stocking rates lower than previously thought and lower than current management goals. It was determined that simple indexes of productivity are adequate for our needs in describing kokanee production potential. More complicated and expensive sampling appears to be unnecessary.
Tool = Stocking guidelines; fishery enhancement potential
Citations = Rieman and Myers 1990, 1992

Hatchery Trout Evaluations (Mauser, Dillon, Teuscher, Kozfkay – 1992-2003)

Lakes and Reservoirs

Fingerling/Catchable tradeoffs

The performance of 72 fingerling and catchable plants in 20 lakes and reservoirs was evaluated to develop a more efficient stocking program. Spring fingerlings typically exhibited the lowest cost/fish in the creel and thus were the most cost-effective to stock. Recommendations were to use spring fingerlings in most Idaho lentic waters.
Tool = Stocking guidelines; increase return to creel
Citations = Dillon and Megargle 1994; Dillon and Jarcik 1994; Dillon and Alexander 1995, 1997; Teuscher et al. 1998

Predicting fall fingerling success

For managers desiring to use fall fingerlings, detection of July zooplankton >2 mm in length successfully predicted the failure or success of fall fingerling plants in most cases. No counting or quantification was necessary to employ the technique, which would allow biologists to minimize stocking failures.
Tool = Stocking guideline; increase return to creel; research brief
Citations = Dillon and Alexander 1995, 1996

Zooplankton ratio

A zooplankton quality index (ZQI) was developed that can be used to prioritize fish stocking programs. The index was an extension of Wyoming G & F's existing zooplankton ratio

index (ZPR) that examines the ratio of two size classes of zooplankton on lentic systems. The IDFG refinement labeled ZQI includes both size and density components in the index. The index predicts which waters have sufficient numbers and size of zooplankton to justify stocking. Collecting data needed to calculate the index is simple and inexpensive and can be done on multiple waters in a single day.
Tool = Stocking guidelines; research brief
Citations = Teuscher 1999a, 1999b (brief)

Review of stocking guidelines for rainbow trout fingerlings

An extensive literature review of other states' fingerling stocking rates and guidelines of lakes and reservoirs was performed. A comparison of stocking densities with a statewide sampling of Idaho stocking densities shows we are in the range of what most other states stock for most but not all waters. Results summarized in the 1994 report and a summary of other states' guidelines were presented to all regional managers for their perspective when ordering hatchery fish.
Tool = Stocking guidelines
Citations = Dillon and Megargle 1994

Trophy trout investigations

Growth, survival, and population abundance of hatchery rainbow trout was estimated for Daniels Reservoir (1994-1995). Results suggest that Daniels Reservoir growth is slow due to present stocking rates, and it was recommended that stocking rates be reduced. Estimates of fingerling and catchable rainbow trout survival were developed for future stocking modeling efforts.
Tool = Stocking guidelines
Citations = Dillon and Jarcik 1994; Dillon and Alexander 1995

Usable trout habitat modeling

Limnology data (primarily temperature and dissolved oxygen) was used to quantify usable trout habitat in 18 Idaho reservoirs. Results indicated the available habitat was not a limiting factor in 17 of 18 waters studied during the water year investigated.
Tool = Stocking guidelines
Citations = Dillon and Alexander 1996

Hatchery capabilities

Hatchery records and manager stocking requests were used to assess how well the current request/production system functioned. Results showed that stocking requests (in terms of size or time) were not met in a majority of instances, and that manager requests were often unattainable by the hatchery system. Recommendations included standardizing production costs, switching to a two-year advance request process, and developing a five-year hatchery management plan in concert with the fish management plans.
Tool = stocking procedures
Citations = Dillon and Megargle 1994

Rainbow trout strain evaluation

A review of nationwide literature on rainbow trout strain evaluations showed that individual strains rarely perform consistently across multiple waters. Many strains outperformed another particular strain in a particular body of water, but results were completely reversed in a separate study. It was recommended that IDFG fish managers not consider use of alternate rainbow trout strains as a method for improving fisheries. If strains are ordered, they should be considered experimental and evaluated against our standard Hayspur broodstock.

Tool = Stocking procedures; broodstock management; increase return to creel
Citations = Dillon and Megargle 1994

Rainbow trout food habits in six Idaho reservoirs

Seasonal estimates were made of the proportion of fish growth derived from individual prey types. Results of this effort demonstrated that forage fish are not needed to grow trophy-sized (20 inch+) rainbow trout in Idaho reservoirs. Based on the literature, it may be more desirable to maintain a relatively high density of medium to large trout on invertebrates than add another trophic level and produce far fewer very large trout.
Tool = Predicting growth potential
Citations = Dillon 1992; Dillon and Jarcik 1994

Fish health and performance study

The effect of prestock fish health on the return to creel rate of catchable-size rainbow trout was assessed from four production sources, including Nampa, Hagerman-Riley, Hagerman-Tucker, and American Falls. Jaw-tagged fish were stocked in 16 lakes and reservoirs during 1999 and 2000. Prestock fish health was not related to return rate, and the Goede Health Index does not appear to be a useful predictor of eventual angler return. Hatchery performance was not consistent among years, but generally, returns and carryover were highest for American Falls. Nampa Hatchery outperformed the two Hagerman sources for the 1999 plant, but this trend was reversed during 2000. The conflicting results suggest fish health effects on angler return may require up to a decade of research investment to fully address the issue. The consistent higher returns from the American Falls facility resulted in a recommendation to test the effect of lower rearing densities on eventual angler returns.
Tool = Increase return to creel
Citations = Megargle 2000; Kozfkay and Megargle 2002

Predator Training

Fingerling rainbow trout were exposed to predators as a means of increasing predator avoidance behaviors and increasing post-stocking survival. Thus far, poor survival due to drought conditions or excessive predation, as well as disease outbreaks during rearing, have prevented fully answering this question. An additional test is ongoing.
Tool = Increase return to creel
Citations = Kozfkay 2003; Kozfkay 2004

Streams

Food training experiments

A test was performed to assess whether food training hatchery rainbow trout would increase return to creel for stream catchables. Results indicated a modest 10% (statistically insignificant) increase in catch rates of hatchery rainbow trout fed night crawlers immediately prior to stocking. Recommendations were to not implement a feeding program, but results suggested potential in modifying catchability behavior of stocked trout.
Tool = Increase return to creel
Citations = Dillon and Alexander 1997

Synopsis of information and guidelines for management of put-and-take trout in streams

Historical census data from Idaho streams was used to evaluate effects of stocking rates and angler effort on hatchery rainbow trout harvest and return rates. It was recommended that stocking 280 fish/km at effort levels of 224 h/km would optimize both return rate (fish

harvested/fish stocked) and harvest rate (fish/hour) at about 0.4. This equates to a recommended stocking rate of about 1.25 fish/angler hour. A literature review conducted on nationwide studies of stocking concluded that fish should be stocked every 1-3 weeks at sites every 1-3 km along the stream. Stocking sites should be publicized as opposed to our past policies on not "hot-spotting." Attempts should be made to develop a more catchable stock of fish for the put-and-take program. Dispersal monitoring suggested that 97% of hatchery catchables remained within 1.5 km of their release site.
Tool = Stocking guidelines
Citations = Mauser 1992; Mauser 1994a; Mauser 1994b

Effects of fish size-at-stocking on return to creel

This study quantified angler return rates for "large" vs. standard-sized catchables in four streams. Results suggest 1.2 times as many large fish as small fish were caught. Almost twice as many anglers fishing Big Wood River streams preferred to catch one large rather than two small hatchery trout. Based on the results of this research, the management recommendation was to stock fewer larger trout. However, ongoing research on a broader scale conflicts with the above return results and may influence future management.
Tool = Stocking guidelines; research brief
Citations = Mauser and Dillon 1997 (brief); Teuscher 1999

Improving catchability of rainbow trout — a selective breeding experiment

A series of fishing trials conducted on Hayspur-strain rainbow trout broodstock determined that individual fish possess varying levels of vulnerability to angling. Fish caught three times or more were used to create an experimental group of "highly" vulnerable fish. When stocked in 16 streams and reservoirs throughout Idaho, vulnerable rainbow trout returned to the creel at the same rate as normal Hayspur strain catchables. Tag return data allowed comparison of return to creel among stocking locations.
Tool = Stocking guidelines; research brief
Citations = Teuscher 2000b; Megargle and Teuscher 2001; Kozfkay and Megargle 2002; Kozfkay 2003; Kozfkay et al. 2004; Kozfkay 2005 (brief)

Sterile fish development and evaluation

Development of recipes for mixed sex triploid rainbow trout and Henrys Lake hybrids

This project investigated sterilization techniques to produce triploidy in rainbow trout and rainbow/cutthroat hybrid trout. Treatments were developed that yielded 95-100% sterility rates, as high as anyone in the literature has achieved. Production of sterile fish has allowed us to continue providing harvest fisheries in lower productivity streams, lakes, and reservoirs while maximizing genetic protection for wild stocks.
Tool = Wild trout management; broodstock management; genetic protection of native/wild trout
Citations = Dillon and Alexander 1997; Teuscher et al. 1998; Teuscher 1999; Teuscher 2000; Dillon et al. 2000b; Megargle and Teuscher 2001; Kozfkay and Megargle 2002; Kozfkay 2003.

Development of techniques to induce triploidy in other species

This research project built off our initial development of sterilization recipes by investigating sterilization techniques to produce sterile brook trout, westslope cutthroat trout, lake trout, and kokanee. All treatments have provided high induction rates (>95%) with acceptable survival compared to untreated fish. The benefits of sterilizing these species include

reduced chance of introgression, control of potential predator or competitor populations, and increase longevity of stocked fish.
Tool = Stocking procedures; broodstock management
Citations = Dillon et al. 2000b; Kozfkay 2003; Kozfkay 2004; Kozfkay et al. 2004; Kozfkay et al. 2005

Performance of diploid and triploid rainbow trout in streams

This project conducted a statewide experiment, including 18 stream stocking locations, to examine the relative contribution to the creel of diploid and triploid put-and-take rainbow trout. No difference was found in return to creel rates or time to harvest of diploid and triploid fish. Results allowed managers to shift stocking from diploid to triploid fish in streams, thereby still allowing harvest on hatchery fish while still reducing the possibility of hybridization between wild and domestic stocks.
Tool = Stocking procedures; genetic protection of native/wild trout
Citations = Dillon and Alexander 1997; Teuscher et al. 1998; Teuscher 1999; Teuscher 2000; Dillon et al. 2000a

Performance of diploid and triploid rainbow trout in lakes and reservoirs

This research project examined the relative performance of diploid and triploid rainbow trout in Daniels and Treasureton reservoirs. Based on electrofishing and gill net samples, relative survival was higher for triploid rainbow trout, whereas growth of the two groups was equal. Managers should not expect higher growth from triploid fish as suggested in some previous work; however, increased longevity of triploid fish may allow them to be susceptible to the fishery for longer periods of time.
Tool = Stocking procedures; genetic protection of native/wild trout
Citations = Dillon and Alexander 1997; Teuscher et al. 1998; Teuscher 1999; Teuscher 2000; Megargle and Teuscher 2001; Teuscher et al. 2003

Performance of diploid and triploid rainbow trout in high mountain lakes

Continuing field evaluations of triploid rainbow trout, this project examined the relative performance of diploid and triploid rainbow trout in high mountain lakes across central Idaho by stocking equal numbers of marked fish during 1999, 2001, and 2003. Initial results from 1999 and 2001 suggest that nearly twice as many diploid fish survived from 2-4 years after stocking. Although diploid fish tended to be slightly larger, the differences were not pronounced. Based on these results, managers will either have to increase stocking rates of triploid fish to maintain similar fisheries or look for alternative strains of triploid fish that perform better in these environments.
Tool = Stocking procedures; stocking guidelines
Citations = Kozfkay and Megargle 2002; Kozfkay 2003; Kozfkay 2004

Irrigation Diversion Project (DerHovanisian, Megargle – 1995-1998)

Synopsis of nationwide data on irrigation diversion losses and fish barriers

Literature reviews were conducted to guide future project direction and to review the potential alternative methods for deterring fish from entering irrigation canals. Synopses reviewed the efficacy of hanging chain curtains, air bubble and water jet curtains, lights (incandescent, strobe, and mercury) and sonics. It was determined that strobe lights may represent the most promising alternative to fish screens. However, power use and capital costs for present-day equipment are quite high, currently exceeding that for construction of fish screens. Bottom line: there is no magic bullet.

Tool = Reference for mitigating fish loss
Citations = DerHovanisian 1995

Inventory of physical characteristics of canals in Magic Valley, Southeast, and Upper Snake regions

This study inventoried 57 canals from 13 rivers to describe the typical Idaho irrigation diversion. Most diversions (86%) were situated on the outside of river bends, and 84% were associated with diversion dams, but only 10% of the diversions completely dewatered the channel. Based on past research and the physical characteristics of the canals surveyed, many of the canals have a high potential to divert game fish.
Tool = Reference for mitigating fish loss
Citations = DerHovanisian 1997a; Megargle 1999

South Fork Snake River diversion investigations

Canal losses (expressed as exploitation rates) were estimated for salmonids intercepted by irrigation diversions on two tributaries to the South Fork Snake River. Estimated exploitation rates of YOY (fish <80 mm) trout were 69% and 44% in Burns and Palisades creeks, respectively. Trout ≥80 mm were exploited at rates of 26% and 62% in the Burns and Palisades diversions. Such high exploitation rates may be common in highly migratory stocks.
Tool = Mitigation in fish loss
Citations = DerHovanisian 1997b

Anadromous diversion investigations

This study estimated the proportion of stream trout that were intercepted by 13 irrigation canals on three streams in anadromous waters. Rainbow trout were predominant in the trap catches, and exploitation estimates were germane to this species only. Exploitation estimates for fish ≤75 mm (FL) ranged from 2-26% and were 2-43% for fish >75 mm. Inferred cumulative exploitation rates for multiple ditches were high in some instances (e.g., 50% for fish >75 mm) and would likely impact the anadromous fish populations. The current anadromous screening program may be indispensable to protecting the fishery.
Tool = Mitigation for fish loss
Citations = DerHovanisian and Megargle 1998

Synopsis on nationwide management strategies in high mountain lakes

The synopsis compared nationwide strategies with Reg-2 high mountain lake management. The synopsis included regression equations for stocking densities from other states and recommended a base stocking rate of 200 or less fingerlings/acre until better Idaho models are developed.
Tool = Stocking guidelines; high mountain lake management
Citations = DerHovanisian 1997c

Wild Trout Investigations (Schill, Elle, Meyer, High – 1990-2004)

Statewide data summary

This research project summarized existing population and fishery data on fluvial wild trout populations in Idaho. Results included a series of “perspective histograms” that have provided managers with instant perspective for any new data from their streams in terms of growth, trout densities, stock structure, standing crop, natural mortality, angler effort, and catch rates. This summary has enabled managers to quickly answer the question “how is my stream doing compared to the rest of the state?”

Tool = Wild trout management perspective
Citations = Schill 1991

Potential stock structure and regulation modeling

This modeling exercise evaluated stream trout regulations. It was determined that slot limits will not protect populations if appreciable numbers of anglers keep fish under the limit. It appears that few do on any existing Idaho slot streams; therefore, the recommendation was to adopt a single slot limit (two at most) for statewide use in trout streams.
Tool = Trout stream regulation options
Citations = Schill 1992

Bull trout enumeration comparisons

Bull trout population estimates obtained by day and night snorkeling and electrofishing were compared. No statistical differences in densities were observed and the precision of the snorkeling estimates were comparable to electrofishing. At the temperature sampled, night snorkeling had no advantage over the two other methods, and it was recommended that biologists could use any of the three approaches.
Tool = Sampling guidelines
Citations = Schill 1991; Thurow and Schill 1996

Electrophoresis sampling guidelines

Some of the earliest genetic work by IDFG was a review of literature and contacts with expert geneticists to determine sample sizes needed to detect 1% hybridization with 95% confidence for Yellowstone and westslope cutthroat trout and rainbow trout. It was recommended that electrophoresis should only be used to detect hatchery introgression. Its use for locating "unique" populations can be misleading and should not be used in management decisions. Minimum levels of introgression that reduce performance of wild salmonid stocks were not available and estimates were deemed unlikely in the foreseeable future.
Tool = Genetic sampling guidelines
Citations = Schill 1991

Bait hooking mortality studies

Bait hooking mortality was assessed in a hatchery environment and a wild trout stream. Mortality was estimated at 16% for wild rainbow trout in a natural setting and cutting the line for deep-hooked trout reduced mortality by 58%. Surveys conducted on a variety of Idaho waters indicate that the incidence of deep-hooking and subsequent mortality may be overestimated by averaging studies in the literature. Bait fishing may be compatible with special-regulation fisheries in more situations in Idaho and elsewhere than has been previously believed. Eliminating bait restrictions in some Idaho fisheries may reduce future conflicts over special regulations and garner more public support for sound harvest practices.
Tool = Trout stream regulations options.
Citations = Schill 1992; Schill 1996b

Statewide bull trout data (1991)

This was a synopsis effort in anticipation of a long-term project focusing on bull trout. Bull trout densities in 1,400 separate sampling events in Idaho anadromous waters averaged 0.08 fish/100m^2. Bull trout were present only 26% of the time in waters with access. Densities were monitored continuously from 1985 to 1991 and have declined 3-fold at these sites since 1985. However, spawning escapement for nearby Rapid River during 1991 was the highest recorded since monitoring began in 1972.
Tool = Bull trout background summary

Citations = Schill 1992

Angler noncompliance studies

An assessment was made for noncompliance with angling regulations on three Idaho waters using random response. Illegal use of bait and creeling of fish in two catch-and-release zones was quite low, but creeling of undersized fish was more common (5-8%) in two nearby minimum size zones. Estimated noncompliance with barbless hook regulations was high, but 75% of these violations were accidental rather than deliberate. Based on creel data and MOCPOP modeling, hooking mortality appeared a more important source of westslope cutthroat trout mortality than illegal poaching in two northern Idaho streams.
Tool = Regulation compliance
Citations = Schill and Kline 1994, 1995

Big Wood River electrofishing injury study

Project personnel randomly sampled trout being collected by Region 4 management personnel with DC current at typical VVP settings during routine population monitoring. Results demonstrate that use of straight DC will minimize electrofishing injury rates. Given observed collection efficiencies and injury rates, negative effects on the Big Wood River population and other Idaho waters are mathematically impossible. IDFG biologists should continue using electrofishing as a sampling tool despite out-of-state interest in limiting its use. A decision tree was provided to all Idaho biologists that outlined optimum waveforms for minimizing injury.
Tool = Research brief; sampling guidelines
Citations = Schill 1994

Fluvial bull trout life history

From 1992-1995, radio telemetry was used to monitor bull trout movements in the Lower Salmon and Rapid rivers. Spawning was concentrated in headwater areas and coincided with declines in water temperature below 9-10°C in September, with rapid exodus from the spawning areas post spawning. Fish returned to the Salmon River by November to overwinter, and there was virtually no movement during the winter with remarkable site fidelity. Bull trout in Rapid River were consecutive year spawners and exhibited considerable growth following initial maturity at 4-5 years of age. Survival of bull trout during spawning migration (May to October) ranged from 33% in low water years to 75% in high water years. Angler exploitation of tagged bull trout during fall 1993 steelhead season was 17%. Implementation of statewide no-harvest regulations on January 1, 1994 precluded estimation of an annual rate, but based on the fall fishery, the annual rate could easily have exceeded 30% of the spawning run.
Tool = Bull trout life history
Citations = Elle et al. 1994; Elle 1995

Radio tag mortality impacts

During 1992, only 33% of upstream migrating bull trout with surgically implanted radio tags survived and left Rapid River, and sources of mortality for most instances was unclear. If tagging bull trout with radio tags resulted in elevated spawning and migratory mortality, a valuable research tool would likely not be available with impending ESA listing. Using both upstream and downstream weirs and both PIT tags and radio tags, we determined that the latter did not result in increased bull trout mortality during the spawning run from May to October. These results demonstrated that radio telemetry could be used to monitor spawning runs with little impact.
Tool = Sampling guidelines
Citations = Elle et al. 1994; Schill et al. 1994

Incidental catch of bull trout by steelhead trout anglers

A mail survey of steelhead trout anglers was conducted during spring and fall 1993 and found incidental catch of bull trout by 5.7% and 12.3% of steelhead trout permit holders, respectively. Of those who reported catching bull trout, most indicated they were targeting bull trout. Most anglers indicated they voluntarily release the smaller bull trout caught (<400 mm). Results of this survey were considered in development of statewide bull trout regulations, which were eventually adopted as no-harvest.

Tool = Regulation development
Citations = Elle et al. 1994; Elle 1995

Bull trout scale vs. otolith comparisons

To facilitate development of appropriate bull trout harvest regulations, the project evaluated age and growth of bull trout from three Salmon River drainages during 1993-1995. Comparison of scale and otolith ages yielded variable results between watersheds, indicating a need for watershed-specific aging studies to evaluate age composition. Scales generally provided underestimates of age compared to whole otoliths and sectioned otoliths. Therefore, use of scale ages in many drainages would result in overestimates of natural mortality rates and underestimates of special regulation benefits. If bull trout are delisted in the future and changes in the current No Harvest regulation are considered, use of whole or sectioned otoliths will likely be necessary to develop appropriate length restrictions.

Tool = Regulation development
Citations = Elle et al. 1994; Elle 1995

South Fork Payette River investigation

The study evaluated the fishery, wild trout populations, and the hatchery stocking program from Deadwood River to Grandjean campground during the 1992 angling season. Exploitation rates for wild rainbow trout <250 mm were approximately 20% for various stream segments. Estimated exploitation was less than 5% for larger trout (>250 mm) in the wild trout zone (2 fish bag) but 44% in the general regulation zone stocked with hatchery trout. Return-to-creel of stocked trout was 55%, well above the IDFG guideline of 40% for maintenance of stream stocking. Fifty-three percent of anglers interviewed during the entire season were unaware of the new wild trout regulation (2 fish bag) but most indicated they would not change the areas they fished as a result of the regulation changes.

Tool = Regulation evaluation
Citations = Elle 1993

Angler displacement/dropout resulting from wild trout (2 fish) bag limit

We conducted a statewide survey of anglers during 1994 to assess what displacement effect the wild trout bag limit (2 fish) created following implementation during 1992. The majority (58%) of respondents favored implementation of this regulation on some waters, with 29% opposed. Of the anglers who fished “wild trout” (2 fish bag) waters prior to regulation change, about one third were displaced. The remaining study results suffered from bias but strongly support building angler profiles before regulation change in order to evaluate impacts of changing regulations on angler participation.

Tool = Regulation evaluation
Citations = Elle 1995

Evaluation of bait allowed regulations in four Idaho streams

We evaluated the response of fish populations following implementation of restricted harvest regulations where bait was permitted as a terminal tackle option. Results indicate that fish populations generally increased under special harvest restrictions even with bait allowed.

Census results indicate that effort typically increased under restricted harvest regulation but that the proportion of bait anglers dropped significantly. A past goal of permitting bait in restricted harvest waters has been to increase public acceptance of harvest restrictions and displace fewer anglers. While implementation controversy may be reduced with these types of regulations, bait anglers appear eventually to voluntarily drop out of waters where restricted size and bag limits occur.
Tool = Regulation evaluation
Citations = Elle 1997

Statewide assessment of whirling disease presence/absence evaluation

During 1994, the presence of the parasite *Myxobolus cerebralis*, the causative agent in whirling disease, was associated with population declines in Colorado and Montana. We coordinated statewide sampling to determine the distribution of the parasite in Idaho waters as a first step to evaluate the impact on wild trout populations in Idaho. A total of 166 samples were collected statewide. The current whirling disease distribution is generally explained by transfers of live fish from one private and three state fish hatcheries. Infections were found in rainbow trout, westslope cutthroat trout, Yellowstone cutthroat trout, brook trout, and brown trout and for the first time, mountain whitefish.
Tool = Disease assessment
Citations = Elle 1997

Evaluate impacts of whirling disease on wild trout populations

We conducted population estimate and sentinel fry exposures to evaluate the impacts of whirling disease in wild trout stocks in seven Idaho drainages. Impacts of the parasite are variable in Idaho. Although headwaters of Loving Creek are confirmed positive, the parasite could not be found in multiple samples from Silver Creek. In the South Fork Snake and Big Wood rivers, no population declines have been detected despite being able to consistently find the parasite in samples of wild trout. In the South Fork Boise River, sentinel tests yielded moderate infection ranges and levels. Population data suggest low to possibly moderate impacts in the presence of the parasite in the South Fork Boise River. However, both population monitoring and sentinel tests in Big Lost and Teton rivers indicate high infection levels are probably resulting in depressed populations of rainbow trout and cutthroat trout.
Tool = Disease assessment
Citations = Elle 1998; Elle and Schill 1999

Evaluation of impacts of electrofishing injury at the population scale

This study projected potential electrofishing impacts of all IDFG sampling during 1995 and 1996 at the population scale in an effort to put electrofishing injury in perspective with natural population dynamics. Under assumed “worst case” mortality estimates assigned to fish collected with electricity, the population loss was estimated to be from .01 to 2.99% (mean = .49%). Only nine of 155 drainages had estimated mortality greater than 1%. Put in the context of annual natural mortality rates (typically 30-60%), we conclude electrofishing injury does not represent a major mortality threat to wild trout populations using methods currently employed by IDFG biologists. Methods for reducing electrofishing injury should be used at all times, but electrofishing should not be restricted as a sampling tool except under very rare conditions.
Tool = sampling guidelines
Citations = Schill and Beland 1995; Elle and Schill 1999

Healing rate of electrofishing induced hemorrhages

This study of electrofishing-induced muscle hemorrhages from both Direct Current and Pulsed Direct Current indicated that electrofishing-induced hemorrhages heal rapidly following

5-8 weeks post-injury. Although hemorrhages are readily observable, the long-term impacts to trout survival were near zero in our hatchery evaluation. We conclude that hemorrhages should not be equated with vertebrae damage in electrofishing injury evaluations and should be reported and considered separately. If future studies replicate these findings, hemorrhage rating should be discontinued.
Tool = Sampling guideline
Citations = Schill and Elle 2000

Electrofishing size selection

This effort summarized data from six past mark-recapture electrofishing surveys conducted by IDFG. Results revealed 3-4.5 fold difference in susceptibility to electrofishing gear for stream trout from 150 to 400 mm in length. Use of data uncorrected for this size selection will result in large underestimates in population size and overestimates in the proportion of large fish. Methods to easily avoid this bias are provided along with computer software.
Tool = Sampling guidelines; research brief
Citations = Schill 1994b (brief)

Yellowstone cutthroat trout status assessment from the 1980s to 1999/2000

With the help of numerous biologists from around the state who conducted Yellowstone cutthroat trout (YCT) population estimates in southeastern Idaho in the 1980s, we relocated the exact same reaches at 77 locations and assessed abundance and stock structure changes. Findings indicated that abundance of YCT greater than 10 cm did not change, averaging 41 fish/100 m of stream during the 1980s and 41 during 1999-2000. The proportion of the total catch of trout composed of YCT also did not change, averaging 82% in the 1980s and 78% in 1999-2000. Stock structure changed very little except at the Teton River sites, where there were fewer small YCT and more large YCT. The number of sites that contained rainbow trout or hybrids rose from 23 to 37, but the average proportion of the catch composed of rainbow trout and hybrids did not increase. Recommendations were to continue periodic monitoring of these same sites to track YCT trends and status.
Tool = Conservation assessment
Citations = Meyer et al. 2001; Meyer et al. 2003a

Evaluating Yellowstone cutthroat trout length and age-at-maturity

Length and age at sexual maturity and other demographic parameters were determined for Yellowstone cutthroat trout (YCT) from a variety of locations, from small headwater streams to large rivers. Most YCT (90%) were between ages 2 and 4, and <1% were older than age 7 (all from the South Fork Snake River). YCT 100-250 mm were much more likely to be mature if they were from resident rather than migratory populations. Male YCT almost always matured at a smaller size than females. Length-at-maturity models were developed to predict the length at which YCT mature at any given location, and these models have subsequently been used to estimate extinction risk assessment parameters for YCT, such as the number of breeders in individual populations or entire drainages.
Tool = Conservation assessment
Citations = Meyer et al. 2001; Meyer et al. 2003b

Westslope cutthroat trout status assessment

This study summarized existing population trend data for westslope cutthroat trout, used the trend data to estimate population growth rates, and combined these with various likely initial population sizes to assess generalized extinction risk for westslope cutthroat trout within select Idaho drainages. Results of trend analysis indicate that westslope cutthroat trout have maintained or increased their population abundance over a large area within Idaho during the

past 15-34 years. The total estimate of westslope cutthroat trout in Idaho was approximately 1.2 million fish. Westslope cutthroat trout within most GMUs had a high (≥95%) probability of persistence over 100 years, and this information was used in IDFG's response to ESA petitioning, which was denied.
Tool = Conservation assessment
Citations = Schill et al. 2004

Angler Behavior/Public Involvement Project (Schill – 1995-1999)

Barbed vs. barbless hooks: A social issue

This study summarized the results of all past studies evaluating the merits of barbless hooks. Only one of 11 past comparisons demonstrated any statistically significant benefits to barbless hooks. The study concluded that use of barbed or barbless hooks play no role in subsequent mortality of trout caught and released by anglers and that the decision to restrict barbed hooks is largely a social issue. Based on past research, 75% of barbless hook violations on catch-and-release waters are accidental and committed by largely compliant anglers. Managers proposing new special regulations should consider the social costs of implementing barbed hook restrictions that produce no demonstrable biological gain.
Tool = Regulation development
Citations = Schill and Scarpella 1997

Angler fish identification studies

In this study, biologists presented 670 upper Boise River anglers with mounts of five trout species and asked them to identify them. A strong majority of anglers could identify rainbow trout (82%) but less than 50% of the anglers identified the remaining species including brown trout, cutthroat trout, brook trout, and bull trout. The low identification rate for bull trout (30%) may be problematic in eventual bull trout recovery, but only 1% of all anglers had mistakenly harvested bull trout in the creel. The year following massive education efforts, included distribution of bull trout ID stickers, better on-stream signage, etc., anglers' ability to identify bull trout increased to 57%. Of the three education tools tested, road signs were by far the most effective method for improving angler knowledge of bull trout regulations and bull trout identification. Findings were similar in subsequent years in eastern Idaho cutthroat trout waters.
Tool = Regulation evaluation
Citations = Schill and Lamansky 1999; Schill et al. 2001a, 2001b; Lamansky et al. 2001a, 2001b

Lakes and Reservoirs (Teuscher, Butts – 1999-2003)

Use of hydroacoustic equipment to estimate population abundance and size structure

In this study, biologists over several years investigated the effectiveness of using horizontally- and vertically-aimed hydroacoustics to estimate and monitor abundance and size structure of fish populations in lake and reservoir systems. Conclusions were that hydroacoustics can provide a reasonable population estimate for an individual species in water bodies with complex species assemblages with a few caveats: 1) the target specie(s) must utilize pelagic habitats and not be limited to the benthic region; 2) biologists should have some understanding of the biology and behavior of the target specie(s); 3) intensive fish collection efforts are crucial to obtaining reliable estimates of species proportions, and the number of nets that are deployed should be based on the desired error bound for a proportion; 4) surveys that are repeated during different seasons are extremely helpful in determining the appropriate timing for the optimal population estimate; and 5) as with trend netting, every effort should be

made to conduct future surveys during the same seasonal or environmental period as previous surveys so that behavioral biases are minimized. Because costs can be very high, the benefits and value of a survey should be carefully evaluated before deciding to proceed.
Tool = Sampling guidelines; lake management; kokanee management; research brief
Citations = Butts and Teuscher 2002; Butts 2004, 2005

MANAGEMENT SUPPORT

Items in this section include items performed in pursuit of research objectives that could also be considered as basic fishery management tasks. These would include creel censuses conducted or funded in large part by various D-J research projects from 1988 to 2003 (Table 1). Also listed are a number of direct service tasks undertaken at the request of Fishery Managers or Bureau Staff.

Table 1. Creel surveys completed or funded by IDFG Dingell-Johnson research projects from 1988—2003.

System	Year	Project
Creel census (structured-season long)		
Little Wood Reservoir	1992	Put-and-grow evaluations
Magic Reservoir	1992	Put-and-grow evaluations
Rock Creek	1992	Hatchery trout
South Fork Payette River	1992	Wild trout
Little Wood River	1993	Put-and-grow evaluations
Magic Reservoir	1993	Put-and-grow evaluations
Little Wood Reservoir	1994	Put-and-grow evaluations
Magic Reservoir	1994	Put-and-grow evaluations
Big Wood River	1994	Hatchery trout
Trail Creek	1994	Hatchery trout
Warm Spring Creek	1994	Hatchery trout
Little Wood Reservoir	1995	Put-and-grow evaluations
Magic Reservoir	1995	Put-and-grow evaluations
Mormon Reservoir	1996	Put-and-grow evaluations
Roseworth Reservoir	1996	Put-and-grow evaluations
South Fork Snake River	1996	Wild trout
St. Joe River	1996	Angler behavior
Mormon Reservoir	1997	Put-and-grow evaluations
Roseworth Reservoir	1997	Put-and-grow evaluations
Big Wood River	1997	Wild trout
St. Joe River	1997	Angler behavior
Arrowrock Reservoir	1998	Angler behavior
Middle Fork Boise River	1998	Angler behavior
North Fork Boise River	1998	Angler behavior
Creel data analysis (from management data)		
St. Joe River (U of I data)	1992	Angler behavior
Twin Lakes	1992-94	Put-and-grow evaluations
Chesterfied Reservoir	1992-94	Put-and-grow evaluations
24-mile Reservoir	1992-94	Put-and-grow evaluations
Winder Reservoir	1992-94	Put-and-grow evaluations
Springfield Reservoir	1992-94	Put-and-grow evaluations

Management Assistance

- 1991 ESA whitepapers 4-5 month tasks (each)

  "Potential predation impacts from smallmouth bass and channel catfish on Chinook parr and smolts in the Lower Snake and Salmon rivers" (Dillon)

  "Potential predation impacts of hatchery rainbow trout on juvenile salmon in the Salmon River, Idaho" (Mauser)

  "Potential predation impacts of bull trout predation on wild/natural stocks of Idaho salmon" (Schill)

- Smallmouth bass bioenergetics modeling for Region 5 (Southeast) to describe growth potential in Blackfoot Reservoir. Also presented this information at public meetings (Dillon)

- Estimated for Region 6 (Upper Snake) total number of rainbow trout in Badger Creek (Schill)

- Consultation with Region 5 (Southeast) on adjusting Daniels Reservoir stocking rates (Dillon)

- Smallmouth bass modeling for proposed introduction to Palisades Reservoir for Region 6 (Upper Snake) staff (Dillon)

- Development of Usable Trout Habitat (UTH) model for Cascade Reservoir (Dillon)

- "Wild Bunch" MOCPOP modeling workshop (Schill and Rieman)

- MOCPOP/Management 101 workshops – Henrys Fork, Henrys Lake, South Fork Snake River (Schill)

- MOCPOP modeling of lake trout regulations for Priest Lake (Schill)

- Crack and burn and otolith section/aging of lake trout in Priest Lake (Schill)

- Otolith aging of Middle Fork Salmon cutthroat trout (Elle/Schill)

- Used food habits data to create seasonal fly-fishing guide for Daniels and 24-mile reservoirs – draft to Region 5 (Southeast) manager (Dillon)

- Otolith aging of Daniels Reservoir rainbow trout and training of Region 5 (Southeast) personnel (Schill/Elle)

- Produced multiple-species standard weight table and sent to most regions (Dillon)

- Daniels Reservoir modeling discussions with Region 5 (Southeast) staff (Schill/Dillon)

- St. Joe River MOCPOP modeling assistance (Schill)

- Williams Lake limnology review and brainstorm (Dillon)

- Provide information for lake trout bioenergetics modeling to Region 1 (Panhandle) staff (Teuscher)

- A graphic summary of statewide biomass estimates was completed as a "perspective histogram" to assist managers statewide in developing a frame of reference for biomass estimates (DerHovanisian)

- Marking of Palisades Creek cutthroat trout fry for future known age assessments by Region 6 (Upper Snake) staff (DerHovanisian)

- Consultation with Region 5 (southeast) on adjusting Chesterfield Reservoir stocking program (Teuscher)

- Technology transfer of surgical procedures for radio tag implants into body cavity of trout for radio telemetry studies in Regions 1, 2, 3, 4, 6 and 7 and Idaho Power Co. (Elle)

- Conducted 3 mark-recapture population estimates on Big Lost River in conjunction with management during 1996 and 1997 for comparison with historical data (Elle)

- Conducted 5 mark-recapture population estimates on Big Wood River during 1995, 1996 and 1997 to evaluate changes in regulations and whirling disease impacts (Elle)

- Training and gear support for radio tracking used on rainbow/cutthroat hybridization graduate research project on South Fork Snake River (Elle)

- Radio tagged and tracked 13 Arrowrock Reservoir bull trout for pilot study to test feasibility of radio telemetry methods for assessing reservoir movements of bull trout. Provided 13 used radio tags (Elle)

- Provided surgical tagging gear, telemetry equipment, training, collection manpower and 10 used tags for cutthroat transplanted from Middle Fork Salmon River to Valley Creek (Elle)

- Conducted kokanee population estimate in 2002 at Anderson Ranch Reservoir to estimate kokanee numbers following a fish kill to help determine whether stocking was warranted (Butts)

- Conducted hydroacoustic population estimates at Daniels Reservoir in 2002 and 2003 (Butts)

- Conducted water quality survey at Mormon Reservoir to assess available habitat to trout during ice-over in January 2003 (Butts)

- Conducted hydroacoustic population estimate at Williams Lake during fall 2003 and assessed vertical fish distribution in relation to dissolved oxygen during ice over in February 2004 (Butts)

- Conducted kokanee population estimates with hydroacoustics at Payette Lake during 2002, 2003, and 2004 to provide an estimate of the magnitude of the spawning escapement (Butts)

- Conducted hydroacoustic population estimates and intensive gillnetting at Cascade Reservoir during 2002, 2003, and 2004 to assess whether northern pikeminnow and largescale sucker removal efforts were working (Butts)

- Assisted management biologists in designing and implementing an area-under-the-curve estimate for estimating the size of the spawning escapement of kokanee in Deadwood Reservoir tributaries (Butts)

- Conducted bioenergetics estimates of kokanee consumption and growth in relation to food supply at Deadwood Reservoir in an attempt to approximate carrying capacity during summer in 2004 (Butts)

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