ID

spillway and turbine passage, (4) reduction of predation, (5) elimination of gas supersaturation from the migration route, and (6) maintenance of water resources and economic development in the Basin.

Annual Report
University of Idaho
Aquaculture Research Institute

Aquaculture has always been an important industry to Idaho's economy. In terms of "on–the–farm" meat production, aquaculture ranks fourth in the world. In Idaho, commercial aquaculture is the third largest animal agriculture industry, after beef and dairy cattle. Idaho produces about 75% of the farm–raised food trout in the United States, in addition to smaller quantities of other species such as catfish, tilapia and alligators. Income from the sale of Idaho–produced aquatic animal products, fish feeds, and aquafarm supplies and equipment is approximately $100 million annually.

The American Sportfishing Association's latest study found recreational fishermen contributed $108 billion to the US economy in 1996, including $38 billion in direct expenditures on trips and equipment. The economic output to Idaho was $465 million, including $280 million in direct expenditures. Anglers from within Idaho and from around the world flock to Idaho's world–renown trout streams every year. The sport fishing industry relies heavily on the ability of resident state and federal fish hatcheries to supply sufficient quantities of sport fish to supplement the wild fish populations. These activities, combined with activities designed to protect and restore populations of threatened and endangered aquatic species in the Columbia/Snake river system, comprise Idaho's very important conservation aquaculture industry.

The Aquaculture Research Institute (ARI) at the University of Idaho assists in the development and expansion of aquaculture statewide through research, education and outreach in the areas of both commercial and conservation aquaculture. The programs and studies underway at the University of Idaho in behalf of this valuable industry are exciting and innovative.

ARI Personnel

The ARI is fortunate to have a well–qualified and dedicated staff for its programs at both its campus in northern Idaho and at the Hagerman Fish Culture Experiment Station in southern Idaho. All staff work together to form a dynamic and effective team.

Aquaculture Research Institute, Moscow

Dr. Ernest L. Brannon, Director (Aquaculture and Conservation Fisheries); State Aquaculture Extension Specialist; Prof., Animal and Veterinary Sciences, College of Agriculture; Prof., Fish and Wildlife Resources, College of Forestry, Wildlife and Range Sciences

Paul Anders, Graduate Research Assistant (Ph.D.)

Gayle Bryngelson, Account Technician and Secretary

Matt Campbell, Scientific Aide (Fish Genetics)

Keya Collins, Sr. Research Technician (Water Quality) and Graduate Student (M.S.)

Joyce Faler, Sr. Scientific Aide (Fish Genetics)

Joel Green, Graduate Research Assistant (Ph.D.)

Bonnie Jacobsen, Educational Outreach Program Administrator and Sr. Administrative Assistant

Bill Johnson, Wet Lab Manager and Graduate Student (M.S.)

Dave Smith, Graduate Research Assistant (Ph.D.)

ARI Hagerman Fish Culture Experiment Station, Hagerman

Dr. Ronald W. Hardy, Director, HFCES and Assoc. Director, ARI (Fish Nutrition); Prof., Animal and Veterinary Sciences, College of Agriculture

Michael Casten, Hatchery and Facility Manager

Jana Cole, Sr. Secretary

Carol Hoffman, Scientific Aide (Fish Nutrition)
Dr. Madison Powell, Research Scientist (Fish Genetics)
Dr. Shozo Sugiura, Post Doctoral Fellow (Fish Nutrition)

Other Closely–Affiliated Personnel

Dr. Larisa Ford, Assistant Professor (Aquaculture and Fish Health); Dept. of Fish and Wildlife Resources; UI College of Forestry, Wildlife and Range Sciences
Gary Fornshell, Aquaculture Extension Educator and Assistant Professor; College of Agriculture Cooperative Extension Service; UI Twin Falls County Extension Office; Twin Falls, Idaho

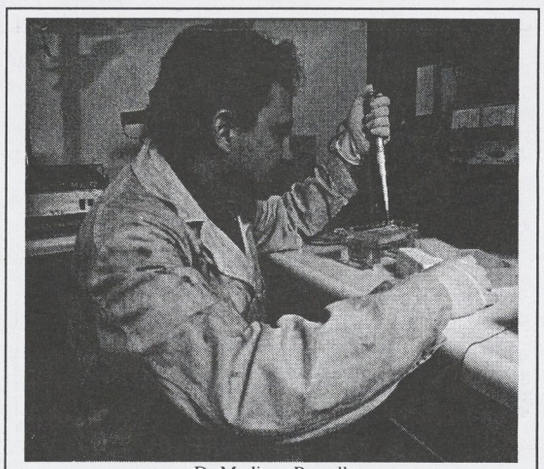
In addition to the above, UI faculty from various academic disciplines are involved in aquaculture–related activities. These disciplines include fish resources (fish health and physiology), agricultural economics (marketing aquaculture products), agricultural engineering (fish farm effluent technology), animal sciences (fish nutrition and growth physiology), and biological sciences (reproductive fish physiology).

Research

The Center for Salmonid and Freshwater Species at Risk. The great abundance of natural resources along the Pacific Coast of North America that attracted the early pioneers, is the foundation of economic prosperity in the West. However, as rivers were harnessed and forests cut, it became apparent that such exploitation also destroyed the habitat so critical to Pacific salmonid species. New pioneers of the west are the scientists that are restoring the salmonid legacy using a "Common Ground" approach, referred to as such because a healthy environment is common to both our economic development and recovery of our renewable resources. We can have both, and coming together through science is the key to achieving such a goal.

The Center for Salmonid and Freshwater Species at Risk was established by the University of Idaho with an EPSCoR grant from the National Science Foundation to provide essential information on genetics, life history, and recovery measures of salmonid and other aquatic species that were facing risk of extinction. Some of the only remaining native fish species in the Columbia River basin are in the upstream habitats; including Snake River chinook salmon, Snake River sockeye salmon, and Kootenai River white sturgeon. The interior lands east of the Cascade mountains are also central to other affected species in the Pacific Northwest, including bull trout and cutthroat trout. The objectives of the Center are:

- to genetically identify stocks of fish and aquatic species at risk of endangerment;
- to preserve genetic diversity;
- to provide new aquaculture and habitat supplementation technology, including captive broodstock;
- to provide a germ plasm repository for fish species; and
- to develop water quality assessment and mediation measures to meet the objective of the Endangered Species Act (ESA) process with minimum negative impacts on other resource use.


Dr Madison Powell

A methodical and independent approach is necessary in the ESA process to recognize the equitable interests of the public in protecting species at risk of extinction, assure that species are appropriately identified, and ensure that recovery efforts maximize the capability of the environment available.

theme

Public Lands and Native Fish

40 yrs review - Public Laws - re- TU efforts
progress & my 1st 40 yrs +
changing times

- A tu.-w-NW hdwtr
- B-mgmt

- 1957 UCB - Nev. - AK - wild & esp. cutt. - wtrs to Colorado exhibit
fed-st
- Mgt. agencies. - No interest - not great ests - native sp. bi-d vs.
ecosyst. mgt. (what is?) - because exhibit -
AFS meeting L.V. - native trout/ meet in phone booth
1997 - Monterey: - - - great effort - st & fed law - E.S.A.
- 1959 S. Griffith: saw Au Sable R. --- goals-purpose-
wild Trout vs. hatch. (catchable trout) - Griffith - on F&G Comm.
many years frustrated -- his home water. - 8.9 mil - Holy water-
manage wild trout w/ spec. reg. - hatchery craze - Fish. Div.
completely controlled by fish culturists - no bad/good - self interest - Fish. Res.
Inst. (U.Mich) - habitat - lakes & streams - USFS CCC guidelines -
- Mich streams - (Clark) - He's dangerous! --- 1963 Republican Romney
- 12,000/m. - blue ribbon panel - meetings - recom. change - Governor Romney
- Great change / Au Sable not stocked - Mich. trout - no cats or rbw
but - Grt. Lks. ≠ hatch. much longer than 40 yrs ago. - but
- put-grow - returns good - economics. i.e. not anti hatch. -
not anti catch. (all or nothing) but moderation - how much ?
Einstein total fish budget - catch. - how much anglin supported - value ??
- TU - 40 yrs. -- give figures - shocking - ! - TU failed? -
- Whew great success - re. restoring public laws, - environment.
30-40 yrs - When I started west for native trout found - horrible cattle waters
USFS - BLM (Sept Nov!
- livestock overgrazing most obnoxious prob. - ! why? - fed land.
intellectual heritage - long history of human use - environment - utilitarian commodities
- landscape - trees = dominant for GNP - grasses, forbs = livestock - red meat -
Don Yates anti diversion - underground - minerals to mine - water for irrigation - Single use
good/bad/official/ - cost/agency focused on max. return - Trees Boat ft timber
(sp. - bad, worthless, - AUMs, acres irrigated esp., - F&G - raise more/more fish to stock
we know everything) - Natural processes - sustainable use - ramifications. how-

Not considered - Colleges - target foresters, range mgrs, hydrologists, fish+game = No holistic integration for

~~[illegible]~~

Sierra Sportsman: 1932 2 h P.2. 192
1998 last. 11 fish 239 lb. 39 in -

What happened? Bur Rec. 1902 - green ~~[illegible]~~ avoid want
(take all ~~[illegible]~~ possible out of rivers - put on land -)

* Derby Dam 1905 Newlands Proj. - Comm. Francis Newlands -
6 000 ac 10,000 acres/socks
Tot ~~[illegible]~~ re. Pyramid L. its Trout - (Paiute Indian Rec.) - concern re
(Ecosyst-mgr.)
multiple use - water for irrigation - water for fish - riparian, wild. ~~[illegible]~~
classic, narrow utilitarian view)
(+ Paiute tribe) - - " Pyramid L. exists only to satisfy the thirsting sun". - Also " Fish (no Indians) don't vote" -

~~[illegible]~~ J.O. Snyder 1911-13 Lahontan basin fisher - most complete data on Pyramid Lake fish - Humboldt R. cutth dam part cutin (Maggie Cr. - Susie Creek - 1860s - comment)

(Per public attitude segment gov. Newspaper petitions successful w/o. - start to - Taylor Canyon - guns - but stop casting, hitting clinic - take gun - canyon-free zone People - gun users)

~~[illegible]~~ Aware Bur Rec. - Truckee R. - Pyramid L. -
U.S. Bur ~~[illegible]~~ 1917

Any consideration of ~~[illegible]~~ methods for propagating & protection of fish must begin and end with the assumptions that agricultural and manufacturing interests are of paramount importance. A considerable and constantly increasing amount of flowing water must be used first for power and then for irrigation, and when any measure intended for the protection of fishes is found seriously interfere with workings of power plant or demands of agr. - it will have to be abandoned" - only stating fact of the reason of time.

- No fed regulation ~~[illegible]~~ B.R. - no multiple use mandate - no E.M.
CV - log time - jump ahead 1960 - Mul.U.S.Y.A. Congress " The N.R. found on Nat'l + Fed. Forests, shall be managed without impairment of the productivity of the land with consideration being given to the relative value of the productivity of the land, with consideration given to the relative values of the various resources and not necessarily the uses that give greatest dollar returns or the greatest unit output

early imply E.M. ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~ ~~[illegible]~~

vague, but - 1966 USDA-FS, SCS - Humboldt. phreatophytes beneficial - now [illegible] inc. -

1969 NEPA, 1973 ESA 1956 FERC

1959 Inland Trout 1957 AFS 1997 AFS
TU 1997 40 yrs. Conn. Dept

my start 1957 - Nev. - Lahontan cutthroat - extinct 1941 - we now do trout - Between Cats

40 yr. Evolution of me and TU - how changed -

1959 - Wild vs. Hatchery trout specifically focus on 9 mi. section of Au Sable

wild means wild native not Grayling MI - hatchery by stocking domestic catchable fat ensure wild

self-sustaining w/ spec. regs. ? - Geo. Griffith - a large Conservation engineer

specialist vs. generalist - bankers for fly fisher, no kill, - that's it! -

T.U. politics now - ecol. - but first pres. Casey Westell - TU will not endorse

solve any issue not supported by sci. evidence

How has TU done 40 yr - how have it done.

- catchable vs. wild trout - TU - 1963 - Blue Ribbon Panel - Gov. - politics

TU agenda stated hatch. Done away - but - - -

- Come back to your program on catchable - but - legislation - use - reject. or

- ex. Coldwater conservation - wild trout habitat.

wild vs. native trout

1966 - USDA Forest Serv. - SCS - . Phreatophyte control - environmental disaster

- 1960 - Multiple Use - Sustained yield Act - USDA - Forest Serv.

- basis for law suit - TU coalition.

- history - big time : Roosevelt - Pinchot - 1904 Detroit Rec. -

Allotments - Nev. - sustained use - not overgrazing -

1972 Chamber of Comm. SCS

- Conservation ethic - greatest good - greatest no, longest time - sustained

Aldo Leopold but - 'good' - strictly narrow interp. - good, value - both versus

how nature viewed. put on need - reduction

Fed 1986 Thus pid. of acre-ft. water for beneficial use

costs : - bank stability - channels - wildlife - wetland riparian - agencies single purp.

Bur Rec, 1902

down track

- inertia to change - legal action ...

- Pyramid L. - - - why save native - -

- values : inherent intrinsic - vs. instrumental economic -

Bergat - spec. adapt. - 830 - day trout - Humboldt cut - 80 - Whitehorse 80

- slides : - -

- Catchable fat 1949 - 1980 - 1986 - Colorado R.

Nev. 1958 - Lahontan

- elitist - Hafthorn -

USDA Humboldt
- SCS 1935

1964 Phreatophyte control - willow, cottonwood, transpire-
riparian, wetlands

vegetation beneficial - non beneficial

grasses forbs forage for livestock

riparian wetlands forest - watershed

1 acre = 43,560 sq ft

narrow
- utilitarian values nature

- bot. transpiration

Rocky Mt. - Nelson Colo
Little Snake Colorado

Pinchot Conserv. - sustainability - but

sp. - beneficial, valuable commercial; forage sport.

- vermin pred. - bounty bears, wolves, mtn lion

Swing
political environ

force public
TU - Dev - legislation - could reverse mandate to restore nat. re-
correct

USDA Nov. 1966 - USDA - SCS, US FS;
+ Nev Dept. Conservation and Natural Resource
Univ. Nev Coll. Agr.

Large-scale cattle - sheep ranching Nev. 1862 - year-round - open range
public lands - damage very early - 1904 US FS (Gen. Reserves)
Pinchot & Roosevelt 1906 - new Humboldt N.F. - 1907 (Toiyabe N.F.)
1908 - Toiyabe
allotment mgt - set-up (boss USFS) - 1910 - Pinchot - out - ranchers free of
Czar Pinchot tyranny
BLM - (Grazing Service) - 1934 Taylor Grazing Act
allotments - but - - - -

livestock
TU
E.S.A.
legal action

S-S Sustained yield Multiple Use Act 1960 1973 E.S.A. 1969 NEPA EIS EA

Berkeley 58-59 - Conservation Club - CFS logging devastation - worth/value - Zivnuska -

SCS channelz.

focus on single use

green and west
1902 US Bur. Rec. - First Proj. - Newlands - Truckee - Pyramid 1905 - Derby Dam
first director Francis Newlands - Pyramid L. exists only to
satisfy the thirsting sun" "Fish (and Indians) don't vote"

Technol. fixes - hatcheries.

golden Trout

Counsel - n

(310) 522 1877

TU Reno

history - learn fm. - Einstein - Santayana - -
- mr. career

1959 - 1999 1957 (1960s - ex. progress note T.U.

rhetoric to research - change - cutthroat trout 1952 meetings in phone booth

- Fed. Laws - 10 - FEPA ESA - - -
now -

- Pinchot conservation
1964 - Humboldt. phreatophyte good, bad - ecosystem mgt

stream destruction
1970: S.C.S. - NEA - Symp. - S.D.S. venue - Tuscarora p

(environmental coalitions - common cause - more clout, influence)

Pyramids: 1932 Sierra Sports
1957 42nd - native cutts trees -
40th anniv. - Role TU - commonality + wild trout vs. hatchery

but Au Sable non native Brn Bn AB - vs. demonstrate catch. / re. wild / native -

2 bn. 1925 & trout
- history past vs. history - do we learn - can't rule trade in - - over forgets doomed to repeat errors.

- perception of nature - biodiversity - new - End. Sp. A

235 lb.
5 22. - 40 yrs. - Nat. - Ecosyst. mgt -
39 lb.

Teddy Roosevelt
better how let go. - Conservation. Pinchot - sustainability . greatest good, greatest no. longest tr

1904 For. Res - open range 1910 - A
- obvious clash w/ special interest - USFS - allotments - $ sheep -
good intentions - corrupted

- agencies Bur Rec. / CE / BPA irrig. - focus on c.

commodities: sp. of plants, anim - valuable - Venison
good timber bad - pred. control bounties

- fed legislation -

log time - 1957 -

USDA 1964 Humboldt Rep.
FS - FSCS

- BLM

- SCS - 1972 symp. ... - environmental coalitions.
Scott da... - chronology legal action ...

change TU rhetoric - research

ST. agencies - catchable trout

socialistic - coal miners cost/benefit govt. sc. subsidies
livestock, timber roads, mining - but west. congressmen advocacy
fiscal conserv. until govt. welfare.

T.O.
- same w/ catch. Idaho. 2.2 mil 1983 > 3 mil 99

control - million: greatest
- 1959 - TV great ways - greatest work - not because "sound science"

workers, children, elderly blue collar vs. yuppie
wealth dilletante
Elitism - fly fishers.
constituency vs $

Inland.

T U . 40 yrs 1939 ← inland nothing there cott. redbud 1957 -

my 42nd. - 1957 - Newsl. cotts extinct

Pyramid L. 1920s

Sierra spotted owl

11 pairs 233 sq mi x 22 = 5126 sq mi

41 - 60 lbs. trail lbs/sq mi

Brim

T U

T.V.

1938 only Klow go extinct - - - later paradigm -

original discard pilot pool 1979 - 20 yrs. 12g rime -

- very practical reason for doing -

T U changes - flow

= 1957 + coil ht (ecotech - dust-tolerance vs. Au Sable R.

- - - grow potent material consend. angle

rhetoric - reasoned

- monoloses

- follows why T U, impl. - court cases flowing not rhetoric over goal

T.V. Then

A75 97 - monterey bay symp. inland cott - 1957 - cold in phone box

- hetchhetchy Yosemite - Treat with. - - pulp mag

- Wallop Breaux -

1958 Needham - Leopold Rec. Comm. Survey

options for future - too many catchable stocked - great waste

conclusions

- S. Fk. Trinity - Bird Cr - Ten

- Trinity Ridge City - seaside rec - Mattole - Eel - Single - Johnson, Wallop Breaux -

T U intro why George Gorby Comm. - 1950 - clear. - habitat will be surv

1982 - 2.4 cost/hr 1984 2.8

widnor ? spotlight - dangerous man

- True story - Repub. party contact.

Socialist labor union children old

- elitism - poor, disable - under a relf interest

chamber commerce

1970 - Middle R. - 15-20% -

Provincialism - fly fishy - no kill - barbless hk

warm - vibrant - unanimously received.

expand

equally

colorful

environ

- Casey Cecil - first rec. = Sci. Adv. Bd. -

1963 - Romney - Blue Ribbon Comm. - evolve

essentially T U plan - dampen habit. use

T U not supported any register not based on sci. evidence.

Catchable Trout : 21st Cent.

N.H. Etc.

— I grew up CT - only hatchery trout - wild??

— Why? 1853 Garlick 1855 . . . Ill. Technique, Techol-fix, improve on nature — USFC 1872-73 — — —

States — hatch / wardens — — — public

— Capital Investment. — advocacy — legislator · employees

— or coal miner union by Legislature court — —

— Planning .. 5–10 yrs. — → project design → supply

built-in expand Internal review, plan — don't address calculus —

— Costs - benefit - economics vs. accounting — —

standards? — — — a 3/4.

— Not anti hatch — pro hatch — Catchable $ - space here

more effective use . .

— like slide down grassed board · more efficient/cheaper,

— politicians advertising chamber commerce P.R. - attribute, prefer, - fishing vs. wishing — CA prefer Rail, Boyce

Wallop-Breaux

— ID experim. 6–7/yr MA/CT 1356 - 57 Built 100,000 lb. limit - like concern

— restoration" >300, -521,000 lb

— Mission of concern. agency — prevent, protect, enhance

long term investment for future? — — catch . .

— license sales, catch — CA inverse, neg. —

— has Vega, $15/lb. — . . <10% >50?

— Polarized, ID - youth in drugs & crime. Demonize, Demean, Solidify — play into by

— Econom. MT Madison wild - resist #30 vs 1568 - 1990 - >50% non resident -74% Minnesota Min. Canada vs 43 St. - Manitou Fk.

SAVING CALIFORNIA STEELHEAD

Herb Joseph, M.D.

*Herb Joseph first wrote in these pages in January 1992 (Issue No. 14). At that time he had been "(chasing) steelhead from California to Alaska for 40 years." A retired dermatologist, Herb was a founding governor of Cal Trout and chairman of that organization's steelhead committee. In this (his third) article Herb continues his vigorous crusade to contest his state's prioritizing of money and manpower to steelhead habitat restoration at the expense of developing baseline data for existing wild populations and conserving what already is working. Readers can refer to California F & G biologist Dennis McEwan (*The Osprey, *Issue No. 28, November 1996) to see how these two authorities differ in their approaches to saving California steelhead.*

"**T**here are hundreds of fishery and watershed restoration projects either completed or now underway in California. In fact, the State of California expended over $60 million for stream and fishery restoration from 1981 to 1996. Recent legislation, SB 271, allocates an additional $43 million over a six year period. Additionally, the Governor's 98-99 budget proposes significant bond funds to support watershed efforts State-wide." So states The California Department of Fish and Game in its February 4, 1998 Strategic Plan for Management of Northern California Steelhead Trout:

What have the $60 million done, over those 15 years, for steelhead and coho? After an extended search, not a single stream restoration project has been discovered from which it can be conclusively documented that a substantial, sustained wild (naturally spawned) steelhead run has been restored. No previous runs have been re-established or shown to return as a result of one of these projects. This observation has been verified by distinguished fishery biology professors from two universities.

Since 1981, California's coho have become practically extinct.

In response to a letter of inquiry to the chief of DF&G's Inland Fishery Division, he writes, on December 5, 1997, "It is not possible to state the overall effect, or even the specific individual restoration projects on steelhead populations given currently available information and staffing levels. Many factors affect steelhead populations, both in fresh water and in the ocean. There is no simple answer, much as we might wish it. We continue to believe that restoration of instream habitats and watersheds cannot but help to restore steelhead numbers."

Coho salmon, since 1981 and under DF&G management, for all practical purposes have disappeared from California. Are the Golden State's wild steelhead headed in the same direction? Without adequate data it is not possible to know. Many of us believe they are, but steelhead differ from coho in many ways. Coho were subjected to intense commercial harvesting in addition to severe habitat losses. Coho are more vulnerable and sensitive, die after spawning, and have a different life cycle. Steelhead are tough, resilient, tolerate harsher conditions, do not all die after spawning, and have not been subjected to widespread commercial fishing. Repeat spawning and straying helps preserve steelhead runs which otherwise would be lost. Straying averts inbreeding, which, if prolonged, weakens the stock.

"Every possible effort must be made to avoid further habitat loss."

In his article on Kamchatka steelhead (Issue 31 of *The Osprey*, March 1998) Mark Chilcote emphasized the importance of repeat spawners. More than twenty years ago 38 percent of Gualala steelhead were found to be repeat spawners — a much higher percentage than usual. These numbers were obtained by scale readings from large fish, and it is noteworthy that the large, early run Gualala steelhead now appear to have been lost. Many other steelhead runs have been lost as their gene pools disappear.

Here, at the southern extreme of their range, as with their Kamchatka cousins, repeat spawners are important for preserving gene pools under difficult conditions. Some California steelhead still manage to survive extremely harsh, inhospitable environments. Magically, their existence hangs by a thread.

Ocean commercial harvesting was a factor in the coho's demise. Steelhead also are commercially harvested at sea, but the numbers are not known. However, there are recent reports that El Nino depleted the food chain from plankton upward through anchovies and sardines, so a negative impact can be expected on anadromous salmonids, including steelhead.

Why are the coho gone? Destruction of gene pools of individual stocks and substocks is the basic reason. After at least one completely non-productive life cycle (average 4 years for steelhead, 3 for coho) a stock or sub-stock is extinct. Each spawning pair must produce another pair in order for that run to remain viable. During the recent seven-year drought, in addition to habitat losses from logging, water diversions and development, many runs of steelhead were lost, and it is not surprising that coho are practically gone. Wild steelhead are an indicator species for the health of an ecosystem encompassing both sea and land. The prognosis is not good.

Restoring habitat has not been shown to restore wild steelhead that previously utilized the habitat. Once its gene pools are destroyed, that stock of fish is extinct and cannot be brought back. This principle applies to all species.

What are the solutions? For starters:

1. Stream-by-stream, tributary-by-tributary, baseline inventories of fish populations and habitat: There must be *identification* of each stream's several genetically diverse stock and sub-stocks with acknowledgment of the special, genetic basis of spawning behavior such as timing and the selection of each special spawning habitat. Modern technologic methods for accurate determination of fish populations and genetic variations are readily available. Populations can be calculated from direct and underwater observations, tagging and recapture, creel census, punch cards, redd counts, electrofishing, weirs and electronic devices. Genetic varieties can be separated by combinations of physical characteristics, behavior patterns (e.g. repeat spawning), and by laboratory procedures such as DNA testing, electrophoresis, and chromosome studies.

2. Focus on conservation of existing, established, viable runs of wild steelhead and of their identified habitat: Restoration projects have failed, and time is running out on remaining runs of wild steelhead. Known spawning and rearing habitat can be improved, but first pre- and post-project population counts will be needed. Every possible effort must be made to avoid further habitat

The reverse side of this sheet concerns a $100 million "stream and fisheries restoration" program in California. Herb Joseph (has been active member of California Trout) called me last year, inquiring if I knew of any example where this program of stream restoration (after spending $60 mil.) has been documented to result in restoration or enhancement of a steelhead or salmon run. I had participated in some of the annual conferences in California where these projects are discussed. I checked some of the procedings that predicted great success, but no one, to my knowledge, ever presented "before and after" type of data to document successes and failures.

This prompted his letter to Tim Farley, Chief of CF&G Inland Fish. Div., who responded That due to "staffing levels" no information is available. Considering a $100 million program of stream and fisheries restoration, and its potential for good if properly conducted, should not "staffing levels" for such an apparently high priority program be ranked higher than catchable trout for put-and-take fisheries? How would business people view the trade offs between short term investments that lose money vs. a long term investment of great potential (if recognized as such)?

Robert Behnke

Catchable Trout: Are Anglers Getting Their Money's Worth?

PUT-AND-TAKE FISHERIES ARE TO ANGLING WHAT PROSTITUTION IS to love. This opinion was expressed by environmental author Mark Sagoff in a 1991 essay, "On Making Nature Safe For Biotechnology." The analogies between prostitution and catchable trout and between love and wild trout have some obvious implications for both moral and economic values. No matter how much one may agree with Sagoff's sentiments, however, the controversy over catchable trout vs. wild trout — where to place the emphasis in fisheries programs — will not be determined on moral or ethical grounds. Prostitution is not known as the world's oldest profession because of lack of demand.

How does one respond to the charge that elitist fly fishers want to impose their standards of angling ethics and morality on the general public and do away with catchable trout stocking thereby depriving the poor common man, the children, the old, and the physically challenged of the opportunity to catch fish?

For many years, I have attempted to respond to this myth ("From Hatcheries to Habitat? Look Again," Autumn 1991 *Trout*). During the past year I published a paper with natural resource economists on the economics of catchable trout and participated in a review of an assessment of the California Department of Fish and Game hatchery system. I now have more detailed information and data to address certain key issues of the wild trout-catchable trout debate that have not, heretofore, been adequately considered or were misunderstood.

My major goal is to demonstrate the need for examination of the role of catchable trout in government hatchery programs and in overall fisheries programs into the 21st century. My presentation should not be construed as anti-hatchery. Hatcheries are indeed necessary to create and maintain salmonid fisheries in lakes, reservoirs, tailwaters, and other waters where natural reproduction is lacking or inadequate. My contention is that this vital aspect of hatcheries could achieve much greater success if emphasis were to be shifted from catchable trout as the dominant hatchery product.

My focus is on inland fisheries which omits anadromous fisheries and the fisheries of the Great Lakes. I use my critique of the California hatchery program as a basic outline to address such questions as:

- What proportion of the total fishery budget is devoted to hatcheries and, what proportion of the hatchery budget is devoted to catchable trout production?
- How important are catchable trout in the overall fishery? That is, what proportion of total angling recreation (angler days per year) is "dependent on," "attributable to," or "resulting from" stocking catchable trout?
- What is the economic value of an angler day and how much can catchable trout contribute to this value?

Reforming catchable trout programs requires exposing some long held

myths, fallacies, and misconceptions. This concerns mainly issues of economics, equity, and better fisheries management. Ethics and morality, and elitists vs. the common man are really not issues.

The annual inland fisheries budget of California Fish and Game is about $48 million, of which, $19 million (40 percent) is consumed by the hatchery program. Although California Fish and Game administrators claim that "direct" hatchery costs are only about half this amount, if one uses true economic evaluation (which includes administrative overhead, other support services, and capital replacement (depreciation amortization)), the true economic costs of hatcheries are at least twice what is claimed by selective cost accounting.

Thus, for the California study, a "true estimate" of the cost to produce catchable trout came to about $3 per pound — about 4.5-5 million pounds could be produced for about $15 million, or 30 percent of the total inland fisheries budget. Of all hatchery production, by weight, of all fishes in California state hatcheries, catchable trout production makes up 97 percent of the total! The other 3 percent consists mainly of fingerling trout and kokanee salmon planted in lakes and reservoirs for put-and-grow fisheries which can be very effective in cost-benefit comparison of pounds stocked vs. pounds caught — the type of fisheries typically highlighted to demonstrate the benefits and need for hatcheries. Indeed, this 3 percent by weight of fingerling production probably accounts for more angler days than does the 97 percent.

Wild trout and threatened native trout programs have received about 1 to 2 percent of the total annual inland fisheries budget over the past several years. Is this the proper "balance" we often hear of when the catchable-wild trout debate is raised?

Is the catchable program a good bargain for California anglers? Are they getting their money's worth? How are the benefits distributed? California stocks about 9 million catchable trout per year. Let us make a best case scenario and stock 10 million catchables with a 60 percent return to the creel (=6 million fish caught). It is claimed that in California, the average catch is three per angler day in put-and-take catchable fisheries. This catch would be equal to two million angler days. The total annual number of inland fishing days is estimated to be 30 million. According to the above calculations, the catchable trout program supports two million of the 30 million days or about 7 percent. Even if 10 percent, is it fair to devote 30 percent of the total budget for this 10 percent of angling use? In regard to equitable distribution, a California study on catchable trout fisheries found that less than 10 percent of the anglers fishing for catchable trout caught more than 50 percent of all catchables that were caught. The highly subsidized catchable trout specialist is the real elitist in regard to monopoly of benefits. If the catchable program in California were put in proper perspective and costs contained to devote to other management and research programs, would most anglers benefit? According to 1991 data, about 70 percent of inland angling in California was devoted to nonsalmonid fishes. Are these anglers getting their money's worth from the catchable program?

It is the romance and the mystique of wild trout fishing that accounts for most of the trip's value, not the number of fish caught.

Commonly, greatly inflated numbers of angler days and economic values are attributed to catchable stocking. For example, catchables are stocked in lakes and reservoirs where other species of game fish such as bass, walleye, and panfishes are dominant, but all the angler days are attributed to catchable stocking. In the 1994 proceedings of the symposium, "Wild Trout and Planted Trout: Balancing the Scale" (the cover of the proceedings shows a scale — wild trout on one side and planted trout on the other — perfectly balanced), one can read that in the northeast region of Colorado "...84 percent of the total recreation days result from the stocking of hatchery-reared trout, primarily catchable rainbow trout." This catchable trout success story goes on to tell how many millions of angler days generating hundreds of millions of dollars in economic benefits "result from," are "dependent on," or "attributed to" stocking catchable trout. I don't doubt that the zealous pushers of the catchable agenda believe what they claim, but it simply ain't so. If we dig below the dazzling display of benefits "resulting" from catchable stocking and dissect the assumptions made, fallacies become apparent.

The basic questions concern: Why do we go fishing? Why do we spend the money we do on the sport? Study after study, for many years, has looked into the question: What motivates people to go fishing? All studies agree that the main motivations cited by anglers are attributes as beauty, solitude, getting away, relaxation, adventure, mental health, and so on. The fish themselves and the number caught consistently receive the lowest score in the scale of values that make up an angler day of recreation. The differential economic values between wild trout and catchable trout and the relatively low monetary value of the fish themselves is apparent when considering what motivates an angler to spend thousands of dollars on a trip to New Zealand, Argentina, or Chile. They are not attracted by stocked trout. The economic value of an angler day of a long distance trip compared to the number of fish caught makes clear that it is the romance and the mystique of wild trout fishing that accounts for most of the trip's value, not the number of fish caught.

I became interested in attempting to better quantify the value of the number of fish caught during an angler day of recreation and this led to a publication, coauthored with three economists, on the economic benefits of catchable trout. The results of studies on two rivers in Colorado were presented. Both rivers had good populations of wild trout and also were stocked with catchables. Anglers were asked what they would be willing to

pay to catch an additional trout. For example, if an angler caught three wild trout and his total catch could be increased to five by adding two catchable trout, what would the fourth and fifth fish be worth (willingness to pay or contingent valuation of marginal values)?

In both studies, adding a fourth or fifth trout in the day's catch were valued at less than one dollar each. In one river, with an abundant wild brown trout population, creel census revealed that only 29 percent of the catchables stocked were taken by anglers. This resulted in a cost of over $3 for each catchable caught, while the anglers were valuing them at less than $1. If it were assumed that an angler day has an economic value of $50 and an angler caught two catchable trout, it might be further assumed that even if these two trout cost $6, they "created" $50 in economic benefits resulting in a highly favorable cost-benefit ratio. By understanding the human motivations of why we go fishing and using contingent valuation to get at the value to the angler of additional fish in the day's catch, we can put the true contribution of catchable trout to economic benefits in its proper perspective.

The fallacy of a dependency between catchable trout stocking and angler use is also evident in California statistics. From about 1965 to 1980, an average of slightly more than two million licenses were sold each year for inland angling. In the 1980s a sharp decline in license sales occurred — from about 10 percent to 5 percent of the state's population who purchased inland fishing licenses. Yet during these two periods, catchable trout production increased from about 3.5 million pounds per year (pre 1978) to about 4.5 million pounds per year (late 1980s, early 1990s). This should not be surprising in view of the relatively minor contribution catchables make to all sport fishing in California and in relation to angler motivation.

It would seem obvious that the balance of the scale measuring relative values of wild trout and catchable trout is in need of recalibration. Opinions similar to mine are found in a Report of the National Fish Hatchery Review Panel to the Director of the U.S. Fish and Wildlife Service (December, 1994). The panel concluded that because 80 percent of the total fisheries resource budget of the Fish and Wildlife Service is consumed by hatcheries (the largest hatchery system in the world), there are insufficient funds to initiate new and needed studies for true resource management. The real resources are being shortchanged.

One hopes that intelligent, rational dialogue and critical, true economic evaluations will be made on catchable trout programs and their role in overall fisheries management as opposed to the emotional rhetoric often used in defense or promotion of what has come to be viewed as an "entitlement" program (creel insurance).

I hope I can make a contribution to the cause. If I have some success, I acknowledge some predecessors who have oriented my thinking on the matter. The late Paul Needham of the University of California began the Sagehen Creek trout research project 45 years ago to demonstrate the considerable amount of angling and angler satisfaction that could be generated by wild trout in good habitat. Phil Pister, retired California Fish and Game biologist, made the true transition from Aldo Leopold's type A (perceives nature as commodities) to type B (as something more, much more) biologist, and has been an inspiration for a new generation of fisheries biologists.

Despite the examples and influence of Paul Needham and Phil Pister, the California catchable trout juggernaut rolls on, constantly expanding in the belief that it represents a mandate from anglers. It just ain't so. ■

Editor's Note: Beginning in 1996, Trout Unlimited will be conducting a national coldwater fish hatchery assessment funded by the Coldwater Conservation Fund. The study will examine the biological and economic impacts associated with fish hatchery production and stocking.

The Orvis Company has established a $30,000 matching-funds drive in which your donation will be doubled to support this important effort.

To contribute to Orvis' generous campaign, call 1-800-333-1550 or write: Trout Unlimited/Hatchery Review, c/o The Orvis Company, Route 7A, Manchester, VT 05255.

Gary LaFontaine

Giant Mayflies, Pesky Whitefish, and "High Sticking"

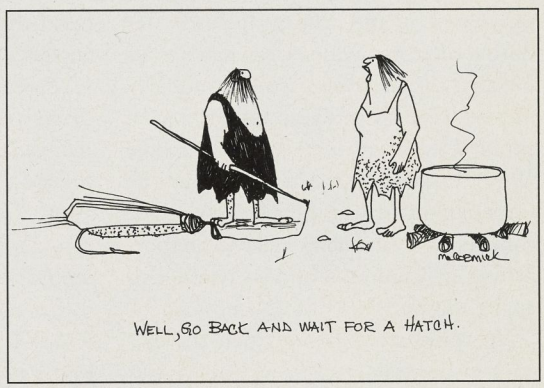
SINCE WE'RE TRYING TO MAKE TROUT *A LITTLE FISHIER, I AM DELIGHTED to welcome Gary LaFontaine to the magazine. No serious angler's bookshelf is complete without a copy of his seminal work* Caddisflies, *and I am convinced that 1994's* Trout Flies: Proven Patterns, *with its unique blend of the science, lore, and practical experience of angling will prove an enduring classic, too. As a longtime admirer of his work, I can honestly say that it is an honor to add him to the list of contributors to this magazine. Gary's new column is intended to be interactive. An angling challenge got you stumped? Wondering not just how, but why? Want to know a little more about the science of fishing? Send your questions to Gary, care of this magazine. For this first column, the questions come from Gary's files.* —*PAR*

"What are the largest mayflies?"

Joseph Worthem — Oklahoma

IN NORTH AMERICA, THE LARGEST mayflies fly fishermen try to imitate are in the Hexagenia genus. These burrowing mayflies are abundant in silt-bottomed streams and lakes throughout the Midwest. On Michigan's Au Sable the erroneously named Michigan Caddis, *Hexagenia limbata*, emerges at night. Anglers come from all over for this event, looking for the huge brown trout that gorge on the big bugs.

It's not easy to imitate large insects. They move on the water — the Hex flutters and flexes as it tries to fly off the surface. A fly tied on a regular size 4 hook, with that long, perfectly straight and rigid shank, is such an obvious fake that selective fish refuse it even in the black of night. An articulated hook that bends offers a big advantage for any imitation larger than size 12.



DON MCCORMICK

In the Carboniferous Period, 360 to 286 million years ago, mayflies were as big as canaries. Zoologists speculate on the reasons for the giant insects in that age of swampy forests. The atmosphere was rich in oxygen, measuring 35 percent (compared to 21 percent today). Because of all this oxygen, the atmosphere was denser, making it easier for insects to fly, and, with their simple respiratory system of spiracles, to breathe.

I would have liked to have seen the fish rising to those mayflies.

Brown Bag Reading 3/8/90

Please return to. windowsill

THE ROLE OF CATCHABLE TROUT IN A STATE FISHERIES PROGRAM:

HOW MUCH IS ENOUGH?

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ABSTRACT

Over the years various pleas have appeared in the literature proclaiming the need for "assessment" or "consensus" on the role of catchable trout in a state's fishery program. No one, to our knowledge, however, has given directions on how such an assessment should be made. We propose various standard ratios that express the role of catchable trout in terms of percent of total stocking to assess the question of how much is enough? The results for Colorado and Wyoming may be surprising.

In the 1940s it became apparent that the traditional fisheries management practice of stocking large numbers of trout fry and fingerlings was wasteful and essentially useless, especially in streams, as a way to increase the catch of adult trout. Survival and return to the creel were found to be directly related to the size of the fish stocked. Thus began the era of put-and-take catchable trout stocking as a significant part of state agencies' overall management programs in states with coldwater resources.

Catchable trout programs are generally well received by the public (often it may be the only perception of what fish and game agencies do with their money) and can be good public relations. Catchable trout programs, however, can grow to a disproportionate size, diverting funds that could be better used elsewhere (for example, management options lost that could produce an angler day for much less cost). It is also recognized that put-and-take catchable trout stocking is not true natural resource management in the sense of preserving, protecting, and enhancing --- to maximize future returns on investment. Catchable trout stocking is a short-term investment comparable to a return in 30 days of 60 to 70 cents on each dollar invested.

The problems and dangers of catchable trout programs getting out of control and threatening the integrity and creditability of a state's fishery agency were early recognized. The November 1956 Sport Fisheries Institute Bulletin discussed the long-range program of the Connecticut Fish and Game Department. The decision to limit the annual production of catchable trout to 100,000 lbs. was highly praised in the following quotation: "Without this limit, as with cancer, the trout hatchery craze would continue to eat away the vitals of the fishery

program. Connecticut anglers owe a debt of gratitude to the Connecticut Board of Fish and Game for wisdom and intestinal fortitude."

In 1959, Trout Unlimited was founded specifically to change the Michigan Department of Natural Resources' overwhelming emphasis on the stocking of catchable trout to an emphasis on wild trout management. The Winter 1980 issue of Trout Magazine presented an interview with T. U. founders George Griffith and Arthur Neumann with the following quotations: "By the late 1950's the fisheries program was geared almost 100 percent to put-and-take and so reduced the quality of wild trout fishing that, if something hadn't been done, we might have lost it all...What was needed was sound wild trout management, but the hatchery bureaucracy was so entrenched there was no way we could do anything with the Fish Division or the Conservation Department or the Commission itself...A million and a half catchables a year were being stocked...We knew it was a great waste."

The response of the Michigan DNR to the challenge of the upstart T. U. organization was to conduct a simplistic public opinion survey. We use the term "simplistic," because the angling public, by and large, is not informed on the issues and alternative management strategies to make intelligent choices. Some questions asked on the Michigan survey were "Do you think that hatchery trout stocked by the Conservation Department improve trout fishing to an important degree? (Yes. No. No opinion). Do you feel that the proportion of the Conservation Department budget now spent on trout stocking is: too small, satisfactory, too great, no opinion?" (McFadden et al. 1964). Such simplistic questions stack the deck and load the dice to obtain a sham public endorsement of the status quo because of the lack of knowledge and understanding by the angling public to make intelligent choices. It is comparable to setting standards of medicine and for disease treatment in public hospitals based on public opinion surveys.

Fortunately, the early membership of Trout Unlimited included politically influential people. Despite the "endorsement" of the status quo by the public opinion survey, the Fisheries Division of Michigan's Department of Natural Resources was completely reorganized and the stocking of catchable trout in inland waters ceased (it must be recognized that the booming coho salmon fishery in Lake Michigan greatly dampened public outcry against the termination of catchable stocking). James McFadden, the senior author of the public opinion survey paper cited above, gave the keynote address at the 1968 annual meeting of the American Fisheries Society in which he stressed the need for leadership among fisheries managers to set trends rather than blindly follow the trends of the status quo (McFadden 1969). A few years and political and biological realities can make a large difference in one's perspective.

The Michigan case history, although providing insight into how angler organizations can effect a change in a state agency, does little to address the basic question on the role of catchable trout in a state program --- how much is enough?

TABLE 1: Comparative data on catchable trout programs of selected states. Numbers of catchable trout and costs from Fisheries, Mar.-Apr. 1988 based on 1982 figures for Colorado and Wyoming (1983 figures for other states). License sales and revenue data from S. F. I. Bull., Aug. 1987 (1986 figures).

State	Catchable Trout Stocked	No. Licenses Sold (No. Catchable Per License)	Total Revenue (Catchable per Dollar)
CO	5,419,802	842,367 (6.4)	$ 8,112,431 (.67)
CA	12,350,000	3,425,717 (3.6)	$36,768,883 (.34)
ID	2,221,881	469,667 (4.7)	$ 4,259,384 (.52)
NV	885,335	258,907 (3.4)	$ 2,359,840 (.38)
NM	1,412,840	262,748 (5.4)	$ 3,153,737 (.45)
NY	2,138,541	1,140,926 (1.9)	$ 9,446,449 (.23)
OR	2,351,230	1,115,944 (2.1)	$10,471,777 (.22)
PA	4,911,600	1,110,054 (4.4)	$12,687,629 (.39)
UT	1,569,856	421,746 (3.7)	$ 5,715,367 (.27)
WA	2,528,000	1,156,777 (2.2)	$11,337,798 (.22)
WY	1,209,172	285,000 (4.2)	$ 3,351,403 (.36)

State	Cost of Catchable Production	Cost per Catchable	Cost of Catchables per License	Percent of License Revenue
CO	$3,047,127	$0.56	$3.62	38%
CA	ca. $5,000,000	$0.40	$1.46	14%
ID	$ 925,000	$0.42	$1.97	22%
NV	$ 503,352	$0.57	$1.94	21%
NM	$ 673,000	$0.48	$2.56	21%
NY	$2,500,000	$1.17	$2.19	26%
OR	$1,500,000	$0.64	$1.34	14%
PA	$3,966,800	$0.81	$3.57	31%
UT	$ 784,928	$0.50	$1.86	14%
WA	$1,280,000	$0.51	$1.11	11%
WY	$ 302,000	$0.25	$1.06	9%

Johnston (1979) published a paper entitled "Catchable trout - a consensus needed." Hartzler's (1988) paper is entitled "Catchable trout fisheries: the need for assessment." Neither paper, however, tells us just what the "consensus" or "assessment" is all about in relation to the question of the overall role of catchable trout in a state program. Since the first wild trout symposium was held in Yellowstone Park in 1974, numerous symposia and proceedings have been devoted to wild trout and hatchery trout in fisheries management. None has adequately addressed the question of assessing the role of catchable trout in a quantitative manner. Typical of what one will find in such proceedings is the telegram from then Secretary of Interior Rogers Morton, read by the then Assistant Secretary Nathaniel Reed to the first wild trout symposium in 1974: "The future of wild trout, well balanced with selective use of hatchery-raised trout, is in your collective hands." This is a noncommittal, mush-like statement, unlikely to offend anyone, but it does raise the issue of balance between wild trout and hatchery trout.

An attempt to make a quantitative assessment of the "balanced" role of catchable trout in a state program is long overdue. The data presented in Table 1 can be considered as a beginning for such an assessment. The first point that we stress is that Table 1 represents a method to quantitatively address the question; the precision of the outdated data as a basis for valid comparisons is questionable. For example, it is doubtful that the $0.25 Wyoming catchable trout is truly comparable to the $1.17 New York catchable trout. It is likely that many of the Wyoming "catchables" were subcatchable trout (125-175 mm) stocked in put-grow-and-take fisheries. Increased precision and refinement based on up-to-date figures would allow Table I to be used as a basis for assessment and consensus on the role of catchable trout in a state's program and to answer the question "How much is enough?"

Besides Colorado and Wyoming, states were selected to represent high and low population densities and abundant and limited cold water resources to assess magnitude of their catchable trout programs in relation to these factors.

If at least the ratios presented in Table I are approximately correct, it can be seen that Colorado is second only after California in the number of catchable trout stocked; but it leads the nation in the number stocked per license sold (6.4), the number stocked per dollar of revenue (.67), the amount per license devoted (or diverted) to the catchable program ($3.62), and the proportion of license revenue devoted to the catchable program (38%). Are these leading figures something to be proud of, or should they be played down as indicative of shortcomings in the state's overall fisheries program? The answer to this question concerns the role of the catchable program in relation to its support of annual angler days of recreation in the state.

Some basic, bottom-line questions to be asked in relation to the percent of the total license revenue (or total fisheries budget) devoted to maintain a catchable trout program concern: What percent of the total annual statewide angler days of recreation is supported by the catchable program? What is the cost to produce (create or support)

an angler day by catchable stocking? What management options are foregone (programs not funded or inadequately funded) that could produce an angler day for less cost?

The first problem faced in an attempt to assemble quantitative data to deal with these questions concerns the validity of the figures. The Colorado Division of Wildlife periodically issues planning documents ("Today's Strategy --- Tomorrow's Wildlife," 1973, 1980, 1988 draft). The 1988 draft plan claimed a total of 7,750,000 statewide angler days for 1988 broken down into 21% warmwater, 29% coldwater streams, and 50% coldwater lakes. Projection to the year 2002-03 is nine million angler days. The 1973 plan claimed about 8.2 million angler days in Colorado at that time and projected a 1983 figure of about 11.3 million days. The 1980 plan stated 11.5 million angler days in 1980 and projected 14.6 million days for 1988. The reason for the discrepancies in estimated angler days is not explained. If the present estimates in the 1988 draft are the "best guess," why then were the earlier figures so grossly inflated?

To get on with the analysis, let us take a figure of eight million angler days with the average catch of 2.3 fish per day, as given in the state's plans. This roughly translates into about 800,000 or so anglers fishing about eight million days to catch about 18.4 million fish. If five million catchable trout are stocked with a 60% return, then three million catchables are taken by anglers. With an average catch of 2.3 per angler day, three million fish support 1.3 million angler days or about 16% of the eight million angler days of the statewide total. If it costs three million dollars to stock five million catchables, then the 1.3 million angler days cost an average of about $2.30 per angler day. With further refinement, this cost per angler day could be a standard by which other management options might be compared. Can they produce an angler day for less? It can also be used to evaluate the cost effectiveness of various fisheries based largely or wholly on catchable trout. For example, if a river or section of a river is stocked with 15,000 catchable trout at a cost of $9,000 and the angler use is 2,000 days per year, the cost to produce these angler days, assuming no fishing would occur without catchable stocking, is $4.50 per angler day or about twice the "standard" cost.

Inherent to such quantification is the danger of gross oversimplification. Socioeconomic values are different for different angler days, depending on the angler group producing the angler days. Johnson and Walsh's (1989) study based on a survey of Poudre River anglers confirms previous studies that an angler day based on wild trout (mainly by the high-skill angler group) has a considerably higher value than an angler day based mainly on catchable trout stocking (mainly the low- and medium-skill groups). The relative significance of socioeconomic factors as an influence in a state agency's generation of recreational days can be debated; but for consideration of state and regional economic impact, it cannot be ignored. An angler day based on catch-and-release regulations in sections of the South Platte, Gunnison, and Frying Pan rivers has a much greater value than an angler day based on catchable trout stocking.

The inequities of cost-benefits and catch distribution resulting in a heavy subsidy to a small group inherent in catchable trout fisheries must also be recognized. Butler and Borgeson (1965) profiled a typical catchable trout fishery in California. Six percent of the most successful anglers took half of the total catch. The other half was divided among 39% of the anglers, and 55% had zero catch. Of a total of 1,381 angler days recorded, half of the total catch was accounted for by 86 angler days (the highly subsidized catchable trout specialist group). Interpreting these figures in reference to Table 1, all license buyers have 38% of their license fees diverted to catchable trout production. Only a minority derive proportional benefits, and a very small minority receives a heavy subsidy.

An obvious factor necessary for an assessment of a catchable program concerns the relative magnitude of angling opportunity available without catchable stocking. How many anglers and angler days are supported on how many surface acres or hectares of all fishable lotic and lentic waters in a state? How many angler days per unit area? CDOW claims about 20,000 acres of coldwater streams for Colorado (supporting 2.26 million angler days according to 1988 draft plan or 4.8 million angler days according to 1980 plan) and about 100,000 acres of lakes and reservoirs with salmonid fishes (supporting 3.88 million angler days in 1988 draft and 5.9 million angler days in 1980 plan). If the lowest estimate of angler days is used, it reveals more than 100 angler days (and more than 300 angler hours) per acre of every square foot of public trout stream in the state --- which would focus attention on the type of angling in shortest supply, wild trout angling in streams. Figures we have for Idaho are 122,000 surface acres of lotic waters and 464,000 surface acres of lakes and reservoirs. If only half of the water in Idaho is "coldwater" with roughly half the licensed anglers as Colorado, the ratio of fishable water per angler is enormously greater in Idaho. In view of this and in reference to Table 1, it could be predicted that the catchable trout program in Idaho is extravagant and wasteful to the extreme. The 22% of the license revenue devoted to the Idaho catchable program would appear to be more disproportionate, more out of line in relation to its role in the overall state program, than is the 38% of Colorado's license revenue devoted to catchable production. The basic question relating to the magnitude of disproportion in Idaho's catchable program concerns what management options, if funded from money now wasted (or drawing very low return on investment) on the catchable program, would most probably create lower cost angler days or "higher quality" (more valuable) angler days than is currently generated by catchable stocking.

Some suggested management alternatives with a goal of increasing angler days and/or increasing values of an angler day include: an ambitious and committed program to work with BLM and USFS to effect better multiple use management on federal lands. With the recent publication of the GAO report on public rangelands (GAO/RCED-88-105), the time is ripe to launch a determined program for better multiple-use management to restore and rehabilitate degraded streams. If, for example, such a program spent $100,000 and with the help of angler organizations such as Trout Unlimited was successful in restoring 1,000

miles or 3,000 surface acres of stream to good condition and if these 3,000 acres then supported 100 new angler days per acre, the 300,000 annual angler days would have been created at an extremely low cost, especially when amortized into the future.

In relation to the ratio between lotic and lentic waters in Colorado, it is obvious that the greatest opportunities to increase angler days are in lakes and reservoirs, both warmwater and coldwater. Warmwater programs should emphasize the most cost-effective programs to increase angler catch with such fishes as walleye, channel catfish, wipers, tiger muskies, etc. The catch from coldwater lakes and reservoirs could be increased by intelligent and creative use of interspecific and intraspecific diversity (Trojnar and Behnke 1974) and learning how to optimize growth and survival of stocked salmonids for individual lakes by manipulating the time, size of fish, and place of stocking. The use of mass-produced sterile fish for lake stocking would perhaps double the lifespan and maximum size of the fish stocked. The combined use of these suggested options should be expected to increase the catch and angler days on the 100,000 acres of lakes and reservoirs by at least 30% -- from the present estimated 3.9 million angler days to more than five million angler days at much less than $2.30 per additional angler day.

The greatest disparity between supply and demand for specific types of angling in Colorado is wild trout angling in streams. The viable options to improve this situation concern the restoration and rehabilitation of streams on public lands discussed above, special regulations designed to recycle the catch, and stream improvement. Colorado is a leader in special regulations for stream trout fisheries and has a record of outstanding success. Special regulations for wild trout fisheries must continue to be expanded. Despite the successes, considerable opposition to expanded special regulations exists among the angling public. The role of public information and education is most important to inform the public on the need for special regulations to maximize use of the limited resource of wild trout. This raises the issue of credibility of the profession of fisheries biology --- we don't get much respect. As an example, I cite Bill Logan's outdoor column in the January 29, 1989, edition of the Rocky Mountain News, Colorado's largest circulation newspaper. Mr. Logan, it should be mentioned, has never been noted for heaping praise on CDOW or for doing his homework on the subject matter of his articles. His January 29th column concerned the "deterioration" of the Blue River since it became a wild trout fishery managed under special regulations. Some of the comments include: "...it's only a shadow of what it could be. Its fish population in both numbers and size has fallen off drastically within the past few years. Why is this? Common sense would tell you the policy of trying to turn the Blue River into a wild trout river without any stockers is a faulty one. The failed attempts to try to let wild trout grow to size in the river and term the Blue a Gold Medal stream are an insult to the angler's intelligence."

CDOW annual D-J reports (stream fisheries investigations) contain sampling data on the Blue River. It would be assumed that a newspaper writer doing a story on the Blue River would consult these reports to

document his contention of a drastic decline in size and number of fish and the failure of wild trout management. Since the change in management to wild trout under special regulations, the sampling data reveals the following changes in two sections of the Blue River. In one section, from 1983 to 1987 the trout biomass continually increased from 77 kg/ha to 223 kg/ha and the number of trout more than 356 mm increased from 12 to 94 per ha. In the other section, from 1981 to 1987 the biomass continually increased from five to 135 kg/ha, and trout larger than 356 mm. increased from one to 60 per ha.

The Rocky Mountain News runs a diversity of columns, such as Dear Abby, Bridge, Parenting, Health, etc. If, for example, the health columnist wrote an expose of current health fads and included his own expert advice that to live a long, healthy life, one should start off each day with a pound of bacon, consume lots of fats and sugars, smoke at least two packs of cigarettes per day, and finish each day with a fifth of bourbon. What might be the response of health professionals and the informed public to such an outrageous article? What would it do to the reputation of a newspaper that would publish it? The parallel makes it clear that we don't get no respect and that we have a long way to go. An ever-expanding catchable trout program, however, is not the way to get there, despite what people like Mr. Logan might think.

LITERATURE CITED

Butler, R. L., and D. P. Borgeson. 1965. California "catchable" trout fisheries. California Department of Fish and Game Fish Bulletin 127.

Hartzler, J. R. 1988. Catchable trout fisheries: the need for assessment. Fisheries 13(2):2-8.

Johnson, D. M., and R. G. Walsh. 1989 (in press). Effects of participant skill on the value of alternative fishery management practices. Transactions of the North American Wildlife and Natural Resources Conference (March 1989).

Johnston, T. B. 1979. Catchable trout - a consensus needed. Fisheries 4(5):14-15.

McFadden, J. T. 1969. Trends in freshwater sport fisheries of North America. Transactions of the American Fisheries Society 98:136-150.

McFadden, J. T., J. R. Ryckman, and G. P. Cooper. 1964. A survey of some opinions of Michigan sport fishermen. Transactions of the American Fisheries Society 93:183-193.

Trojnar, J. R., and R. J. Behnke. 1974. Management implications of ecological segregation between two introduced populations of cutthroat trout in a small Colorado lake. Transactions of the American Fisheries Society 103:423-430.

Wild Trout & Catchable Trout:
Balancing the Scale

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This title was the theme of a workshop held in Denver in May, 1994. To me it was so much déjà vu; I've heard that song before. My quest to seek a proper balance between catchable put-and-take fisheries and wild trout fisheries in state fisheries programs began in 1957 when I began graduate school at the University of California, Berkeley. We had a trout research station at Sagehen Creek, a small creek in the Sierras. The purpose of the research was to demonstrate with abundant data that wild trout in a good environment can support considerably more angling than was generally believed possible by the advocates of catchable trout. The research was intended to influence the California Department of Fish and Game to place more emphasis on wild trout management and less on the production of catchable trout. Success, or lack thereof, can be assessed by the fact that in the next 40 years, production of catchable trout in California hatcheries increased by more than three fold, by the 1990's consuming about 30 percent of the total inland fisheries budget (while "supporting" about eight percent of total angling days). Catchable trout make up 97 percent by weight of all fish production in California hatcheries (about 94 percent in Colorado Division of Wildlife hatcheries which produce large numbers of kokanee and walleye). In the 1990's, California Fish and Game was spending about one to two percent of their annual inland fisheries budget on wild trout and native trout programs.

After all these years, five national wild trout symposia and articles on the subject of proper "balance," without any basic change for the better, might seem discouraging, but if nothing else, I do have patience and perseverance. Thus, I have another article in the Winter 1996 issue of *Trout* magazine on proper balance and the need to recalibrate the scale. For those who have a passion to join the cause, I can offer some advice.

My position is not anti-hatchery. I want to stimulate rational dialogue to critically examine the role of catchable trout in a state's overall fisheries program and the relative emphasis of catchable production in hatcheries. The three percent of noncatchable trout production in California and the six percent in Colorado represent the stocking of fingerling and subcatchable size fish for put-and-grow type fisheries. I would like to see this small segment of total hatchery production greatly expanded and refined to make it more effective. We should avoid anti-vs. pro-hatchery polarization. We only want to put the catchable program in proper perspective by using an economic cost benefit analysis to come up with what might be called optimum production of catchables - how to get the most bang for the buck; find the fat that needs trimming.

We must avoid inflammatory rhetoric which reflects an unfocused, irrational position. If there is to be emotional, irrational rhetoric, let it come from the advocates of catchable trout.

Avoid appealing to ethics and morality. This is basically an issue of economics, equity, and better fisheries management.

Learn the line of reasoning used by catchable advocates and understand the fallacies of the basic assumptions used to support their position. Here is an example. Catchable trout are stocked in many waters (can be a specific water, regional or whole state) and so many angler days are counted on these waters; each angler day has an economic value (say $40 or $50 or whatever), therefore all economic benefits of angling (on waters stocked with catchables) is "created" or "results from" the stocking of catchables. This line of reasoning typically goes over big with the chambers of commerce, but won't hold up to critical analysis. The basis for analysis here concerns human motivation. Why do we go fishing and spend money on the sport? In study after study, the fish caught have the lowest value of economic valuation of an angler day. Adventure, beauty, "getting away," mental health aspects have the highest values in motivating anglers. To sort out the value anglers place on each trout caught in relation to total economic value of an angler day, I collaborated with three economists to publish a paper in the *North American Journal of Fisheries Management* on the results of studies in the Poudre and Taylor rivers in Colorado. Anglers were asked how much they would be willing to pay to catch 1-2-3-4-5, etc. trout per day. Both rivers have abundant wild

trout and are stocked with catchables. By the fourth and fifth fish, anglers were valuing them less than the production and stocking costs. That is, if an angler caught three wild trout and his total catch would be five if two catchables are provided, the "benefits" or value to the angler of the catchables is less than the costs to produce and stock them. This is the type of critical analysis necessary to optimize use of catchables and avoid wasteful stocking.

Also, it must be understood that economic value of an angler day varies greatly and that wild trout fisheries have greater values than put-and-take catchable fisheries. Anglers do not travel long distances and spend large sums to fish for catchables. In Montana the economic value of nonresident anglers fishing the Madison River is calculated at $156, whereas a resident fishing local water (as in a Colorado put-and-take fishery) has a value of $30 per angler day. Twenty years ago Dick Vincent convinced the Montana commissioners to cease stocking catchables in the Madison and manage it as a wild trout fishery, the business people and most local anglers in the Madison Valley were outraged. Today, they would be more outraged if it were to be proposed to stock catchables again. The economic benefits of a wild trout fishery are very apparent.

California, Colorado, and Pennsylvania are the three states with the largest catchable programs. California stocks the most catchables but Colorado stocks more catchables per licensed angler than any other state (about five million catchables weighing two million pounds: equaling about six catchables per licensed angler). Pennsylvania stocks about the same amount of catchables as Colorado but has almost three times the demand for trout angling. Although Pennsylvania has considerably higher demand, with "supply" of catchables to anglers similar to Colorado, there are much less quality wild trout waters in Pennsylvania and much less area of lakes and reservoirs for put-and-grow type of stocking. Pennsylvania has, perhaps, about 1,000 miles of streams that support wild trout populations of 50 pounds per surface acre or more vs. about 6,000 miles in Colorado. Pennsylvania has 23,000 surface acres of lakes and reservoirs suitable for stocking trout and kokanee for put-and-grow fisheries vs. about 120,000 acres in Colorado. Yet, angler satisfaction in Pennsylvania is high. This might seem impossible to Colorado catchable trout advocates: How could this be? Can we learn some valuable lessons from Pennsylvania?

In this brief article, I have barely scratched the surface of the issues and subject matter necessary to adequately address the question of balance between catchable trout and wild trout in a state's fisheries program. Another symposium on balancing the scale might be a possibility, but it should address what was not said at the May, 1994 workshop. The facts, figures, and economic evidence are on the side of wild trout, but to get the evidence out for critical review we need dialogue, not diatribe.

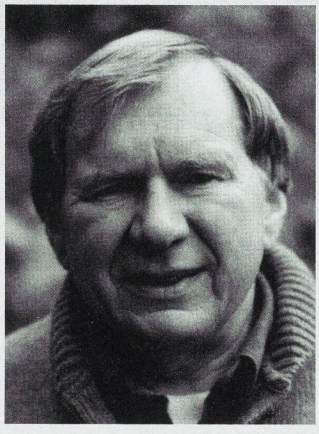
From Hatcheries to Habitat? Look Again.

Despite the rhetoric exalting wild trout management, catchable trout production still dominates.

Robert J. Behnke

TROUT UNLIMITED WAS FOUNDED in 1959 specifically to address the issue of wild trout versus hatchery-raised catchable trout – and to the emphasis given to each in a state's trout management program. Since then considerable progress has been made toward increasing emphasis on wild trout management by special regulations and better understanding of habitat. All this was summarized by Ray White in his excellent feature article, "We're Going Wild: A 30-Year Transition from Hatcheries to Habitat," in the summer 1989 issue of ***Trout***. Yet greater progress is needed.

I served as the summarizer for the Wild Trout IV symposium in 1989, where I pointed out that this transition from emphasis on hatchery trout to emphasis on wild trout during the past 30 years has not been proceeding as rapidly as most anglers believe it has. I cited presentations given at the first wild trout symposium in 1974. The tenor was one of euphoria, celebrating a new age of fisheries management – I then cited figures comparing total production of catchable-sized trout in all state and federal hatcheries from 1958 to 1983. During this 25-year period, catchable trout production increased in the United States from 50.2 million to 78 million fish. The cold facts reveal that, during this period of transition from hatcheries to habitat, catchable trout production increased by 55 percent!



The battle for more rapid implementation of wild trout programs will not be won by emotion or rhetoric...but by hard evidence.

I provided data in my summary to show that, in many states, the continuing emphasis on catchable trout results in inequities in relation to cost-benefits to the majority of anglers. A relatively small proportion of licensed anglers is heavily subsidized by all other anglers in large-scale catchable programs.

The battle for more rapid implementation of shifting emphasis from catchable trout to wild trout will not be won by emotion or rhetoric. Changes for the better will come about by compiling, analyzing, and documenting evidence from diverse sources – making a case much as a skillful attorney prepares for trial. Gain an in-depth understanding of all of the evidence favoring your point of view and all of the evidence supporting the opposing viewpoint.

I will review some of the evidence that relates to the issue of wild trout versus catchable trout and will attempt to present an unbiased interpretation – while admitting that I am handicapped by a strong bias for wild,

natural trout, especially in wild, natural environments.

Some important fundamentals that relate to the wild trout/catchable trout issue concern the missions, mandates, and goals of government agencies involved with fisheries management, economics of fisheries management, and economic values associated with angling.

Probably all state conservation agencies have a legislative mandate that directs the agency to preserve, protect, and enhance the natural resources of the state. A public fisheries program based on catchable trout is not natural resource management; it does not preserve, protect, or enhance natural resources; it is at variance with the agency's mandate. Many agencies have recognized the internal contradiction inherent in their catchable trout programs. (Typically non-native rainbow trout are stocked.) The agency's fisheries management plans or policy statements may have a footnote or a parenthetical disclaimer to the effect that the stocking of catchable trout is necessary in certain areas to maintain recreational fishing. The implication is that the catchable program is de-emphasized, a minor part of the state's overall fisheries program.

A basic question concerns the distinction between major and minor: If 10 percent to 20 percent of all funds derived from angling license sales are devoted to raising and stocking catchable trout, would this be considered minor? What about 30 percent to 40 percent or more? A critical examination should also be made of the accuracy and veracity of how costs are computed. How does the percentage of license fees devoted to catchable trout production compare to the percentage of total angler days expended in the state that are dependent of catchable stocking?

Concerning economic valuations of wild trout versus catchable trout fisheries, I will not attempt a weak imitation of Roderick Haig-Brown to extol the more intangible aesthetic values associated with wild trout, but a value differential becomes apparent by playing a game of "what if." Consider the changes in impact, meaning and symbolism in Ernest Hemingway's story, "Big Two-Hearted River," if Hemingway had Nick Adams drive to a stocking site, toss out his bait, and haul in a fish transported from a hatchery a few hours before.

With more tangible economic analyses, the value of an angler-day is always higher for a wild trout fishery than for a catchable trout fishery. The differential varies from slight to enormous depending on the quality of the fishery, demand in relation to supply, and the method of economic valuation.

In relation to the economics of a fisheries program, an in-depth, critical economic evaluation of the true costs of producing fish in hatcheries has yet to be done, to my knowledge. Historically, state and federal hatchery costs have been computed by cost accounting methods, not by economic evaluation as done by economists. Thus, in many instances, the cost to produce the fish does not include capital construction costs. For example, if $10 million is invested to construct a large hatchery which produces one million pounds of catchable trout per year, with good interest rates, a private investor may pay off the debt in 20 years for $20 million. During that 20 years, each pound of trout produced would have an additional cost of two dollars just to retire the debt, but this cost can be hidden in computing fish costs in government hatcheries. Construction and many other costs (land acquisition and taxes) borne by the private sector are not calculated in computing fish production costs by many state and federal hatcheries. Until a true economic evaluation is made of fish production costs, all that can be said is that the true economic cost to produce a catchable trout in a state or federal hatchery is considerably more than the official figure arrived at by selective cost accounting.

Consider the changes in impact, meaning and symbolism in Ernest Hemingway's story, "Big Two-Hearted River," if Hemingway had Nick Adams drive to a stocking site, toss out his bait, and haul in a fish transported from a hatchery a few hours before.

To this point, it may seem like an open and shut case for reducing catchable trout programs – diverting funds to more morally and economically defensible fisheries programs. It's not that simple. Changes for the better will come about slowly and only after all aspects of a state's fisheries program are critically analyzed and the findings effectively communicated to the public (including legislators and commissioners). Some fundamental factors that favor continual expansion of catchable trout stocking must be clearly understood before effective counter arguments can be developed.

The first concerns public perception of fish hatcheries and the role played by the stocking of hatchery fish to maintain public fishing.

For more than 100 years, the public, political, and business perception of fish hatcheries and fish stocking has been enthusiastically favorable. In 1872, Congress appropriated $15,000 to fund the United States Fish Commission to investigate the causes of decline in our fisheries and to come up with a solution to reverse this decline. The obvious solution was to build many hatcheries and propagate and stock millions and billions of baby fish of many species and scatter them about like Johnny Appleseed.

The unbridled optimism of fish culturists in their belief that they would make our waters teem with fishes is epitomized in an address made by Robert Barnwell Roosevelt at the annual meeting of the American Fish Culturist Association in 1876. Roosevelt recounted the great deterioration of our fisheries but concluded that "there is no need to fear scarcity of fish food either in the ocean or in our great lakes – we have only to take advantage of these opportunities" (to build more hatcheries and stock increasing numbers of fishes). Roosevelt continued: "This is the national centennial; fish culture has existed only a few years; what will be its condition at its centennial the most enthusiastic can hardly conceive…A new science was being

born into the world...but the clear light is visible at last...There need be no fear for the future, and in much less than a hundred years, the waters of America will teem with food for the poor and hungry, which all may come and take."

Roosevelt's prophecy came true, but with an ironic King Midas-like twist. The following year, 1877, the U. S. Fish Commission began the propagation of carp, imported from Europe, and soon dispersed them all over the country. In much less than 100 years, the carp became the dominant species in freshwaters of America – that is, there are more pounds, tons and megatons of carp than of any other single species – but even the poor and hungry don't want to come and take them.

During the 1940s and '50s, the rearing and stocking of catchable trout for instant put-and-take fisheries increased at a rapid rate. Objections were raised on moral, aesthetic, economic and biological grounds, but no real organized opposition to catchable trout came about until Trout Unlimited was established. During the past 30 years, however, the catchable trout tidal surge that began in the 1940s has not been checked to a significant degree. The annual production figures for state and federal hatcheries continue to rise.

The tide cannot be easily turned because the public, in general, still maintains a favorable perception of fish hatcheries. Hatcheries and stocking are typically the only tangible part of fisheries management of which the public is aware. Angler surveys consistently show endorsement of catchable trout stocking. The most common response when the average angler is asked how the state fisheries agency can make his fishing better is, "to stock more and bigger fish." This is due to the makeup of the angling public.

Anglers can be commonly grouped into categories for economic analysis. The largest group are the "casual" (or occasional) anglers who fish incidentally as a secondary aspect of an outdoor recreational experience such as family picnics or camping trips, and the "skilled" (generally experienced) angler whose primary outdoor experience is focused on fishing and who have a typical goal to "catch a limit." The overwhelming majority of the anglers grouped as casual or skilled have no real preference for wild trout over catchable hatchery trout – to most of them, a trout is a trout, is a trout. The smallest group (about 10-15 percent of all anglers in states where trout fishing is dominant but where warmwater fishing is available) is the "purist" (or expert) angler group who are concerned with tackle and techniques and have a distinct preference for wild trout. Almost all angler opposition to catchable trout comes from the purist group. When a state agency transforms a stream or a section of a stream from a catchable trout fishery to a wild trout fishery with special regulations, which prohibit bait, there is often a backlash of outrage from the main body of anglers who believes that wild trout management with special regulations is simply a ploy by elitist fly fishers deny them fish that are rightfully theirs – frequently they have the backing of politicians and local business people.

If anyone believes that a rapid turning of the catchable trout tide will be a reality soon, the experiences of the Idaho Department of Fish and Game in recent years is instructive.

The ratio of miles of wild trout streams or surface acres of salmonid waters per licensed angler in Idaho is about the most favorable of any state. That is, Idaho has the least need for catchable trout stocking to meet angler demand. Idaho, however, stocks more catchable trout per licensed angler than does Pennsylvania – by popular demand. When the Idaho Department of Fish and Game declared certain sections of the Henry's Fork of the Snake and Wood River drainage to be wild trout waters with special regulations, the changes were met with fierce opposition from organized anglers, resulting in legal challenges and threats of legislative injunction.

Because of the abundance of high quality wild trout waters, it is predictable that catchable trout fisheries in Idaho are wasteful to an extreme degree. A study was conducted in 1976, 1977 and 1980 on five sections of the Henry's Fork stocked with catchable trout. A total of 105,000 catchables was stocked in these sections during these years. The catchable trout averaged 11 inches in length and slightly more than a half pound in weight. The return of these catchables to anglers in the various sections ranged from 3 percent to 46 percent of the numbers stocked. In total, 18,743 (18 percent) of the 105,000 fish stocked were caught by anglers. Of about 60,000 pounds of catchables stocked, no more than 10,000 pounds were harvested by anglers. Even in the section where catchable trout made their greatest contribution to the fishery, 56 percent of all trout caught were wild rainbows. Despite such statistics, many anglers and business people vehemently protested against replacing catchable stocking with wild trout management and special regulations; they believed the Fish and Game Department had caved in to a small group of fly fishing elitists.

An important finding on the Henry's Fork was that in the special regulation, wild trout section in the Box Canyon, more than half of the anglers were nonresidents (from other states). These are the anglers who produce the greatest angler-day value, especially in relation to money spent in the local region – these are the anglers that chambers of commerce want to attract. They won't come to Idaho to fish for stocked trout.

It should be obvious that the catchable tide cannot be stemmed by an "us versus them" approach based on morality, ethics or poetry. There are many more of them than there are of us. (See Del Graff's "The Politics of Wild Trout" in the winter 1986 issue of ***Trout*** to understand why the fiercest opposition to implementing Pennsylvania's wild trout program came from the purist fly-only group.) "Us" or any grouping is far from a unified entity. In any event, we must convince "them," whoever they may be, that better fisheries management is in their own best interest. We must examine options that will provide as many or more catchable trout to those anglers who want them, distribute them in a more equitable manner, while creating more wild trout waters. In the Henry's Fork area, for example, if there are waters such as gravel excavation ponds where catchables can be dumped, a return of 75 percent of the stocked fish could be expected. (Angler profiles show that most anglers in the casual and generalist groups do not place much emphasis

on aesthetic considerations of their fishing sites.) With a 75 percent return, the same number of fish would be caught by stocking 25,000 catchables as were caught in the Henry's Fork from stocking 105,000. Could the money saved be put to better use?

Several studies have agreed that with catchable trout stocked in streams, 50 percent of all the catchables caught are caught by a small proportion (6-8 percent) of the anglers fishing that stream (the catchable trout specialist). In ponds or small lakes (typically less than 100 acres surface area) with good access, not only is the percent return typically higher than with catchables stocked in streams, the catch is better distributed among all anglers and extends over a longer period of time.

The key to stemming the catchable trout tide is not to cease or even reduce production, but to hold the line and develop strategies to make more effective use of hatchery fish. For example, a hypothetical state agency presently takes in about $10 million annually in license sales and spends $3-4 million on catchable trout; if the expenditures for catchable trout production remains stable over the next 10 years, while license sales rise to $15 million, an additional $5 million would be available for better fisheries management, including greater emphasis on wild trout, warmwater species, and studies on how to use hatchery trout more effectively to increase returns to the angler. This sounds good, but the success or failure for additional funding to result in better fishing depends on the talent and enthusiasm of agency biologists. In agencies that have long devoted a large proportion of their total fisheries budget to operating hatcheries and stocking great numbers of catchable trout, and where the administrative hierarchy is dominated by hatchery people, management and research has suffered. Such an agency may be staffed by management and research biologists who have no feasible alternatives for spending additional funds to provide more fish for more anglers except by stocking more catchable trout.

In my summary for the Wild Trout IV symposium I suggested some ideas how money could be well-spent in fisheries programs. A program that should yield a greater cost-benefit ratio concerns strain evaluation of hatchery trout stocked at a small size in lakes and reservoirs for what is known as put-grow-take fisheries. Where natural selection factors such as competition and predation are prevalent, the genetics of the stocked fish can be extremely important for survival and growth. There are tremendous opportunities to increase the effectiveness of put-grow-take fisheries.

A recent paper in the *North American Journal of Fisheries Management* reported on salmon and trout stocked into Lake Michigan by the Wisconsin Department of Natural Resources. From 1968 through 1980, 4,354,471 yearling rainbow trout were stocked. The angler catch one and two years later equalled a 9.8 percent return of the stocked fish (considering that after one or two years of growth in Lake Michigan, the rainbows caught should be large and the weight of caught fish probably exceeded the weight of fish stocked). From 1981 through 1984, 1,832,487 yearling rainbows were stocked but only 5.1 percent were subsequently caught by anglers. For every million yearling rainbows stocked, the difference between a 5.1 percent return and a 9.8 percent return is 47,000 fish (and probably well over 100,000 pounds). The difference in percent return was the result of the strain of rainbow raised in Wisconsin hatcheries. During the 1981-84 period, the highly domesticated Shasta strain was used, probably because they are cheaper to rear. In the 1980s, could it be that Wisconsin fish culturists were unaware of evidence accumulated over many years that there is a strong inverse correlation between degree of domestication (cheapness to raise) and survival-return to angler in put-grow-take fisheries, especially in lakes with an abundance of competitors and predators?

Wisconsin has some excellent trout biologists; were they asked for advice?

How good is communication among management, research and hatcheries?

Fish culturists may be doing an outstanding job, based on job performance ratings for cost effective fish production, but the fate of the fish after leaving the hatchery is not part of their job. Wisconsin stocked more than five million brown trout yearlings, which returned to the fishery at a 12.2 percent rate. Skamania strain steelhead rainbows stocked in Lake Michigan by Indiana returned at a 12.8 percent rate. When one considers the multitude of strains represented by diversity within trout species, the potential to greatly increase the effectiveness of put-grow-take fisheries appears almost unlimited.

This same issue of the *North American Journal of Fisheries Management* contained a report comparing three strains of cutthroat trout stocked in two Montana ponds. Over a two-year period, the total return to angler of the three strains were 11, 28 and 52 percent of the fish stocked – quite significant differences and fisheries management implications resulting from very slight intraspecific genetic differences.

What is your state agency doing on the matter of improving the returns of hatchery fish? Probably all would agree that it would be a good idea to devote the time of one or more biologists to study the issue, but that funds are not available to staff such a position. Why not? Any state with a large-scale catchable program, no matter how efficient the return to the angler is assumed to be, will have pockets of wasteful stocking as bad or worse than what occurred in the Henry's Fork. Elimination or large reduction of wasteful stocking should result in savings to fund several professional positions.

The progress made in fish culture techniques, engineering, improved diets, disease control, and overall skill levels and efficiency during the past 30 years, far exceed advances made in fisheries management and research (which have been inhibited by funds diverted to fish culture). In relative dollar terms, hatcheries can produce a pound of trout for much less cost than they could 30 years ago. And better use is made of catchable trout in relation to percent return and reduced conflicts with wild trout management in streams. Much improvement is yet possible, however, in increased effectiveness of hatchery fish utilization to provide more fish for more anglers.

Before any new major hatchery construction for continued expansion of a state's catchable program is approved, I would urge critical scrutiny.

Bob,

I received your analyses of New Hampshire & Connecticut yesterday. CA, & CO in hand. NV not received.

① I think I understand your point, but have a couple questions regarding assumptions.

For example, your selection of the "Gross Cost to Anglers" as the Department's total budget for "fisheries". may not be accurate ~~in~~ in this case.

True, the sales of licences brought in ~$2 million in 1997 plus another ~$1.6 million from Federal Aid (NH is a minimum apportionment state). Although this is what they "took in" not all of it goes to the "fisheries" program. There are a variety of enforcement & public-relations & education functions, too that are in part paid for by license $$. FYI, states are not allowed to use Fed. Aid for "enforcement".

56%
44%

The I spoke w/ NHFGD folks about the 78% expenditure on hatcheries. This refers to only the expenditures going to Inland Fisheries Division ($1.7 million) in the central office. 78% goes to "hatcheries" operations & 22% to "administ

- Boat Access gets another $400 K.
- Aquatic Resource education gets $184 K.

Field offices, where the biologists do their work, are not included ~~in~~ in the 78/22% split. There are 4 regional offices which, when apportioned by program gets about $725 K.

So, in total $1,700 K + $725 K + $425 K (hatcheries + field offices + admin.) = $2.85 K of the Department's $13,900 K (wildlife/enforcement/fisheries/marine fisheries/public relations) budget.

∴ - Hatcheries really gets only 60% of fisheries budget
- Admin. gets 15% & Field guys get 25%.

Now using the production of 938 K catchables & adults (~427 K pounds), or for whole system 520 K pounds produced (include Atlantic salmon fry for "restoration") then

$1700K / 520 K pounds ~ $3.27/lb

OK, so what? my figure is lower. My primary concern is that an "economy of scale" argument will be invoked & shed to the public. ~~How so?~~ Let charts

Division Activity	$ (x 1000)	% of IFD funds	Personnel	% of IFD personnel
Field Offices*	726	25	10	21
Hatcheries 2132	1,700	60	31	65
Administration 2130	425	15	7	14
Atlantic Salmon**	42	--		
Education***	184	--		
Public Access****	423	--		
IFD Total	2,851		48	
DFG Total	13,900			

* Inland Fisheries program (2283-2286)
** Wildlife Management Division (2166)
*** Public Affairs Division, Aquatic Resource Education (2122)
**** Access and Engineering Division, Public Boat Access (2117)

Facility	Total Biomass Produced (Lbs.)	O &M Expenditures	Mean Average *Marginal* Cost per Lb.	Total [1] Capital Outlays
Berlin	180,650	700,393	3.88	496,035
Milford	212,607	798,723	3.76	63,776
New Hampton	148,242	543,480	3.67	7,585
Powder Mill	369,047	675,252	1.83	16,392
Twin Mt.	25,549	228,519	8.94	304
Warren	8,392	225,995	26.93	3,133
NH	944,487	3,149,546	3.33	598,381

Warren is a special use facility producing brood stock and

[1] This total figure is larger over the past decade, approaching a million dollars (Fawcett 1997).

Colo. Div. Wildlife

Revenues from 1996 Annual Rept.

Revenues generated from:

Hunting.... 51.4 mil. $ (license + fed aid + ?) 70%

Fishing.... 18.1 mil $ " 25%

other - 5%

Expenditures by program:

Hunting.... 33.4 mil. $ 46%

Fishing.... 28.0 mil. $ 40%

others 14%

Almost 11 mil. $ (from nonresident hunting licenses) is used to subsidize fisheries.

Note total expeditures of fisheries = 29 mil $.
total revenues from license, fed aid = 18.1 mil $

USFWS Federal Aid statistics for FY 1996 show Colo. to have 760,614 "paid license holders"; i.e. number of people purchasing one or more licenses, tags, stamps etc. Total number of licenses, tags, stamps = 957,460. (1997 figures are 756,355 and 933,869). The "Gross cost to anglers" in 1996 = $11,893,625 ($11,757,177 in 1997). What is "gross cost to anglers"? If it means total revenue from license sales, there is a 6.2 mil $ difference between CDOW fishing revenue of 18.1 mil. $ and the 11.9 mil $ "cost to anglers". This, I believe, is considerably more than fed. aid to fisheries for Colo. in 1996. How explained? Of the total expenditures for the fisheries program (29 mil $), the 11.9 mil $ ("gross cost") is 40% of the total expenditures. How is

the other 60% (17.1 mil. $) spent? I suspect the 60% "overhead" goes for law enforcement, administration, and construction, but we should have a breakdown of total expenditures.

In any event, I use the 11.9 mil $ figure as the basis for calculating costs of catchable trout. Accordingly: Colo. stocked 3.6 million catchable trout weighing 1.4 mil. lbs. (2.5 trout/lb.) for 89% of total hatchery production (in pounds).

Of the 11.9 mil. $ budget ("gross cost"), 57% was devoted to propagation (= 6.8 mil $). This = $4.25/lb. for all fishes propagated (1.6 mil lbs.). If the 11% (ca. 200,000 lbs.) of non catchable trout production cost $10/lb., then the cost of catchable trout would be $3.57/lb. -- which is comparable to costs projected by Johnson et al. (1995, N. Am. J. Fish. Mgt. 15:26-32) for CDOW hatcheries when administrative and associated overhead costs are figured in.

According to data from John Epitanio, of the 11.9 mil $ of "gross costs" to Colo. license holders in FY 1996, 68% (8.1 mil $) came from "license sales", 28% (3.3 mil $) came from "federal aid" and 4% (ca. 0.5 mil $) from "other" sources. To generate 8.1 mil $ from sale of 760,000 license holders, $\bar{x}$ cost per license holder would be $10.60 (much too low) -- how explained?

Based on above figures, for FY 1996, CDOW stocked 4.7 catchable trout, wheighing 1.9 lbs. for each licensed angler at a cost of about $7.00/angler.

An obvious problem concerning a stardendized cost figure and associated proportional calculations to put catchable trout programs into perspective, is the different ways the various state agencies figure and assign costs and revenues. Cost per pound of catchable trout is the desired figure (no./lb. varies from < 2 to 5). Any reported cost of less than $3.00/lb. is highly suspect (again, the agencies have different ways to figure costs, especially when it concerns minimizing costs of catchable trout). To figure cost of a catchable trout program in relation to license holders, various statistics can be useful for attempts at standendization. No. and pounds, and cost per license and as % of cost of license, % of total fishery budget, etc.

To answer question; is the average angler getting their money's worth from a catchable program? the following data are necessary. What propontion of anglers fish for salmonid fishes. What proportion fish for catchable trout (i.e. they would not purchase license if no

catchable trout are stocked)? The first question relates to hatchery production of non catchable size salmonids (fingerlings, sub catchable trout, ~~[illegible]~~, and Kokanee salmon)-- these are the fish stocked in lakes and reservoirs for "put-and-grow" fisheries.

That very few license buyers are "dependent" on catchable trout is strongly supported by the 1997 TU economics reports by John Loomis-- that there is no correlation between numbers of catchable trout stocked and license sales; and, anglers are not willing to pay the cost of a catchable trout to catch one. Another statistic from California F. & G. (and supported by study in Colo.) is that of all anglers fishing for catchable trout, more than 50% of all the catchables caught, are taken by 7-8% of the anglers. When considering that only a small % (<10%?) of Colo. anglers fish only or mainly for catchable trout, it becomes apparent that a very small fraction of license buyers are highly subsized for low economic value "angler days"; and, why there is no correlation between license sales and number of catchables stocked. Thus, is it fair to all Colo. anglers to support a program costing each angler about $7 (of a $20 resident license = 35% of license cost) to supply only about 10% of all fish caught

(CDOW estimates 20,000,000 fish of all species caught each year - at 60% return of ~~316~~ mil. catchables, = 2.2 million of the 20 million)-- and this 10% of total fish caught are caught by very few anglers specifically targeting catchable trout.

Or, calculating from the 11.9 mil$ CDOW 1996 "fishery budget" (or "gross cost" to anglers, which I assume means the budget devoted to actual fishery programs-- propagation, research, management, etc.), catchable trout costs are more than 40% of the "fishery budget" (about same for Calif.).

Another data sheet from John Epifanio lists "% of angler licenses attributable to trout", i.e. licenses purchased by anglers fishing solely or primarily for "trout". For Colorado, 91% of the licenses are "attributable" to trout. This is a gross overinflation. Previous CDOW estimates were ca. 50% of anglers fishing in lakes and reservoirs (lentic waters) stocked with trout, ca. 30% warm-water fishing, ca. 20% stream fishing for trout. Given that, in many popular warm-cool-water reservoirs stocked with catchable trout, the main species sought by anglers are nonsalmonids-- bass, walleye, crappie, etc., it is apparent that the 91% figure is grossly overestimated. And, it's a major leap of naive faith to associate "% licenses attributable to

Trout", with the stocking of catchable trout -- there is no correlation, as documented in the 1997 TU economic reports.

Are there better ways to use at least some of the funds now devoted to catchable trout for other programs yielding a higher return to the average angler? No doubt about it in my mind.

Despite the impact of whirling disease on CDOW catchable trout production -- declines from >5 million catchables, weighing >2 million lbs, 5-10 years ago, to 3.6 mil. and 1.4 mil. lbs. in 1996, Colorado is still one of the major players in the league of catchable trout states in no. & lbs. per angler and $ to cost/angler.

Note that CDOW plans to renovate its hatcheries in an attempt to eliminate whirling disease. Cost estimates are in the range of 12 to 18 million $. If, over a three year period, an average of five mil $ is added to the "propagation" budget for whirling disease control, total hatchery costs and cost per pound of all hatchery fish would increase by more than 70% (from 6.8 mil. $ to 13.8 mil $). Where would these funds come from? Will the budget data accurately reflect this increase?

California Dept. of Fish & Game

California F&G has the largest catchable trout program of all states. Comparing the same categories used for Colorado, CF&G figures for 1996-97 are:

Licensed anglers: 2.2 million

Fish. budget ("gross cost to angler"): 44.85 mil. $

(41% = 18.3 mil$ from license sales = $8.32 per license holder [Colo. = $10.60/license])

(23% = 10.3 mil$ from fed. aid)

(36% = "other")

Percent of budget for hatcheries = 40% (17.9 mil$)

Catchable trout 7.0 million = 3.7 mil. lbs. (96% of all hatchery production). All hatchery production = 3.9 mil. lbs. ÷ 17.9 mil. $ (hatchery costs) = $4.60/lb. → using $10/lb. for the 200,000 lbs. (4% of total production) the 3.7 mil. lbs. of catchable trout would cost $4.43/lb. ($3.57/lb. Colo.).

% licenses "attributable to trout" = 77% (91% Colo). As with Colo., this estimate is a gross inflation. According to Lee (1995, A.F.S. Symp. 15: 16-20), using CF&G data, the % of California anglers fishing for salmonid fishes is about 30% and about 70% fish for other species (Most likely interpretation is that 70% of angler days associated with nonsalmonid species).

Amount of angler days (% of total catch of all fishes) supported by catchable trout:

7-8% (Based on data in: An environmental document on the culture and stocking of resident trout in California. Coastal Res. Inst. Cal. Poly. Univ. 1995). Thus, about 35+% of total fishery budget used to supply 7-8% of (low value) angler catch.

Note that from 1980s through early 1990s, license sales in Calif. significantly declined. Down to about 1.5 million angling license holders in 1990. Yet, in 1990, C.F.G. hatcheries stocked more than 10 million catchable trout as follows:

	no.	wt.
Rainbow trout domestic strains	8,968,118	4,420,310 lbs.
Eagle L. rainbow	733,134	432,415
Brown trout	~~77,528~~ ~~58,165~~	~~58,165~~ ~~1,000~~
Brook trout	190,050	111,435
1990 TOTAL	10,058,830	5,022,225 lbs.
1997 TOTAL	7.0 million	3.7 mil lbs.

Thus, in 1990, C.F.G. stocked more than 40% more catchable trout than in 1997, but sold >35% fewer licenses (2.2 mil. 1997 vs. 1.5 mil. 1990).

In relation to a correlation between no. of catchable trout stocked and license sales, when data plotted from 1980 through 1997, a negative correlation is apparent -- the more catchables stocked, the fewer licenses sold.

Despite all of the above analyses, a "strategic plan" prepared by C.F.G.

in 1998, cites the "need" to increase catchable trout production "by 300%" by the year 2010 to "meet demand"--what demand? The "strategic plan" is designed to "chart the future direction" of C.T.&G. Obviously, strong and persistent external pressure will be necessary to realign the future direction.

Similarly, in Colorado, a 1996 report on management alternatives associated with the problem of whirling disease, ~~"~~ assumed that.." there is a direct and equal correlation between the number of (catchable) fish stocked and the number of recreational days generated" (implied is recreational days = fishing license sales). Examples of how isolated and insulated are the staff of state fisheries agencies from realities.

Some overall 'bottom line' type figures in relation to the 40 year history of T U and its original purpose to change emphasis from catchable trout to wild trout:

1958 (total catch. trout)	1983	1997
50.2 million (state + fed.)	78 million	60.1 mil. (23.6 mil. lbs)

- Shift from more smaller catchables to fewer larger catchables, but no true critique on proper role of catchable trout. Also, 1991, Wallop-Breaux fed. aid ~~$~~ allowed to be used for catchable, put-take fisheries.

New Hampshire

Using some data used to compute parameters for CO, CA, and NV, N.H data are (for 1997):

Paid license holders... 166,985

Total fishery budget... $3,571,449 (3.57 mil $)

% Budget from license sales.. 56% (2.0 mil $)

% " " federal aid 44% (1.57 mil $)

Total hatchery production... 438,382 lbs

Catchable trout... 426,701 lbs. (97.5% of total)

No. catchable trout.. 938,130 = 2.2/lb. or ca. 9-10"..

No. catchable trout per license: 5.6 (2.6 lbs.)

% licenses "attributable to trout".. 64%

.Note from CA, CO, & NV summaries, that "attributable to trout" does not mean attributable to catchable trout. CA and CO data show: 1. no correlation between no. of catchable trout stocked and license sales, and 2 (for CO study), anglers are not willing to pay the costs of catchable trout to add another fish to creel. This would be especially true for New Hampshire if anglers realized the cost of catchable trout, according to N. H. figures... total budget is $3.57 millions, % of this budget allocated to hatcheries is 78% = $2.9 million. A total of 438,382 pounds of all hatchery fish, then would cost $6.37/lb. Using $10/lb. cost for noncatchable trout (2.5% of total hatchery

production in biomass) and subtracting, results in cost per pound of catchable trout of $6.25 (vs. $4.40/lb CA, $3.57/lb. CO, and $2.60/lb. NV). New Hampshire probably lacks water supplies to operate large, production hatcheries as found in California, but the discrepencies among cost/lb. of catchable trout per state, is more likely the result of how costs are figured and assigned rather than hatchery efficiency. Perhaps New Hampshire F&G is simply more honest in assigning 78% of total fishery budget to hatcheries, but it should be obvious that there are insufficient funds for research and management re. habitat, wild trout, native fishes, etc.

Does the average angler in N.H. realize that catchable trout cost more than $6.00/lb., based on N.H. figures? And, what is % of catchable trout stocked that are caught by anglers? If it is only 50-60% as in most states, the cost per catchable caught increases to $10-$12/lb. And, what % of catchable trout are caught by what % of anglers? If, as in other states, <10% of anglers are catching >50% of catchables that are caught, the problem of overreliance of catchable trout in a state's overall fishery program should become obvious.

OTHER New England States: MA, ME, VT

	License Holders	Fish. Budget
MA	193,299 (1996); 180,581 (97)	$4,865,026 (96); $4,639,786 (97)
ME	256,884 " ; 248,070 "	$7,065,908 " ; $8,304,434 "
VT	96,733 " ; 96,793 "	$2,222,100 " ; $2,080,281 "

% budget from:	licenses	fed. aid
MA	100%	0
ME	25%	75%
VT	56%	44%

% budget for propogation (hatcheries)

MA 58% (of $4.6 mil. = $2.69 mil.)

ME 60% (of ca. $8. mil = $4.8 mil.)

VT 40% (of ca. $2.1 or 2.2 mil = ~~$~~ $40,000 - $80,000)

Total Hatchery Production (% of total in catchables) + Number catchable h2o

MA 505,502 lbs (100%) 664,525 = 1.1/lb.

ME 243,107 lbs (77%) 639,136 = 3.4/lb.

VT 185,483 lbs (94%) 612,859 = 3.5/lb.

Cost/lb. all trout, catchable trout

MA 505,502 lbs. (all catchables) ÷ $2.69 mil. = $5.32/lb.

ME 243,107 lbs. (77% catchables, 23% non at $1.0/lb.) ÷ $4.8 mil = $19.60/lb. !!

catchables cost/lb. ??? (~~ca. $5/lb. catchable~~)

VT 185,483 lbs (94%) ÷ ca. $860,000 = ca. $4.65/lb. for all

ca. $4.000/lb. catchables

No. (and lbs.) of catchable trout per license holder

MA 3.5 (3.2 lbs.) / angler

ME 2.5 (< 1 lb.) / angler

VT 6.3 (1.8 lbs.) / angler

Although MA stocks fewer catchables than VT, MA catchables weigh > 3X VT catchable - Thus MA leads in biomass / angler.

New England, cont.

Some obvious discrepencies appear in the comparisons. According to data supplied by ME, fishery budgets for 1996 = $7.1 mil. and $8.3 mil. for 1997. It is stated that 60% of budget is devoted to propagation which would be about $4.3 mil. in 1996 and about $5.0 mil. for 1997. If a figure of $4.8 mil. is used to produce a total of 243,107 lbs. of hatchery fish (77% of which is catchable trout biomass), then the cost/lb. of all hatchery production would be $19.60/lb. Something is in error of how ME assigns 60% of budget to propagation. Critical analysis of ME "propagation" costs should be made.

MA claims 100% of its fish. budget comes from license sales, which would be a cost of about $26 for each license holder. What happens to fed. aid funds in MA? All (100%) of MA hatchery output is for catchable trout. Are there no ponds, lakes, reservoirs, or "softer" waters favorable for put-grow type fisheries?

IDAHO

License holders

508,937 (1996); 406,505 (1997)

Fishery Budget (gross cost)

$7,159,158 (96); $5,647,322 (97)

No data on sources of revenue; license, fed aid?

Hatchery Production (1997)

lbs. 1,244,872 lb. total, 908,733 lb. catchables (73%)

no. 11,575,197 total, 2,492,177 catchables 2.7/lb.

% budget for propagation: 27% (?) -- research = 14%, no other category listed. 27% & 14% = 41%, what other 59% used for?

For 1997, if 27% of $5.65 mil., = $1.5 mil., devoted to propagation, cost per pound of hatchery fish is greatly underestimated.

For all hatchery production, 1,244,872 lbs to cost a total of $1.5 mil., would be a cost per pound of $1.20! - No way.

Now, using the $10/lb. cost assigned for fingerling, subcatchables which were 356,139 lbs. (9,053,020 in number for ⅄ of 27/lb.) = $3.36 mil. - If 'true' cost of catchable trout were $3.20/lb., their cost would be: 908,733 lb. x 3.20 = $3 mil., for total of more than $6 mil., or more than total fish. budget of $5.65 mil.

Something is obvious wrong in how ID calculates hatchery costs. Van Vooren (1995. AFS symp. 15) cites a 1994 estimate that the cost of rearing and stocking a catchable trout in Idaho was $0.62. At 2.7/lb. = ca. $1.70/lb.; which would be about half of true cost.

(ca. $3.50/lb.) when overhead, administrative, and other associated costs of propogation are correctly calculated. However, even with the gross underestimate of $1.70/lb. for catchable trout in Idaho, the 908,733 lbs. produced in 1997 would cost just about $1.5 mil., which is the total cost of all propogation in ID as calculated from the 27% of budget (of $5.65 mil.) given in the T.U. data. If the 336,138 lbs. of subcatchable trout (averaging 27 per lb.) cost only $3.50/lb. to produce (gross underestimate), this would add about $1.2 mil. to propogation budget; 1.2 + 1.5 = $2.7 mil, which although large underestimate of true costs of propotion, it is considerably greater than the $1.5 mil. attributed to propogation.

Catchable trout production in Idaho, as in California, has declined in recent years due to budget restrictions. Van Vooren (op. cit.) stated that (in early 1990s), Idaho ~~at~~ annually stocked "over 3 million harvestable-size trout" for "400,000 licensed anglers" (ca. 8 catchables per angler). Although stocking levels declined, in 1997, Idaho stocked 6.1 catchables weighing 2.2 lbs. per angler. To place this is perspective of "need" in relation to a state's overall fishery program, consider that Idaho has almost ~~45~~ 500,000 surface area of ponds, lakes, and reservoirs for put-grow stocking (ca. 150,000 acres ca).

and almost 26,000 miles of rivers and streams for wild trout fisheries (ca. 8000 mi. CO (vs. 760,000 CO)), and a little more than 400,000 anglers in 1997.

Comparing how much water available per angler in Idaho, with states such as Conn. and Mass., and "need" for catchable trout stocking, Conn. stocks 3.8 catchables/angler, Mass. 3.5/angler, and Idaho 6.1!

From all of the above, Idaho might be considered with Nevada as the most "backward" states in relation to emphasis on catchable trout vs. wild trout. Actually, ID has more miles of trout streams (7000) managed for wild trout with special regulations than any state. Each proposal for wild trout mgt., however, is typically fought bitterly. Polarization occurs between the "common man" who associates catchable trout stocking with trout eating and the purist, elitist no-kill fly fishers--at least that how the issue is commonly perceived. There is little room for national dialogue based on facts and figures (a biologist told me of a public meeting in Idaho where a section of a river was proposed for wild trout, special regulation management, and someone in audience loudly proclaimed this would result in youth turning to drugs and crime as their fishing would be taken from them).

Idaho was one of the first states (in early 1970s)

to protect populations of native westslope cutthroat trout in Kelly Crk. and St. Joe R. with special regulations and cessation of catchable (rainbow) trout stockings.

A 1987 survey of Idaho anglers asked opinions on what the F.&G. Dept. should emphasize - 1. wild trout, 2. habitat, 3. hatcheries (rankings) - Habitat ranked highest (72%), wild trout next (67%), and third, hatcheries (60%). Evidently, many of the anglers didn't realize any contradiction in their rankings. I would point out that "hatcheries" or "propagation" which are necessary for put-grow type fisheries in lakes and reservoirs with no natural reproduction, should not be equated with catchable trout. This distinction is basic to address the question on the most proper use of catchable trout, their role in overall fishery program, and equitability of costs of catchable program among all anglers in relation to benefits. How can funds saved from reduced catchable trout production be better used to increase benefits to all anglers, is the crux of the issue.

NEVADA

Data on Nevada's catchable trout program can be compared with Colorado and California to illustrate major discrepencies on how costs are assigned and problems faced by any attempt toward standardization of parameters.

Using the same USFWS Fed. Aid data as for Calif. & Colo., and T.U. data, In 1997, Nevada had 160,130 individual license holders. 1,613,000 catchable trout weighing 474,194 lbs. (97% of total hatchery output) were stocked. It's total fishery budget ("gross cost to anglers) was $2,975,239 (round off to 3 mil $), of which, 25% ($750,000) come from license sales, ~~70%~~ 2.1 ~~1.775~~ mil. $) from fed. aid, and 5% 'other'. The license sale revenue of $750,000 ÷ 160,130 anglers = $4.75 from each individual license holder contributed to the fishery budget. Compared to the $8.32 for Calif. and $10.60 for Colorado contribution per license holder, large differences in how revenues are assigned is apparent. A much larger share of Nevada's budget comes from fed. aid (70% vs. 28% CO and 23% CA - but cost per license does not vary much among these states. Why the large difference in the proportion of license revenue making up the total fishery budget?).

i.e. $4.75 vs. $8.32 and $10.60 ?

Nevada, as contrasted with CO (91%) and CA (77%), claims that only 52% of licenses are "attributable to trout". A more realistic

figure.
For each license holder, Nevada stocked about 10 trout weighing about 3 lbs. (or about 20 trout and 6 lbs. per license "attributable to trout"). Nevada claims that 45% of fishery budget was devoted to hatcheries (45% to "research"). If true, 45% of 3 mil. $ = 1.35 mil $. Thus, accordingly, total hatchery production of 488,000 lbs. would cost $2.75/lb. ($4.60/lb. CA, and $4.25/lb. CO). Using some formula of $10/lb. for fingerling, subcatchables, and subtracting this, the Nevada cost of catchable trout would be $2.60/lb. vs. $4.43/lb. CA and $3.57/lb. CO. I doubt that Nevada's hatcheries are that much more cost efficient than CA and CO and the differences are more due to how costs are assigned than to actual costs of propagation. For example, Nevada might assign nutrition and disease research to "research" costs rather than to hatcheries. It is apparent, however that the data do show that Nevada stocks more catchable trout per angler than any other state, and has the most disproportionate emphasis on catchable trout of all states. This is especially true in view of the 52% of licenses "attributable" to trout. What is being done for the other 48% and for trout anglers preferring wild trout, or, at least, put-grow type of fisheries?

The actual situation could be worse than the figures cited above.

The Denver Post, April 28, 1998 issue, had article on catchable trout produced in 10 states (in attempt to show that some states stock more catchable trout per angler than does Colo.). Data was compiled by the Colo. Div. of Wildlife. Nevada led all states with 14.8 catchables stocked per angler. There is an obvious discrepeney between 14.8 and 10/angler as calculated from above figures.

I asked Matt Holford to get "official" figures from Elko office of Nev. F. & G. The "official" 1996 figures are: 1,850,259 (vs. 1,613,000 in 1997) catchable trout, weighing 549,757 lbs (vs. 474,194 lbs. in 1997) were stocked. License sales were 85,802 resident and 27,035 non resident for total of 112,837 (vs. 159,198 for 1996 and 160,130 for 1997 according to USFWS data). How is this discrepeney explained? If 'official' figure of 112,837 license holders is correct, then Nev. stocked 16.5 catchable trout weighing 4.9 lbs. per license holder in 1996.

If the discrepencies cited above can be reconciled and corrected, no matter what the most correct data on Nevada's catchable trout program, it will still be obvious that Nevada places a disproportionate emphasis on catchable trout--more so than any other state--in its overall fishery program. This becomes an urgent

issue in need of external review in light of what was found in Colo. and Calif. that there is no correlation between no. of catchable trout stocked and no. of licenses sold -- particularly for Nev. which claims only 52% of licenses "attributable" to trout (but not to catchable trout).

Concerning "external review", 40 years ago, in 1958, the Nev. Fish & Game Commission contracted with A. Starker Leopold and Paul Needham of The Univ. of Calif., Berkeley, to review the programs of the dept. I was personally involved in this review as a "technician" to do electro-fishing sampling. We found great waste from catchable trout stocking. Many marginal, remote waters that received little or no fishing pressure were being regularly stocked. Many catchables were being stocked in waters where they would not long survive, and many were being stocked into streams with abundant wild trout populations. No data were available to assess the returns on catchable trout in Nevada in 1958, but it was apparent that the catchable program was a great waste of fish and money -- and this was brought out in the Leopold-Needham report to the Commission.

I don't know if there has been any comprehensive studies on return to

anglers of Nevada's ~~catch~~ greatly expanded catchable trout program during the past 40 years. It is likely, from trial and error experience, catchable trout are now stocked in waters where fishing pressure is sufficiently high for favorable returns, but there is a strong suspicion that the present catchable program is still wasteful in fish and funds that could be better used (such as emphasis on wild trout and their habitat, put-and-grow fisheries emphasizing native Lahontan cutthroat trout and redband trout). An article in a 1997 issue of the Trans. Am. Fish. Soc. (126:57) concerned a Nevada catchable trout fishery in the Colorado River tailwaters of Lake Mead. Only about 10% of the catchable trout stocked at 10" in size were being caught by anglers (the rest, evidently were being caught by striped bass). By increasing the length of the catchable trout to 14", return to anglers about doubled to 20%. That is, it took 5 trout (14" = ca. one lb.) weighing about 5 lbs. to produce a catch by anglers of one trout. The implications of article was that this is a "favorable" return (in Nevada). At $2.60/lb. (an understimate), each catchable caught represented an investment, by all Nev. anglers, of $13.00!

CONNECTICUT (1997)

License holders 174,602

Fishery budget . . . . $2,292,000 (37% license, 46% fed. aid, 17% general fund)

Total hatchery production .. 334,000 lbs.

Catchable trout 321,000 lbs. (96% of Total)

No. catchable trout 669,000 (2.1/lb.)

No. catchable trout / license = 3.8 and 21b./angler

% licenses "attributable to trout" = 69%

% of budget for hatcheries = 25%! (66% "research")

25% of $2,292,000 (Total budget) = $573,000.

A cost of $573,000 to produce a total of 334,000 lbs. of all hatchery fish = cost/lb. of $1.72. Subtracting the 4% (13,000 lbs) of noncatchables at $10/lb. gives cost per pound of catchable trout of $1.38! No way!

Compared to New Hampshire, Conn. stocks fewer catchable trout per angler (3.8 vs. 5.6) although N.H. has considerably more water per angler to fish for wild trout and other fishes, but the cost per pound of hatchery fish between these two states, according to the cited data, differs drastically -- $1.72/lb. vs. $6.37/lb. for all hatchery fish, and $1.38/lb. vs. $6.25/lb. for catchable trout. Obviously, this is due to methods of cost accounting and not to comparative efficiencies of hatcheries. Conn. hatchery costs (true costs) need to be reassessed before any "standard" comparisons are possible.

Problems are readily apparent for standardized comparisons between CT and NH. Questions include: CT has more license holders--175,000 vs. 167,000 (rounded figures)--yet N.H. has significantly higher fishery budget (gross cost to anglers-US FWS)--$2.29 mil. vs. $3.57 mil., and contribution of license fees as proportion to budget and contribution of an individual license holder; NH=56% and $11.98 per angler vs. CT=37% and $4.85/angler. Fed. Aid is 44% ($1.57 mil) for N.H. budget and 46% ($1.05 mil.) of CT budget. How can these substantial discrepencies be explained. Why is the contribution per license holder ($4.85) so low in CT budget? Where does rest of license fees go? Despite great underestimate (by more than 2x) of cost of CT catchable trout, CT, ~~stocks~~ only 3.8 trout per angler (5.6 N.H, 10-18/angler NV, 4.7 CO, and 3.2 CA). Considering the density of anglers per unit of fishable waters, amount of water per anglen for wild trout, put-and-grow fisheries, and for other fishes, for CT as contrasted with the other mentioned states, CT might be considered a good example of holding the line on catchable trout production. This, however, is more likely a reflection on the total fishery budget ($2.29 mil.). Why does CT have such a low budget (only $4.85/angler contribution) in light of 175,000 licensed anglers?