

Biol. Indicators of Stress in Fish

- Review for Rivers

Oct 1990

Am. Fish. Soc. Symp. 8-

- book - environment
- monitor disturbances -
- physiolo, behavioral indicators
- molecular, biochem -
- Community Ind. (IBI)
- Ecosystem health
- Pop. indicators

NAJFM 1990 10(3)

p. 362 - Questions of habitat preference

(4)
- Rinne, Heede

- Biodiversity - 22th phono - BLM - USFS

- Tox - nontox -

* ex. mercury
Toxicology

- Salmon - steelhead - 133 -

- Conserv. Biol. - journal

how differ - Fish with mg.

concerns target sp. - related to land, frog - reverts

Ecosystems - 21) elements - holistic

- water development

- in ponds - game fish game bird, mammal

- new frogs, toads, salamanders, lizards -

Kingdom sp. birds -

* insect - plants - E.I.A.

* fragmentation - corridors

- gene flow -

p. 10 Colo. water new
Technol - Policies
* Medication Services
- resolve issue
- not if too polluted
positions fixed, unyielding
uncompromising

* Gellis, A., R. Hereford, S.A. Shumm, and B.R. Hoyer.

1991 (in press - J. Hydrol.) Channel evolution and hydrologic variations in the

Colo. R. Basin: Factors influencing sediment and salt loads - Great nation

- why? - cause - grazing - dams, dikes - road - sediment load - climate change

- landform ev. - dam

no native fishes

* toxic risk -

- hydrologic change

Salt Venet.

- sediment storage in Trib.

BIMONTHLY REPORT: FISHERIES - AQUATIC BIOLOGY

In the Sept.-Oct, report I discussed the need to establish a mechanism to avoid costly and lengthy delays for proposed projects by consensus opinion and professional judgement that would lay out all of the anticipated environmental concerns and predict consequences. My point was that such a consensus based on experience and expertise would produce more realistic and accurate predictions than would quantitative methods and models--simply because the inherent uncertainty and unpredictability of natural biological systems sets the limit of predictive accuracy and no amount of further research, additional data, or sophisticated models can change this fact.

If the predicted consequences of a proposed project were presented at an early stage for public discussion so that all concerns could be addressed, implementation of the project should be facilitated by avoiding lengthy and costly "research" that would be inconclusive in relation to conflict resolution. If there are significant, irreconcilable differences, they should be apparent at this preliminary consensus phase (for ex., Verde R. flow changes and spikedace).

Recently, the U.S. Forest Service granted approval for the Numont Mining Corp. to drill four exploratory holes in Coronado National Forest, Arizona to assess the areas potential for gold mining. According to the news media, there was an outcry from "scientists", "biologists", and "residents" (the "public") because the exploratory area is near Cave Creek Canyon which, "scientists regard as one of the most diverse wildlife mixing areas in the world and mining could shatter the region's ecosystem." It is obvious that "public" perception (the "public" that is organized in opposition and gains media attention) and the perception of U.S.F.S. and Numont personnel in regards to the implications of the "proposed impacts" of the permit has become polarized. Opponents will appeal the permit. I am not familiar with this particular case, but I wonder if this fierce opposition might have been dampened and fears allayed if a mechanism had been available at a prepermit stage to clearly lay out various scenarios that would address the anticipated concerns of the opposition? - Numont announced a 'delay' for exploratory work.

I do have some personal involvement, since 1989, as a consultant to a Numont subsidiary, the Idarado Mining Corp., in relation to action taken by the State of Colorado against Idarado and toxic mine wastes. After a 1988 trail, a federal judge ruled that Idarado was liable for about \$40,000,000 in damages, clean-up and mitigation costs. My role was to review all pretrail an trail evidence in relation to fisheries and aquatic biology damages claimed with a view to reduce the amount of the settlement or reverse the judge's verdict on appeal.

This was a classic case where public perception and attitudes were polarized long before the case came to trail. When I reviewed the evidence, it was obvious that the State had

ANNOTATED BIBLIOGRAPHY

Bestgen, K.R. 1990. Status review of the razorback sucker, Xyrauchen texanus. Colo. St. Univ. Larval Fish Lab. Contrib. 44. Prepared for U.S. Bur. Reclamation. Review of status and prospects for recovery.

Carlson, C.A. and R.T. Muth (in press) Endangered species management. Chapter for book: Inland Fisheries Management in North America. Am. Fish. Soc. Review of Endangered Species Act as applied to fishes. Case histories, restoration programs and problems.

Estes, C.C. 1990. Annual summary of statewide instream flow reservation applications. Alaska Dept. Fish and Game Fish. Data Ser. 90-43. Instream flow reservations can be made in Alaska for fisheries and recreation. In most cases the Tennant method is used to request an annual instream flow regime for specific species of economic value such as salmon. If "legally required", IFIM is used. It should be recognized that "legality" has nothing to do with "reality". The Tennant method, expressed as percentages of average daily flow by season, is biologically more soundly based than highly quantified data derived from a few transects.

Fletcher, R.I. 1990. Flow dynamics and fish recovery experiments: Water intake systems. Trans. Am. Fish. Soc. 119(3): 393-415. Previously, I had a request from SRP (Bill Warskow) on fish screens for irrigation canals. This article discusses efficiencies of various types of designs.

Rivers vol. 1 no. 3. Table of contents and article on problems of Indian water claims are enclosed.

Sanders, L.D., R.G. Walsh and J.B. Loomis. 1990. Toward empirical estimation of the total value of protecting rivers. Water Resources research 26(7): 1345-57. Example of use of contingent valuation method to calculate nonconsumptive values of instream flow.

U.S. Fish and Wildlife Service. 1990.

1. Recovery implementation program for endangered fish for endangered fish species in the upper Colorado River basin.
 2. Bonytail chub recovery plan
 3. Humpback chub recovery plan
- Copies of these three documents are enclosed.

Water Currents, summer 1990. Tenn. Tech. Univ. Riview of international symposium on conservation and management of rivers.

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This was a classic case where public perception and attitudes were polarized long before the case came to trail. When I reviewed the evidence, it was obvious that the State had

convinced the judge to accept some outrageous falsehoods. In regards to the trout population in the San Miguel River, exposed to heavy metal contamination, there was a direct correlation between heavy metal concentration and trout biomass--the greatest biomass per unit area occurred in the area with highest metal concentration, and the least biomass occurred in river segments with the lowest metal concentrations (segments meeting water quality standards). All indices of well-being of the fish--growth condition, fecundity, signs of impairment--reflected a very healthy, above average trout population. It was obvious that trout abundance was limited by habitat not water quality. The State's "experts" applied a habitat model which predicted that there should be five times the abundance of trout than was sampled in the contaminated area--therefore demonstrating water quality limitations. Close scrutiny of the State's habitat model and how it was applied revealed gross errors and "fudging" to achieve the desired predictions. Moreover, when the model was tested in streams with no contamination, there was an inverse correlation between the model's prediction and actual trout biomass!

Another fishery damage claim against Idarado was the loss of a fishery in the newly completed Bureau of Reclamation's Dallas Creek Reservoir, due to heavy metal pollution. The State claimed that this 1000 surface acre reservoir could not support a trout fishery resulting in the loss of values associated with 16,000 angler-days of recreation. The fact is that the water in the reservoir (being filled during 1987-1988) has a pH averaging 8.6. It is common knowledge that heavy metals precipitate out of solution at alkaline pH. With pH of 8 or more, removal is essentially complete. The reservoir had a thriving trout population by 1988, the water in the reservoir met all water quality standards and fish contained no residues of heavy metals. In 1990, the reservoir was open to public fishing. About 16,000 angler days have been expended to catch more than 25,000 trout.

Once this case reached the trail stage, the emotional issue of toxic wastes made the corporation extremely vulnerable to outrageous and erroneous charges. One newspaper headline announced that 22% of the children in the town of Telluride, where the greatest amount of mine tailings existed, had tested above the national average for lead contamination--which literally means that 78% were below the national average--a very healthy environment, much better than the national average.

In 1990 the Appeals Court reversed the judge's verdict, but the legal fees alone for the Idarado case have exceeded \$10,000,000. Evidently, a resolution of the Idarado case before the trail phase was hindered by the great zeal of some middle level employees of state and federal agencies in their belief that they were fighting evil and corrupt forces--reason and common sense had no meaning to them. I still ponder the question, that if an effective mechanism could be established which would promote reasoned judgement and common sense, could controversial environmental issues be resolved at an early stage? The obvious suggestion would be to "set up a committee".

The enclosures accompanying this report illustrate that this can be a high risk alternative where good intentions are

institutionalized, resulting in catastrophic costs with little benefits.

Enclosures 1,2,3, are copies of the USFWS' Recovery implementation program for endangered fish species in the Upper Colorado River basin (work plan for 1991); Recovery plans for bonytail chub and humpback chub. - The Recovery Implementation for upper basin endangered fishes is programmed to spend \$59,000,000 from 1988 to 2003 (15 yrs). This is in addition to several million dollars spent from 1979-1988. Also, not included in the \$59,000,000 estimate is funding for seven years of research that FWS is demanding to allow the Animas-La Plata project to proceed. The enclosed reports mention a FWS "biological opinion" to the Bur. Rec. in regards to operation of Flaming Gorge dam on the Green River. Last week it was announced that this opinion would be delayed for five years--and the Bur. Rec. would pay \$300,000 per year during this period for "further research". Enclosures 4,5,6 illustrate the "structure" of the Implementation Program, "perceived concerns" of its members, and an example of "positive action". Evidently frustrated by lack of any clear benefits for the endangered species after years of "research" and great expenditures, one member has started a crusade to change the name of the squawfish because it is offensive to native Americans. Since no Indian tribe has ever expressed displeasure with the name squawfish, Ms. Young contacted the Southwest Tribal Council to support her efforts to do good. This episode epitomizes the whole history of the upper basin endangered fishes program--good intentions institutionalized to run amok. It all began with a memorandum of understanding between the Bureau of Reclamation and the USFWS in 1979 which essentially said that if the B.R. gave one million dollars to FWS, in two years time the FWS would make biological opinions on all upper basin B.R. projects allowing them to operate in conformance with the Endangered Species Act. What's happened since then is an instructive example that "committees" will spend money to the extent it is available. Millions of dollars are to be spent on "genetics" and "taxonomic" research. Decisions were made by people who have no more knowledge or understanding of genetics and taxonomy than they do of atomic physics or quantum mechanics. I could make a "professional judgement" now, which I believe, will accurately predict the results of the proposed genetics and taxonomic research.

Enclosure 7 are copies of pages from a monograph I recently completed on western trouts (to be published by the Am. Fish. Soc.). My discussion deals with limitations of modern technologies used in quantitative genetics to "characterize". It was written with the expressed purpose to inform uninformed biologists--as exemplified by the committee people who vote millions of dollars for "research" on subjects with which they are ignorant.

In any event, be aware that if a lower Colorado River basin endangered fishes implementation program is proposed it will not likely function in conformity to my concept of a mechanism for conflict resolution. Institutionalization of good intentions does not work.

Enclosure 8 is copy of article from "Rivers" on Indian water claims.

BIMONTHLY REPORT: FISHERIES, AQUATIC BIOLOGY
JAN.-FEB. 1991

Last week Jim Cooper requested rapid critique of draft of "Instream Flow Hydrologic Assessments" for meeting on Instream Flow (copy of my comments enclosed). I have arranged this bimonthly to supplement the comments sent to Mr. Cooper.

The document prepared by the Instream Flow Task Force does not appear to be an attempt to make IFIM the standard method for Arizona (use mandated) as was proposed by this group two years ago. They want to "establish" a method for level 2 proposals to change flows (controversial cases). I would prefer that options be left open rather than to "establish" one or two methods. My preference is based on fact that despite the opinions of the I.F. Task Force (an IFIM advocacy group), no method has any logical basis to claim credibility or defensibility. The basis for my conclusions can be found in my SRP reports over the past several years and are summarized in my comments to Mr. Cooper. Also enclosed is copy of letter to David Harpman of the University of Arizona which provides further elaboration in more detail. Copies of reviews of a paper submitted to the journal Rivers (enclosed) and bibliographic citations to Bartholow and Slauson demonstrate the current state of confusion and disagreement among the most experienced and expert practitioners of IFIM. The citation in bibliography to Heede and Rinne concerns fish habitat from a holistic fluvial-geomorphologic point of view, using Arizona streams and the threatened loach minnow (Tiaroga cobitis) as examples. Such hydrodynamic complexities determining fish habitat simply cannot be adequately addressed by IFIM.

I doubt that the I.F. Task Force members are aware of all of these limitations for IFIM, or have an in-depth understanding why any and all methods lack predictive accuracy. If they did, they would not tout method credibility and defensibility for controversial cases. Again and again the USFWS has declared IFIM was not to be the basis for decision making for flow determinations for endangered species--the most controversial of cases. This was demonstrated in the Verde River case for both flow depletion and flow supplementation in regards to jeopardy to the spikedace. Why would the Task force members believe such a controversial case would now be resolved by the credibility and defensibility of IFIM?

Actually, from a water development perspective, IFIM can make flow depletion look good. Enclosed are pages from BLM document describing an interdisciplinary approach for making instream flow recommendations for the Dolores River below McPhee Reservoir, Colorado. Note that quite different flow recommendations for the trout fishery were made based on IFIM analysis performed by the Colorado Division of Wildlife and by the BLM. This discrepancy is due to river sections studied. The CDOW recommendations were based on a higher gradient, broader reach of

the river (where higher flows are necessary to maintain suitable depths). Even the higher flows recommended by CDOW, however, are significantly less than what would be recommended by level 1 methods, such as the Tennant method based on percentages of long term average flow. Most of the strong criticism and challenges to the credibility of IFIM have come from conservation agencies objecting to flow recommendations derived from IFIM that they deemed too low.

My reservations for embracing IFIM or any method as a standard for conflict resolution concerns delays and costs for a study that may go on for three to five years or more, costs 100s, of thousands of dollars, and still be inconclusive, open to challenge and finally declared, "not for decision-making", as illustrated by the Verde River case.

If the conflict is intense and the opposing interests polarized, no method can resolve the controversy.

In the last few bimonthly reports I have cited examples of various attempts to resolve conflicts among diverse interests in regards to instream flow. There are mediation groups that now specialize in conflict resolution (enclosure of Denver Post article on such a group in Boulder, CO). Perhaps significant progress has been made in techniques and methods for conflict resolution. In this regards, I note the BLM Value-Based, Interdisciplinary Approach listed in Biologic Assessments report as a level 1 method. This method appears to hold the greatest promise for conflict resolution (level 2). Potential irreconcilable differences should be clearly identified at this stage, and decisions made toward resolution. As mentioned in enclosed review of paper for "Rivers", increased predictive accuracy can be expected if critical sites reflecting patterns of high regularity can be identified. Critical sites might be the spawning and nursery areas required by an endangered species. Optimum flows for critical sites for critical times of the year could be determined with some reliability. Such an approach has an advantage for predictive accuracy over a whole river reach approach similar to a rifle vs. a shotgun.

In regards to legal defensibility, things aren't always what they appear to be as given in a news release. The enclosed copy of Habitat Evaluation Notes proclaims that HEP was upheld in court. Both HEP and IFIM are based on Habitat Suitability Indices to quantify habitat (Habitat Units of HEP, and Weighted Usable Area of IFIM). The implication of the title is that the court established the "legality", the "credibility", or "defensibility" of the method. In this particular case the USFWS (after being coerced by environmental groups) reduced livestock grazing intensity on a wildlife refuge (primary purpose of refuge is wildlife, not cattle). HEP was used to demonstrate obvious differences in vegetation between areas grazed and ungrazed by cattle. The livestock interests sued, claiming that HEP (or it would be IFIM if stream flow was involved) is so prone to error, imprecise, unscientific, etc., it should not be allowed as evidence in court. The judge did not rule on credibility of the method, noting that the court is not required to resolve disagreement on methods, but only that the EIS complied with NEPA and its not "illegal" to use a certain method.

Another enclosure is page from a Colorado Division of Wildlife newsletter. The use of the PHABSIM model of IFIM to argue against flow reductions in the Taylor River is cited as contributing to favorable ruling by court. David Harpman's study (see enclosed letter) is based on this same Taylor River and used the same IFIM data and models to conclude that reduced flows from proposed project would have negligible impact on trout population. An experienced and glib expert witness can get away with "murder" in court in a case such as this unless the opposing attorneys (and their consultants) are thoroughly knowledgeable on the methods and methodologies, and aware of pertinent studies such as Dr. Harpman's for refutation. They didn't do their homework adequately and deserved to lose.

ANNOTATED BIBLIOGRAPHY

Australian Water Resources Council Conference Ser. 18 (1989). Proceedings of workshop on instream flow needs. Volume contains 38 papers on instream flow problems, methods, etc. Example of symposia and workshops held around the world in recent years. If any method, such as IFIM, had the qualities originally assumed, there would be no need for such meetings.

Bagley, B. 1990. The updated status of the Sonoran topminnow (Poeciliopsis occidentalis) and desert pupfish (Cyprinodon macularius) in Arizona. Proc. Desert Fishes Council vol. 21 : 231. Report on Arizona G. & F. efforts to restore these endangered species.

Bartholow, J. and W. Slauson (with response from B. Parsons and W. Hubert) 1990. Questions of habitat preference. N. Am. J. Fish. Mgt. 10 (3): 362-63. Controversy about HSI preference curves used in IFIM. Leading experts who develop and use IFIM cannot agree on how to develop preference curves or their usefulness. Also see enclosures regarding review of article for journal "Rivers" on similar subject. I doubt that the Arizona Instream Flow Committes advocating IFIM for "level 2" assesement are aware of these problems of expert disagreement.

Cheslak, E.F. and A.S. Jacobson. 1990. Integrating the instream flow incremental methodology with a population response model. Rivers 1 (4): 264-288. Example of use of IFIM by developers of a California hydroproject to demonstrate benefits to fish populations from new flow regime. As discussed in text, most opposition to IFIM comes from conservation agencies, not developers because IFIM can make lowest flows look good.

Environmental Management. 1990. 14(5). This issue is devoted to papers on stream disturbance and recovery. Several interesting papers.

Gellis, A., R. Hereford, S.A. Schumm, and B.R. Hayes. 1991(in press). Channel evolution and hydrologic variations in the Colorado River Basin. I reviewed this paper, to be submitted for publication, on factors influencing sediment and salt loading to the Colorado River. Conclusion is that trend for reduced loading is result of increased sediment storage in flood plains of tributaries.

GIS World 1990. 3(6). This issue reviews GIS use and development among federal agencies.

Gore, J.A. and G.E. Petts (eds.). 1989. Alternatives in regulated river management. CRC Press. Book contains individually authored chapters pertaining to regulated river management

problems.

Heede, B.H. and J.N. Rinne. 1990. Hydrodynamic and fluvial morphologic processes: implications for fisheries management and research. Fish habitat in relation to flow from a fluvial geomorphologic point of view. Arizona examples given with discussion of habitat for threatened loach minnow. Demonstrates hydrologic control on stream channel, substrate, and fish habitat. Complexities not considered by IFIM.

U.S. Fish and Wildlife Service. Colorado squawfish recovery plan. 1991. Update of 1978 plan, or how to spend additional 59 million \$. Mentions goal to re-establish squawfish in either Salt River from above Roosevelt Lake upstream to Apache Falls or in Verde R. from Horshoe Res. upstream to Pauldin.

U.S.F.W.S. Habitat Evaluation Notes. 1991. 5(1). Contains article, "Court upholds HEP in test case". As discussed in text of report, the use of Habitat Suitability Indices (used in HEP and IFIM) to assess impacts of livestock grazing on a wildlife refuge, was upheld by a U.S. district Court, but this decision has no relevance to the approval or endorsement of a standard method.

Vandas, S. and 8 other authors. 1990. Dolores River Instream Flow Assessment. BLM/YA/PR-90/003 +7200. Discussed with enclosures as example of multidisciplinary approach for instream flow recommendations.

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February 25, 1991

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Dear Dave:

In regards to your paper, I offer following comments. The experimental of state-of-art aspect should be emphasized without implying acceptance of predictive accuracy of IFIM to associate flow-habitat-fish relationships. The actual relationships among these components and the ability of IFIM to quantify flow to habitat (by Weighted Usable Area) and to relate WUA to fish biomass-abundance is so uncertain and unpredictable that little resemblance to biological reality is retained in the quantifications. For example, a basic assumption for predictive accuracy is that the fish population is habitat limited; its abundance-biomass can change only with a change in WUA. The fallacy of this assumption can be understood when it is realized that the abundance-biomass of a population relates to niche volume (increasing volume = increasing population) and habitat (physical characteristics of sites where fish exist) is only a part of the niche volume. In the Frying Pan River for about one mile below Ruedi Dam and in the Taylor River just below Taylor Dam, Mysis shrimp from reservoirs are transported in large numbers into tailwaters. This additional food supply increases the niche volume of trout existing in these zones, but habitat-flows-WUA are unchanged. The habitat limited assumption can be tested by fish population response. In Frying Pan River trout biomass increased from about 200 lbs./acre before Mysis to 1000 lbs./acre after Mysis with no change in WUA. Another test concerns a common fisheries management strategy to chemically treat waters to remove nongame fishes (typically species of minnows and suckers). In theory, the removal of species whose niches overlap the trout niche will increase the biomass of trout by increasing the trout niche volume (with no change in habitat of WUA). Typically when other species are eliminated, trout populations greatly increase in abundance-biomass, with no changes in habitat (IFIM has enough limitations when dealing with ^{single} simple species in simple ecosystems; where interspecific interaction occur, any semblance of association between WUA and species abundance disintegrates).

If all of these limitations for predictive accuracy were not enough, another problem concerns hydraulic simulation modeling to

"backcalculate" WUA from flows of previous years) (for your time-series analysis). None of the hydraulic models can accurately predict depths and velocities for a wide range of flows. I assume the data points for effective habitat available from 1975 through 1987 (fig. 2) are based on average annual flow -- as if the whole year is represented by one day (average daily flow). The gross inclusiveness of such data points would bear little resemblance to biological reality even if there was a strong relationship between WUA and trout abundance-biomass. ✓

Another obvious example of IFIM limitations to assess biological reality concerns rainbow trout in the Taylor River, are stocked. Over many years of observation, no natural reproduction of rainbow trout has been found. That is, if stocking ceased, rainbow trout would disappear. I suspect that if WUA were computed for all life history stages for rainbow trout -- spawning, juveniles, adults -- the quantitative results would show that not only do rainbow trout reproduce successfully, they are dominant over brown trout. A similar situation occurred in the Red River, N.M. A few years ago a paper was published in the Jour. Water Res. touting how IFIM was used to resolve an instream flow case. The paper reproduced weighted usable area quantities for brown trout and rainbow trout for all life history stages to demonstrate that the Red River habitat contained more WUA for rainbow trout than for brown trout for all life history stages at all flows. I was advising the U.S. Justice Dept. on this case and I knew that all rainbow trout were stocked and no natural reproduction was occurring. If the stocking ceased, the Red River, as the Taylor, would have only brown trout, despite the IFIM predictions. ✓
As you mention, all rainbow trout.

In recent years the limitations of IFIM have become generally known. The "parent organization", the USFWS, has declared IFIM is not to be used for decision-making in regards to flow recommendations for endangered or threatened species. The EPA veto of Two Forks dam concluded that the fisheries impacts could not be avoided by mitigation, a trade in WUA (increase WUA in other streams to replace lost WUA inundated by reservoir) was based on "uncertain science". ✓
because

Now that I've refreshed your memory on IFIM limitations, I suggest the lack of clear predictive accuracy be admitted, but point out that the long term data accumulated on the Taylor River and the time-series analysis should make your data better than found in most IFIM studies. A bottom line summarizing statement could point out that despite assumed lack of precision, the before and after flows about balance-out. In high flow years, reduced flows (which would tend toward 100% of long term average) should benefit trout habitat and in low flow years, the post project reduction would further degrade trout habitat (professional judgement quantified in fig. 2). Because of the high catch-rate in the Taylor River fishery, The addition of or loss in the average catch of one fish has relatively low economic value, and the long term economic impact of the new flow regime is predicted to be negligible-slight. The exposition of fishery and economic data by your method allows a basis for negotiation between opposing interests. The USFWS no longer touts IFIM as an ✓

ecosystem model which accurately predicts flow-habitat-fish associations, but as a "negotiating tool."

On page 18 you mention that a regulated flow regime can have beneficial effects on a fishery, citing the South Platte River below Cheesman Reservoir. Actually, most of what might be called the superstar trout fisheries, with 100's lbs./acre biomass and high proportion of large, fast-growing fish, Juan, Frying Pan, Bighorn, Green R. (Flaming Gorge), etc. This is due to more stable flows (lower high flows and higher low flows compared to preregulation) and more optimum temperatures (10° - 20°C) throughout most of year. Also due to removal of sediment load in reservoir and input of food from reservoir.

such as
are
regulated
rivers.

Sincerely,

Robert Behnke

BIMONTHLY REPORT : FISHERIES-AQUATIC BIOLOGY

MAR-APR 1991

In the Jan.-Feb. report I critiqued the naive faith of the people involved in writing the draft of the "Instream Flow Hydrologic Assessments" report for their defense of the "credibility" and "defensibility" of IFIM (or any method) for level II assessments (controversial issues). Last month I was invited to address a dinner for the officers of the Colorado chapter of the American Water Resources Association, along with Ken Bovee (USFWS) who presented a program on the use of IFIM for instream flow assessment (Mr. Bovee is the lead person in the FWS promoting IFIM).

After Mr. Bovee gave his presentation, I further elaborated on the points made in my last bimonthly report to demonstrate that IFIM or any method will lack credibility or defensibility in controversial cases where opinions and objectives have become polarized. I explained the logical basis why any method lacks predictive accuracy in complex natural systems and pointed out that IFIM (or HEP) have been declared "not for decision-making" in cases involving endangered species.

I also pointed out that the most intense opposition against IFIM studies has not been from backers of water development projects but from environmental groups. I cited the TwoForks Dam case whereby the Denver Water Board had intensive IFIM studies made to calculate the 36,000 habitat units (WUA) would be lost due to reservoir inundation. The EIS claimed this loss would be fully mitigated by increasing habitat quality in other streams controlled by the Board by habitat improvements and flow manipulation until an additional 36,000 WUA's were created. The Board played by the rules, using the "official" federal method of habitat analysis and quantification. The critical issue for accepting or rejecting Two Forks Dam concerned if the impacts were mitigatable. The environmental groups intensively fought all claims in the EIS but zeroed-in on the credibility-defensibility of the IFIM results as the basis of mitigation. They were successful. Last November, in the written EPA statement rejecting Two Forks, it was concluded that the proposed project was unmitigatable because the basis for mitigation (IFIM) was based on "uncertain science", I pointed out that concepts of "credibility" and "science" are influenced by politics. In 1981, during the early stages of Two Forks planning and EIS preparation, Ann Gorsuch (later Burford) was head of the EPA. She appointed James Sanderson, chief attorney representing the Denver Water Board, as her "right hand man". Under that political regime, the Two Forks EIS would certainly have been approved by the EPA and the project permitted on the basis that scientific methods demonstrated its mitigatability.

I discussed how controversial instream flow issues are currently negotiated. The citation to Rulifson and Manooch (1990) in bibliography refers to, at least, a temporary resolution concerning striped bass (a species generating controversy in

regards to causes of decline), Roanoke River flows and FERC relicensing of a hydropower dam. An interagency team, after long wrangling, finally agreed to a four year flow regime that would not fall below the long-term 25 percentile or above the 75 percentile flows during the striped bass reproductive period. The decision was based on 10 years of monitoring reproductive success by sampling young bass in the river downstream from the dam. The statistical data were "shaky" but there was a trend showing best spawning success when the flow was not too low or not too high, but "just about right"--although no one could say what "right" should be. Thus, a professional judgement, common sense decision was made, much as it would have been 20 years ago before the naive faith, based on ignorance, pervaded state and federal agencies to unquestioningly embrace standard methods and models to resolve environmental conflicts. A "level I" method was used to resolve a "level II" conflict.

After our talks, Mr. Bovee told me that he completely agreed with everything I had said.

Last month a consulting firm asked me to review a proposal for a study designed to assist the State of Montana in a lawsuit for fisheries damages. Montana has a suit against ARCO (successors of the old Anaconda Corp.) for damages to the Clark Fork trout fishery by heavy metal contamination. Although the mining and smelting operations are shut down, drainage from tailings still contaminate the river. Despite marginal heavy metal pollution, a relatively good wild trout population is established in the pollution zone. The State contends that the trout population would be significantly larger if it was not impacted by pollution. The proposed strategy is to sample a "control" stream and compare its trout population with the polluted section of the Clark Fork (This is the basis for EPA's "use attainability" criterion). There are several excellent trout streams in the area that could serve as the "control" stream and comparisons of trout biomass might show 200-250 lbs./acre in control stream and only 50-75 lbs./acre in polluted section of Clark Fork. To be an acceptable comparison, however, the judge would have to be convinced that all environmental-habitat conditions between the streams being compared are similar except for heavy metal concentrations (that is, highway construction, agricultural, livestock impacts are essentially identical except for heavy metals--which then logically explains why trout biomass is less in Clark Fork than in control stream--and the State is entitled to damages). The proposal to conduct the "control" stream study would use GIS, IFIM, VBT (Valley Bottom Type) computer programs to establish the scientific basis of the methodologies and "prove" damage. "Phase I" of the proposed study would cost more than \$70,000 to get the models in gear and ready for action.

I was asked for my opinion if the investment in such a study would be justified. My response was that if such a study using all the proposed computer models was conducted and presented in court it could likely fool the judge, but if the same court testimony would be submitted for publication in a peer-reviewed scientific journal, it would be rejected as science fiction. The trail, if the case is not resolved, would likely evolve into which

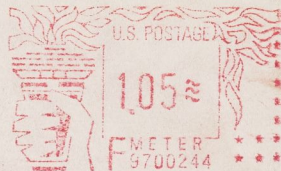
side can create the best illusion, the best slight-of-hand tricks, "science" would play a role only in the opinion of the judge. My advice was that the proposed study might be considered as a risk analysis--would it be worth risking \$100,000 if damages might be increased by \$1,000,000, but scientific soundness has nothing to do with it--it would be a classic example of the illusion of technique. If the budget was limited, I would concentrate on the "hard" evidence such as water and sediment data, fish tissue bioassay, documented fish kills, etc. rather than "soft" evidence derived from models and methods judged to be of "uncertain science" by the EPA. As I mentioned in the last report, an expert witness can get away with murder in court on fisheries-aquatic biology issues unless the opposing attorneys and their experts are highly knowledgeable on the specific issues. I wouldn't expect that ARCO will ^{be} stint on its legal defense.

Enclosures: 1. Excerpts from bulletin of Am. Forest Resource Alliance. Recently, commodity users on federal lands (mainly the timber industry of NW) have established a lobby in Wash. D.C. and has contracted for several studies (published as technical bulletins) in an attempt to counteract trend to de-emphasize commodity values and emphasize environmental, ecosystem, recreational values in multiple use management, mainly on USFS and BLM lands.

Enclosure 2. Includes copy of the Inner Voice, one of the most effective publications driving the movement which the AFRA is attempting to counter. The articles on the proposed ESA listings of Pacific salmon races denote the great endangered species-environmental battle of 1991. The controversy is too intense for resolution by mediation and negotiations. The basis for listing a great number of salmon races (= populations, not species or subspecies) is found in the Mar-Apr issue of Fisheries which I have just received. Further details and implications will be in my next report.

July - Aug.

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ROBERT BEHNKE
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- * Goodman - hatchery violator E.S.R.
Aspen Trout White R. Res.
- USFS program!

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Mar. - Apr. 1991

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BIMONTHLY REPORT

MAY - JUNE 1991

At the end of ~~the~~ my March-April report I mentioned I would discuss the implications and ramifications ^{of the listing of populations or races} of ~~populations~~ under the Endangered Species Act. The northern spotted owl and the Mt. Graham red squirrel ^{formally recognized and described} are ¹ subspecies of widespread species. The problems caused by their listing are well known and ^{the} objections to the listing of subspecies are also well known (for example, Manual Lujan's ^{remarks} in reference to the Mt. Graham red squirrel -- red squirrel, black squirrel, what's the difference?). The Endangered Species Act defines species to include subspecies and their interbreeding parts (= ^{down to} population level). ~~That~~ Until recently, "parts" of ~~species~~ or subspecies populations, stocks or races (groups of closely-related populations agreeing in some attribute such as time of entry into a ^{certain} river of a salmon species for spawning) have not been listed ^{and protected} under the Endangered Species Act.

In 1988, a petition was delivered to the National Marine Fisheries Service (lead federal agency for listing of marine species and anadromous fishes) to list the winter-run ~~stock~~ of chinook salmon of the Sacramento River. After legal action and faced with the evidence

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of only a few hundred fish returning to spawn in 1989-90 (~~for~~ historically the winter run of chinook salmon averaged more than 100,000), this race of salmon. (actually, ^{now a} a single population which spawns in the Sacramento River below Shasta dam) was granted emergency listing as a threatened species in November, 1990. Note that the winter-run chinook salmon of the Sacramento River is not a species or a subspecies (formally described taxa). The chinook salmon, as a species is not rare, ^{many} millions of pounds are caught and ^{sold} ~~marketed~~ annually. The species as a whole is made up of an almost infinite number of parts such as the various populations of chinook which spawn in the Sacramento and Columbia river basins (100's of such populations originally occurred in these basins). In recent years, the field of conservation biology has achieved ^{considerable} ~~high~~ prominence (preservation of biodiversity, most of which is intraspecific diversity found in populations and races of a species, or "nontaxa" diversity), and influence among federal, ^{natural resource} agencies. The formal listing of the winter-run chinook salmon opened the gate for a potential flood of such listings. This listing of the Sacramento chinook population was soon

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followed by a petition from the Shoshone-Bannock Indian tribes of Idaho to list three runs of chinook salmon (spring, summer, and fall runs) ^{of The Snake River} ~~and~~ and the sockeye salmon which spawned in Redfish Lake, Idaho (although this sockeye population is extinct, in its pure form, it has been recommended for listing by the NMFS). This petition was joined by environmental groups which also added the coho salmon of the Columbia basin to the petition. The implications for ^{the} listing of these Columbia basin salmon races for electrical power generation, irrigation, navigation, land-use practices, etc. are enormous. Senator Hatfield convened a "salmon ~~summit~~ summit" bringing in professional mediators in an attempt to reach ~~some~~ ^a compromise among the diverse interest groups. As I have pointed out in previous reports, once an issue becomes highly polarized, no methods, models, or mediators, can satisfactorily resolve the conflicts. An example of the complexity ^s involved can be illustrated by the fact that the Indian tribes of Oregon and Washington are opposed to the listing ^{ing} initiated by the Idaho tribes because such listing would interfere with their commercial fishery for salmon.

~~While~~ While the petitions for listing ~~five~~ ^{to} five

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racess of Columbia basin salmon was under consideration, a paper by Nelhser et al. (1991) was published which identified 214 "stocks" of salmon (including steelhead trout) at risk of extinction in California, Oregon, Washington and Idaho (208 in addition to the five already formally petitioned) and the Sacramento winter chinook). Of these, 101, were identified at "high risk" (qualify for listing under the Endangered Species Act).

What might have appeared to be two possible solutions to ~~the~~ avoid^{the} listing of ~~salmon~~ races, stocks, or populations of salmon ~~now~~ are no longer viable. The obvious response to increase the abundance of an endangered or threatened race would be large-scale ^{hatchery} propagation ~~in a hatchery~~ of young fish for stocking. A paper by Goodman, cited in the Nov-Apr. report ~~below~~ documents the evidence that most of the extinction risks of the wild races of salmon ^{have} ~~has~~ been caused by the long-term and widespread stocking of hatchery salmon -- the ^{unregulated} continuation of hatchery propagation would constitute a jeopardy to the continued existence of the races at risk of extinction; a violation of the Endangered Species Act.

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The ^{often indiscriminant} stocking of billions of hatchery salmon over the years must have resulted in "hybridization" between wild and hatchery salmon so that few, if any, of the present wild races, stocks, or populations would be considered as "pure". Since 1988, ~~attorneys~~ U.S. ~~of the~~ Dept. of Interior attorneys made three opinions ~~that~~ to the effect that hybridization ~~of a species, subspecies, population~~ disqualified a species or subspecies (or race, stock, population) for listing under the Endangered Species Act.

Papers cited in my last report by Fergus (on Florida panther, ~~an~~ hybridized subspecies) and O'Brien and Nays (on bureaucratic mischief) were highly critical of bureaucrats and attorneys meddling in biology and deciding what qualified for protection under the Endangered Species Act. Evidently to avoid further embarrassment, the U.S.D.I. has withdrawn the hybrid opinions (N.Y. Times, Mar. 12, 1991).

Now that the floodgates are open, a rash of petitions to list "nontaxa" (populations) may be expected. For example, ^{a population of} the Arizona chub" once recognized as Gila intermedia, but not recognized as a species by the American Fisheries Society (considered as Arizona populations of the widely distributed G. robusta) ^{found} in a tributary of the Salt or Verde rivers could

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be petitioned for listing as an endangered species, following the same criteria used for races of Columbia basin salmon -- for the time being, at least, in relation to endangered species listing, anything goes.

The lack of a sound biological basis to make any valid flow recommendations for Columbia basin salmon is similar to the situation with the spike dace of the Verde River. The environmental groups are naively ~~pushing~~ ^{demanding} that the Columbia River basin be regulated to duplicate the natural flow patterns, arguing this would be necessary during spring ^{early} ~~summer~~ months ~~to spill water~~ ^{for} high flows to go over spillways of dams (instead of through turbines) to transport the young salmon to the ocean. Presently, nine dams must be traversed by salmon to reach Columbia River tributaries below Grand Coulee dam (upstream limit of migration) and eight dams must be negotiated for adult spawners to reach the Snake River, Idaho, or young from the Snake River to reach the ocean. The problem is that ^{the} water ~~is~~ going over a spillway becomes supersaturated with nitrogen. The mortality ^{to young salmon} caused by nitrogen supersaturation can be much greater than mortality from passage through turbines.

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Also, the ^{few} wild runs of chinook salmon that have maintained their historical abundance occur in Columbia tributaries below Grand Coulee (Wenatchee and Methow rivers and Hanford reach of Columbia). ^{populations of} This summer-run race must negotiate 7-9 dams and their young migrate to the ocean during mid-late summer during the lowest flow period (assumed to be worst possible conditions). Another consideration is that shad, introduced from the East Coast in the late nineteenth century, have increased their abundance in the Columbia River in the past 50 years from a few thousand fish to many millions of spawners (^{The} shad, like salmon, is an anadromous species). What effect do the billions of young shad, also migrating to the ocean with young salmon, have on the salmon (competition for food, etc.)? Thus, a common pattern ^{seen in} of flow-habitat-species abundance controversies is apparent. ^{The} sound biological knowledge to resolve the controversy is lacking - too much faith had been placed in methods, models, and mediators.

Enclosures

1. Pages from publication of Columbia River Indian tribes re. failed salmon summit. These tribes are not in favor of listing of Columbia-Snake R. salmon races because of ~~probable~~ ramifications

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for their commercial fishery and their hatchery operation programs, ~~but they~~

2. Article on ramifications of salmon listing.
3. Re. most logical hypothesis to date explaining decline of striped bass on East Coast. Most reproduction of striped bass occurs in tributary rivers to Chesapeake Bay, and the Potomac River is the most important of Bay tributaries. Note figure 11 of article showing relationship between striped bass abundance and Biol. Oxygen Demand (a surrogate for ^{the amount of} ~~poorly~~ treated sewage effluent discharge). It appears that meeting water quality standards has been devastating to the striped bass.
4. Copy of review I wrote for paper submitted for publication. Example of "in-house" Bureau of Reclamation research (\$500,000 expended) on flow-habitat-survival of young squawfish, which produced no meaningful results. Also example of lack of coordination between USFWS research on same subject (see several citations to Tyus in bibliography) and Bur. Rec. USFWS people do their thing, Bur. Rec. people do theirs, and nothing much ~~of~~ use comes of it all.

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omit -
I'll put
in next
report

Colorado Division of Wildlife - Recovery program
~~Colorado Division of Wildlife~~
for the endangered fishes of the upper Colorado.
Copy enclosed with certain items noted.

Haines, G. B. and H. M. Tyus. 1990. Fish associations and environmental variables in age-0 Colorado squawfish habitats, Green River, Utah. Jour. Freshw. Ecol. 5(4): 427-435. This and four additional citations with Tyus as author or coauthor, relate concern lack of coordination and integration between USFWS and Bur. Rec. research in upper Colorado R. basin to meaningfully relate flows to reproductive success of squawfish as noted in enclosure of my review of paper submitted by Bur. Rec. biologists.

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(2)

(Gila cypha) in the Yampa and Green rivers, Dinosaur National Monument, with observations on the roundtail chub (G. robusta) and other sympatric fishes. Great Basin Nat. 50(3): 257-264.

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→

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BIMONTHLY REPORT: FISHERIES, AQUATIC BIOLOGY
July-August, 1991

I've participated in fisheries meetings in New York, Idaho, and Montana. A prominent theme at all meetings was conservation biology--the preservation of biodiversity. In one of my presentations I addressed the question: What is a species? I reviewed historical concepts of species, past and current controversies, methods and philosophies used to support one viewpoint or another to conclude that there can be no arbitrary, universally agreed-upon definition of a species; it is a matter of professional judgement. In relation to the Endangered Species Act, I used the Columbia River basin salmon, as an example, where more than 100 candidates "species" are available for proposed listing. I pointed out that most biologists and fisheries administrators lack an in-depth understanding of evolutionary genetics necessary as a basis for determining the most significant units of intraspecific diversity (for proposed listing). The situation can easily get out of hand driven by well-meaning people acting in what they assume to be an environmentally correct (EC) position.

Well-organized opposition to ESA listings is building which can lead to a revision of the ESA species definition (now includes all biological groups to level of a single population of a species).

In the conservation biology program at the New York meeting, updates on Arizona endangered fishes were presented. Failures have far exceeded successes. More than 200 reintroductions were made of the Sonoran topminnow (Poeciliopsis occidentalis), less than 30 have survived till present (and most of these are not considered "established"). For the desert pupfish (Cyprinodon macularius), 1 of 18 introductions of one subspecies was established and all of the more than 15 introductions of the other subspecies have failed.

Of more the 10 million razorback suckers and 625,000 squawfish stocked in the Verde and Salt river systems, 519 razorback suckers and 444 squawfish were found during intensive sampling over the years, and almost all of these were found soon after stocking. Almost no survival has been found three months after stocking.

Enclosure 1 is cover letter to U.S. dept. of Interior Inspector General Report on the administration of the Endangered Species Act by the U.S. Fish and Wildlife Service. Enclosures 2 and 2A are notes and news items of the Upper Colorado River Recovery Program. If I were conducting a congressional oversight hearing I would point out the criticisms of the FWS ESA administration, especially the problem of adequate "tracking" of recovery programs to see that they are achieving the expected results in a timely manner and within budgets. The Upper Colorado River Program was initiated in 1979 with a memorandum of understanding between Bur. Rec. and FWS which stated that for \$1,000,000 and two years time FWS would have all the answers for river regulation impacts by Bur. Rec. projects to avoid jeopardy to endangered fishes. Now, 12 years and

millions of dollars later, with another 50 million planned to be spent over the next 12-13 years, one may scan enclosures 2 and 2A to assess the success of the recovery program for upper Colorado River fishes. But, then note on page 1 of "Meeting Summary", that the results of this program were well-received by key people in Washington. After 12 years of gross waste of funds with no change in the status of any of the four species (squawfish, humpback chub, bonytail, and razorback sucker), this program, "is viewed positively in Washington as a proactive, cooperative effort." Clever PR is more important than factual evidence, in public perception of "success". Some reasons for the perceived success is that no jeopardy opinions have been made to block or seriously change operations of water development projects (more money and further research is always necessary), conservation groups have advisory representatives (who are easily "snowed"), and almost all the funds involved are non FWS funds.

It can be concluded that for recovery programs, expenditures will drive appropriations in a seemingly interminable and ever increasing manner. One additional note to this outrageous illusion is that the chief researcher of the Upper Colorado River Recovery Program is presently under investigation for data falsification, misuse of funds, and sexual harassment -- which, perhaps, will further the favorable impression in Washington.

Enclosure 3 is cover letter I received with statistical critique reports of the data used to list the spotted owl under the Endangered Species Act. This reflects a new trend in public relations by resource development-exploitation interests (in this case, the forest products industry), Evidently it is recognized that times have changed. Local "redneck" types of popular demonstrations (such as bumper-sticker advice: save jobs, eat spotted owls) will influence local congressmen and state representatives, but on the national level, there is little enthusiasm for tampering with the ESA or toleration of strong-arm tactics to influence decisions by federal agencies. It is also recognized that environmental groups are popular, well-organized and politically influential. Biologists and administrators working for government natural resource agencies are advocates for environmental protection; they do not want to offend the organized environmental groups. This leads to what I call being environmentally correct (EC), whereby fact, figures, information, and evidence, may not be rationally assessed, but are contorted to agree with a preconceived point of view in agreement with the EC ethic.

To counter this trend, developmental interests such as the forest products industry and the Northwest Power Planning Council (Columbia River salmon ESA proposed listings) have hired teams of top level people--wildlife, fisheries biologists, geneticists, statisticians, etc.--to make known alternative and, what they believe to be, more reasonable interpretations of the evidence.

A point that should be apparent in all this is that such counter-efforts should begin at an early stage. When the Audubon Society, the Sierra Club, the Wilderness Society, etc.,

initiated their campaign to preserve old growth forest and found the ideal symbol (spotted owl) to propose for listing, the counter-efforts to rationally assess spotted owl-old growth habitat relationships should have been initiated with involvement at every step of the environmental assessment. The political clout the industry relied on could not overcome the impetus of the environmental movement and now they are fighting an expensive rear-guard action.

In the upcoming months it will be interesting to follow the process of the proposed listing of Columbia River salmon races and to observe the effectiveness of the power companies and their consultants to counter the EC ethic. The National Marine Fisheries Service (lead federal agency for listing anadromous species) has recommended the listing of the Redfish Lake (Idaho) sockeye salmon and the spring-summer (combined) and fall runs of Snake River chinook salmon. The proposal to list coho salmon was rejected on the basis that no "pure" wild races exist in the Columbia basin.

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U.S. Fish and Wildlife Service. Habitat Evaluation Notes and Instream Flow Chronicle, vol. 1 no. 1. First issue of combined publication (formerly HEP and IFIM had separate newsletters). Article on new sophisticated software programs to produce three-dimensional outputs from IFIM models (but underlying limitations of models in relation to biological reality and predictive accuracy are not mentioned). Analogous to taking an old car whose engine wont run, constructing a flashy new body for show purposes--but car still wont run.

COMMENTS

With regards to possible ramifications of institutionalizing an instream flow method as a standard method, the following points are made to demonstrate that the authors of chapter 3 display an utter lack of knowledge and understanding of what has transpired during the past 10 years concerning the documentation of the lack of predictive accuracy of any method or model to associate flow-habitat-fish relationships in a manner that reflects biological reality.

A bottom-line type of demonstration of my assessment can be had if some of the statements found in the report are submitted to the Aquatic Systems Branch of the National Ecology Center of the U. S. Fish and Wildlife Service for endorsement. The top of p. 18 lists 5 basic assumptions of the Instream Flow Incremental Methodology (IFIM) developed by the Aquatic Systems Branch of FWS. The first 4 assumptions are so rife with unstated conditional attributes (such as effects of predators, competitors, food supply, etc.) that determine fish species abundance (and which are not considered IFIM) that assumption 5 rests on a house of cards -- it becomes nonsensical!! -- "A positive linear relationship exists between WVA and fish biomass." On top of p. 17, an initial objective of IFIM, "was to assess changes in fish standing crop and species composition due to changes in streamflow (Bovee 1978)".

If the authors of chapter 3 favor IFIM as the standard method because it is the most "credible" and "defensible" method and this conclusion is based on their beliefs that IFIM "assesses (i.e. accurately assesses) changes in fish standing crop and species composition due to changes in streamflow" and that "a positive linear relationship exists between WVA and fish biomass" -- "positive" might here be defined in terms of predictive accuracy to mean that the relationship between WVA and fish biomass has no more than a 10% error in 90% of the cases -- then these statements should be submitted to the USFWS for endorsement, refutation, or modification in view of the official 1991 position of the USFWS on the use of IFIM -- primarily as a tool for negotiation or a method that consistently makes accurate predictions on changes in species composition and biomass in relation to streamflow and a method that shows a positive linear relationship between WVA and fish biomass ("positive" to the extent that a consistent, accurate WVA-biomass relationship is a confident expectation).

If the head of the Aquatic Systems Branch, the head of the National Ecology Center, and the Director of the USFWS will not endorse the key statements of chapter 3 as a basis for the credibility-defensibility aspect of IFIM, the basic assumptions of the authors of chapter 3 used to characterize IFIM, disintegrate.

The authors thoroughly confuse terms, ^{such as} quantification, precision, sophistication, etc. with biological reality and predictive accuracy. They do not seem to understand that a method or a model can be precise, quantifiable, and sophisticated but still be completely wrong in its predictions.

I foresee three probable situations where a proposed change in flow might generate a high level of controversy, and none are likely to be resolved by IFIM. If a federally listed endangered species is involved, as in Verde R. (or upper Colorado R. basin), much time and money would be wasted only to have the USFWS declare that IFIM is not to be used for decision making.

If an assemblage of native species is involved, it will be declared that it is the natural, highly fluctuating flow variation that prevents non-native species from replacing the native species, therefore no changes in the natural regime should be allowed. ~~If a non-native species of game prevents non-native species from replacing the native species, therefore, no changes in the natural regime should be allowed.~~

If a non-native species of game fish is involved, the key issue is not likely to deal with habitat quantification as handled by IFIM. For example, the issue might involve maintaining a rainbow trout fishery below a reservoir. A goal might be to maintain water temperatures below 70° for 3-4 miles below the dam. A flow-temperature model could be used to predict how much volume of flow would be necessary to maintain less than 70° F water temperature 3-4 miles downstream when the release water is, for example, 50-60° F and ambient air temperatures 90-100° F. There would be no need for elaborate quantification of depths, velocities, substrates, cover, etc. -- look for the simplest, most direct solution, and it will not likely be IFIM.

BIMONTHLY REPORT: FISHERIES AQUATIC BIOLOGY
Sept.-Oct. 1991

A critique of the Arizona report on instream flow methods was sent to Mr. Cooper last month. A copy of my comments are enclosed (enclosure 1). My point is that IFIM, or any method, should not be formally established as a standard method, an obligatory method, in controversial cases. The areas of potential controversy should be delineated at the very earliest stages and all of the uncertainties that surround any attempt to predict flow-habitat-target species associations should be clearly understood at this early stage. Then discuss possible applications of methods and models and their potential to resolve conflicts, again clearly understanding the limitations for predictive accuracy inherent in the methods, before any standard method be invoked by decree. The authors of the methods section represent an IFIM advocacy group and display an extremely naive understanding of flow-habitat theory and principles, about 20 years out of date.

I would emphasize that I do not want to have IFIM rejected, only not institutionalized as an official standard, obligatory method. Enclosure 2 concerns a situation where the water development interests are demanding that IFIM be made a legal standard method. The Oct. 23 news clipping concerns an Oct. 21 meeting between water users-developers and the USFWS. The upper Colorado River recovery program has been featured many times over the years in my bimonthly reports as an example of what can go wrong with attempts to define necessary flows for endangered species. In recent years, the FWS recovery program did not interfere with water use or water development in the upper basin. This was due to the fact that during the Reagan administration, Frank Dunkel was appointed Director of the USFWS with instructions not to let endangered species interfere with resource exploitation and economic development. Dunkel forged an agreement with water groups as a basis for the upper basin recovery plan, which essentially was based on the assumption that if enough money be spent on "research", developers would not have to be concerned with jeopardy opinions. After Dunkel's ouster, environmental groups began agitation for a bolder stance by the FWS for endangered species protection and recommended river flows for endangered species. This first became evident last spring when the FWS rendered a last minute jeopardy opinion on the Animas-La Plata project because of squawfish in the San Juan River (enclosure 3). The FWS has annually delayed flow recommendations for Bur. Rec. projects in the Colorado River (Aspinall Unit on Gunnison and Ruedi Reservoir) and Green River (Flaming Gorge), using excuse of "further research" (and funding) was necessary. The environmental groups became more adamant in their demands and FWS has recommended flows for a "15 mile reach" of the Colorado River, and flows for the Green River (Tyus and Karp in bibliog.). The recommended flows have not been finalized in detail but they are flows that emulate the historical virgin flows during the squawfish spawning season and during the early life history period. At the Oct. 21

meeting, people mainly representing interests in maintaining higher reservoir levels behind Ruedi Dam for recreation-tourism, demanded the FWS use their IFIM studies as a basis for flow recommendations for "15 mile reach" (which makes low flows look good, and why FWS declared IFIM not for decision-making) and that IFIM be recognized in water court as a legal, standard method.

As I've pointed out in previous reports, the most intense opposition to IFIM has not come from water development interests but from environmental groups. The lesson from Two Forks Dam rejection by EPA concerns the expensive long term IFIM study performed by the Denver Water Board as a basis for mitigation only to have the EPA decision of "unmitigability" based on the "uncertain science" of the method. Why waste time and money on a method if it cannot resolve a controversy.

It will be interesting to learn of the views of western congressmen of the FWS Colorado River recovery program when they learn of the Green and Colorado flow recommendations. It must be recognized that there are upper basin and lower basin western congressmen. California congressmen should be delighted to have "virgin-like" flows coming down the Green and Colorado rivers to Lake Powell.

Enclosure 4 concerns "new, improved" input for IFIM studies, which are likely to be brought up by IFIM advocates in Arizona. It is a common sense approach which, although probably not recognized as such, can make predictions more accurate by focusing on the weakest link of the life cycle (larval-early life history stage). This can only be accurately done after the fact, however. If good correlation can be found in a river section between certain flows during the first few weeks after hatching and the subsequent abundance of a generation (year-class of fish), then I would consider such data quite useful for flow recommendation. However, many years of continual monitoring would be necessary to have much confidence in recommendation.

Enclosure 5 is another example of environmental groups playing hard ball with FWS re. Colorado R. endangered fishes. In May, 1990, the razorback sucker was proposed for listing as a threatened species. According to the law, FWS must make final determination to list or reject within 12 months. Faced with legal action to force listing, the FWS listed the razorback on Oct. 11, but without designating critical habitat. My information is that the environmental groups will pursue the case to force critical habitat designation.

Regarding implications for Salt and Verde rivers, enclosure 6 is pages from FWS' revised recovery plan for squawfish. Note that although the Verde and Salt river squawfish were stocked as experimental, nonessential populations they are considered as a "proposed" species or as a "threatened" species if in a national park or wildlife refuge-- and that before "delisting" squawfish must be "established" and "habitats and streamflows legally protected." The razorback sucker was stocked in these Arizona waters before the species was listed. Now that it is listed, I assume any razorback sucker in the Verde and Salt rivers is protected under ESA. Although it

appears remote that either the squawfish or the razorback can "establish" viable self-reproducing populations in the Salt or Verde rivers under present conditions, individuals of these species can live up to 40 years of age--their presence and associated ESA problems may linger for some time.

Enclosure 7, article from High Country News. Water attorney laments Salt River Project impacts. Enclosure 8, Indian tribes paid to kill squawfish---a different species, but very similar in appearance to Colorado squawfish. I'm sure Columbia squawfish could become established in Verde and Salt rivers.

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Tyus, H. M. and C. A. Karp. 1991. Habitat use and streamflow needs of endangered fishes in the Green River. Utah. Final Rep. USFWS Flaming Gorge Studies Program : 54 p. After 12 years of study (FWS agreement with Bur. Rec. was to come up with flow recommendations for B. R. reservoirs in 1981), flow recommendations to avoid jeopardy to endangered species are to emulate natural virgin flow conditions during spawning and early life history stages of endangered species---a recommendation that could have been made in 1979. All methods and models, such as IFIM, used in early years were found to be irrelevant, Bur. Rec. people are upset.

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U. S. F. W. S. Recovery program for the endangered fishes of the upper Colorado. Summer 1991. Articles on proposed flow regime from Flaming Gorge (see Tyus and Karp), special \$200,000 appropriation to recovery program (quote from Colorado congressman Campbell---"The states, the Bureau of Reclamation and water users are committed to the Recovery Program so that additional development of our water resources can be accomplished consistent with the Endangered Species Act"---western congressmen and water development interests are now, or soon will be aware of new "direction" in FWS Colorado R. Recovery Program re. "natural flow conditions" discussed in bimonthly report).

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BIMONTHLY REPORT: FISHERIES-AQUATIC BIOLOGY

NOVEMBER-DECEMBER 1991

I attended the Desert Fishes Council meeting in Death Valley, November 19-21. There is no doubt that the razorback sucker stocked in the Verde-Salt drainages is an endangered species protected by the Endangered Species Act. A paper given at the meeting concerned razorback suckers in Fossil Creek, a headwater tributary to the Verde R. A total of 16 razorback suckers of about 10-12 inches were recorded in this small stream above a dam. The presenters of the paper claimed that they had no knowledge of how these fish got into Fossil Creek. (Later I was informed that they resulted from a stocking of 20,000 fry three years ago, but there is no written record of this stocking.) This is the first and only record of razorback suckers or squawfish, stocked as fry, surviving for more than a year. Below the dam there is ~~no~~^{an} abundant population of non-native green sunfish, but no sunfish or non-native fishes occur in the stream section isolated by the dam. The dam is scheduled for re-licensing and a "consultation" with the U.S. Fish and Wildlife Service, as required under section 7 of the Endangered Species Act, will be held. The evidence seems clear that the only reason razorback suckers have persisted for three years in Fossil Creek is because the dam has created a sanctuary, preventing their elimination by non-native fishes.

Also at the meeting an update on razorback sucker and squawfish "restoration" activities in the Salt and Verde systems was presented. Currently some relatively large fish, implanted with radio transmitters to track movement, are in the Verde. A

report was given on the threatened Little Colorado spinedace (Lepidomeda vittata). Only two sites, E. Clear Creek and Chevelon Creek, are known to have this species. During sampling in E. Clear Creek, some roundtail chub, Gila robusta, were found. This species had been believed long extinct in the Little Colorado drainage. The spinedace and roundtail chub occur only in river sections where non-native rainbow and brown trout are absent. In all of the former habitat in the range of the spinedace and chub, now occupied by trout, these two species do not occur. Any attempt to eradicate the trout or limit their stocking in the Little Colorado drainage as part of restoration efforts for the threatened spinedace would obviously upset anglers.

Updates on restoration efforts for the endangered desert pupfish and Sonoran topminnow were given. To date, little success with transplants has been found. Transplanted populations seem to disappear at a rate equal to the new transplants being made--very little net gain with these two endangered species.

In Death Valley I met one of my former students who now works for the USFWS. He had been sent to Tempe to attend a meeting on proposed research on the Colorado River endangered species (squawfish, humpback and bonytail chubs, and razorback sucker). I had warned him that the FWS should prepare for "damage control" once they are forced to come up with flow recommendations for the Colorado and Green rivers, and water-users and politicians realize the situation is not what they have been led to believe during the past 12 years (that if funds were given for "research", jeopardy

opinions would not be made that would interfere with water rights or the operation of Bureau of Reclamation projects).

At the research meeting in Tempe, my former student raised the issue of what can the FWS show, in the way of tangible improvement in the status of any endangered species, from the spending of many millions of dollars, and what benefits could be expected from the spending of additional funds? Needless to say, this is not a popular topic. He was also somewhat shocked to realize that the Colorado River endangered fishes recovery effort is an excellent example validating the rule that if money is available, it will be spent--but the spending is not much related to accomplishing the original goal. There is internal strife within the FWS and between the FWS and Bur. Rec., infighting and territoriality among the participants, and greed for research funds among academic institutions--there is indeed "benefits" in abundance from the research funding, but they have not trickled down to the intended targets, the endangered fishes.

Enclosure 1 is the FY 1992 budget of almost four million dollars (3.97 mil.) to be spent on "recovery" during the coming year. Note that \$70,000 is budgeted for an "instream flow senior scientist". Enclosure 2 is the job announcement for this position. Under "Issues", it is stated that the Colorado Water Conservation Board has objected to Oct.-June flow recommendations for the "15-mile reach" (near Colo.-Utah border--any flow passing the 15-mile reach is lost to Colo.), and the Bur. Rec. and Western Area Power Authority are objecting to Flaming Gorge flow recommendations. Note that the objections relate to the fact that the instream flow

recommendations are based on "empirical data and professional judgement rather than analytical habitat models".

The fact is, the FWS began intensive IFIM studies on the Colorado, Green, and Yampa rivers in 1975 to quantify flow-habitat relationships for squawfish. After many years, it became apparent that in such a complex system with so many unknowns and uncertainties that it was futile to attempt to come up with a habitat model that would accurately predict flow-habitat relationships. Thus, in 1989, IFIM was declared "not for decision-making", and "professional judgement" instituted. It is hoped that a "senior scientist", a person of great reknown, can resolve the controversy, but I doubt there can be a resolution without considerable bad publicity resulting from scrutiny of the FWS' Colorado fishes recovery program.

In relation to what lessons might be learned from the fiasco associated with instream flows and endangered fishes in the upper Colorado basin which might apply to endangered species conflicts in Arizona, the lesson of early warning, early participation is apparent. It is apparent that any method or model cannot accurately quantify flow-habitat-fish relationships and in controversial issues with polarized interests, resolution will not be achieved. At the very beginning of a developing conflict, all sides must be made aware of what issues are involved and all sides must understand the limitations that any method, model, or "research" have to resolve a conflict. An informed consensus should then be reached on a course of action, rather than to plunge into a long term instream flow study (as in the upper Colorado

basin and in the Verde River) with a naive faith that the issue will be resolved because "research" is done and a quantitative model developed--only to have the results declared "not for decision-making".

In the past few reports I have mentioned the efforts of the American Forest Resource Alliance to counter the impacts of the listing of the northern spotted owl as a threatened species. During the fall semester I had a student write a term paper on the subject. He did a thorough job, including interviews with AFRA people. Several years ago when environmental groups began a campaign to preserve old growth forests and found a symbolic or "flagship" species to rally around, the forest products industry of the Northwest, based on historical precedent, believed they could count upon political clout to overcome the opposition. Legal action forcing the listing of the spotted owl and the development of a recovery plan, which would protect an additional 11 million acres of old growth forests, caught the industry off guard. Since then they have been forced into an expensive rear guard action. They have spent, or will spend 6 million dollars for a campaign orchestrated by the Washington law firm of Crowell and Moring. By hiring their own experts, they have questioned the validity of the Forest Service-FWS report on the status of the spotted owl, the statistical interpretation of data, and the economic evaluations made. Several million additional dollars will probably be spent to demonstrate that spotted owls can do perfectly well in second-growth forests. AFRA people now realize that if they could have accurately assessed the old growth controversy in its early stages,

they could have been proactive and accomplished their desired goals at much less expense and hardship. By waiting too long and fighting a rear guard action the forest products industry is now generally perceived as the "bad guys" in the issue of old growth forests and spotted owls. A statement attributed to the Chairman of Pacific Gas and Electric is pertinent: "The environmental train left the station long ago. We can stand in the track, shake our fist and get run over or we can join the engineer in the cab and help direct which track to take."

Enclosure 3 concerns a suggestion to resolve environmental damage claims (or, any controversial environmental issue) where interests are polarized, by use of "friend of the court" studies.

Enclosure 4 relates to my contribution toward conflict resolution, and demonstrates that to be effective, such resolution must come at the beginning, before people become polarized. It is ironic that the two opposing groups in this case, anglers and rafters, are both recreational users of instream flow and should have a common interest in regards to environmental issues of water quality and instream flow. It became a matter of personalities with some anglers and some rafters developing an intense dislike of each other. Some of the riled anglers are members of Trout Unlimited and that organization acted to represent the interests of anglers--they were against any flow modifications provided by the Bureau of Reclamation that would benefit rafters (but their claim was that such flows would be detrimental to the trout population). The modified flows would maintain a minimum flow in the Arkansas River of 700 cfs until August 15. In normal years, the July-August

flows exceed 700 cfs and the flow supplementation would occur only in low run-off years (raising summer base flows to 50% or more of average daily flow should be greatly beneficial to the trout population). Trout Unlimited appealed to the Colorado Division of Wildlife to back their complaint against modified rafting flows. Division of Wildlife biologists, acting as advocates for anglers, put together a report supposedly demonstrating a negative impact on trout at flows of 700 cfs. I critiqued this report and found it wholly without factual substance--a mixture of easily-exposed sleight of hand tricks patched together to support an already made conclusion. However, the Division of Wildlife is willing to take a closer look at the situation if the Bur. Rec. will fund 7 years of "research".

The polarization has gone too far for amicable resolution. This controversy should have been put to rest at the very start when all the issues involved could have been critically and rationally reviewed to come up with a win-win resolution. Polarization is characterized by irrationality.

Enclosure 5 is a job announcement for a biologist to develop cost-effective ways to eradicate squawfish (northern squawfish). Compare with enclosure 1.

Enclosure 6 is pages of article on IFIM use.

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NOV-DEC 1991

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U.S.E.P.A. News Notes (12) 1991. Summary of water quality news.

U.S. Fish and Wildlife Service. Recovery Program for the Endangered Fishes of the Upper Colorado. Summaries of recovery implementation meeting and of management committee meeting; Recovery Implementation Program for FY 1992. Copy of budget page enclosed. Although \$4,000,000 is scheduled to be spent in upcoming year, basic question remains: What good will it do to "recover" the listed species? Enclosure on hiring of an instream flow guru (under 'senior scientist' in budget).

BIMONTHLY REPORT : FISHERIES-AQUATIC BIOLOGY
JAN-FEB 1992

I was invited to talk to the annual meeting of the Upper Colorado Endangered Fishes Researchers, Feb. 11-12, Moab, Utah. My views on the failed efforts for recovery of the endangered Colorado River fishes and the wasteful expenditures of many millions of dollars on diversionary projects along the way, frequently expressed in my bimonthly SRP reports, are well known. Some of the state and federal people involved with the recovery program have also been dissatisfied with the lack of meaningful progress and I was invited to express my opinions to all of the members of the committees and subcommittees of the recovery team.

I was specifically assigned to discuss the genetics program but I pointed out that this program is just one example of a long history of dissipation of funds and focus away from the primary goal of "recovery"--the restoration of the endangered species to the point of delisting. I pointed out that as long as a serious confrontation did not occur in regards to flows, water development and jeopardy opinions, the "recovery" efforts could bumble and muddle through, wasting money on meaningless projects, without a challenge to the credibility and accountability of the program. I believe a confrontation may soon occur when hard decisions will have to be made on specific flow recommendations that will impact the flow regimes from Bureau of Reclamation dams and threaten state water rights. A critical investigation of the history of the upper basin recovery program, taking an in-depth look at credibility, accountability, and expenditure of funds in relation to the degree of success achieved toward "recovery" could be a terrible embarrassment to the USFWS.

There is a well-marked paper trail over a 15 year period consisting of contracts, memoranda of understandings, statements by FWS administrators, FWS opinions found in environmental impact statements, in explanatory sections of nonjeopardy opinions given in return for "flow depletion" payments, etc. These documents could be cited to detail the record of what FWS personnel claimed would be done, at what cost, and in what time period, and contrasted to what has actually been accomplished toward achieving the goal of recovery, how much has been spent and for what purposes during the past 15 years.

The early years were characterized by what I call delusion by the illusion of technique. If only all kinds of data were randomly collected, somehow a computer program would be developed and everything would fall into place and be understandable. Instream flow studies (IFIM) were a major part of this early phase, seeking a quick, technological fix. The technological fix syndrome continued with constant diversionary grasping at gimmicks and slogans, irrelevant to the goal of

recovery. An "ecosystem approach" would be used with IFIM, HEP, GIS (geographic information system), PVA (population vulnerability analysis) modeling. All the time, the administrative hierarchy of the recovery program and number of participants has steadily grown till it has taken on a life of its own, essentially unrelated to the reality of "recovery". A review of the personnel involved over the years in the administration and research-management activities of the recovery program would make it clear that no real consideration was ever given to finding the brightest and the best people to employ for this most important program. By and large, they were qualified simply by the position descriptions and GS levels which resulted in entrenched mediocrity.

I used the current genetics programs to illustrate my point. People serving on committees and subcommittees vote to spend millions of dollars on projects with which they have little understanding. Thus, more than a million dollars will be spent on "genetic characterization", endorsed by people who have not much more perception of genetics than the average man on the street, nor do they understand how spending this money can contribute toward the primary goal of recovery. The money is available so let's spend it.

A citation to Romesburg in the bibliography pertains to problems of credibility-accountability in the natural resources and environmental sciences. We must do a better job in the future in relation to achieving success in such matters as recovery of endangered species. Romesburg solution is to attract better and brighter students to the profession. This would be important, but because virtually all natural resource-environmental management and research is controlled by government agencies, the administrative structure which entrenches mediocrity will suppress the creative-innovative ideas of the best and brightest in favor of committee consensus.

Enclosure 1 is a copy of a review I wrote of a paper submitted to the journal, Regulated Rivers. Some of the views discussed above are apparent in my review. The paper concerns an IFIM (instream flow incremental methodology) study in the Green River below Flaming Gorge dam which has been ongoing for more than 10 years, resulting in several M.S. and Ph.D. theses, but no flow recommendations as yet. Each successive study has failed to come up with a reliable flow-habitat-fish association as a basis for recommending a flow regime to optimize trout abundance, but each study leaves off with a suggestion for "future research"--which led to my rather negative comments on the "bioenergetic approach" proposed in this paper. The authors well document the "flexibility" of the trout they observed, how they changed their habitat preference in different seasons and at different sizes, which "messes-up" any attempt to develop a standard HSI (habitat suitability index) curve which would correctly designate flow-habitat-fish relationships (necessary for any predictive accuracy of IFIM). The authors seemed unaware that this "flexibility" or habitat switching is a natural, dynamic process that has been long and abundantly documented in the literature as can be amply demonstrated from a review of my annotated bibliographies. In reviewing the

literature for the Jan.-Feb. bibliography, I cite three current papers on "flexibility" and habitat switching, and the implications for limitations of predictive accuracy in modeling flow-habitat-fish relationships, to illustrate how common are such documentations. Unfortunately, it seems that each IFIM practitioner discovers this fact of nature independently, thus promoting further "paralysis by analysis". It was obvious to me that the Arizona instream flow subcommittee members recommending IFIM as the "standard method" for controversial flow recommendation, did not understand this fact of nature.

Enclosure 2 is copy of cover of Atlantic magazine (Jan. 1992) which is largely devoted to exposing the bungling, expensive boondoggles and bureaucratic inertia of the USFWS's operation of its endangered species program (but none of the case histories discussed can match the record of the recovery program of upper Colorado River fishes). The Endangered Species Act is up for reauthorization this year and it has come under concerted attack by business and industry groups who want to weaken the Act. The more sophisticated groups are not asking for a free hand to rape the environment and exterminate species to maximize profits, but emphasize the long record of bungling and incompetence by federal agencies, as illustrated in the recent issue of the Atlantic. They are offering more reasonable, less costly solutions to environmental protection by proactive participation in the process.

Just what changes will come about in the Endangered Species Act and the way federal agencies perform environmental assessments are difficult to foresee. I suspect, however, that the current most popular option to delay a decision, that of expending large sums on long term and inconclusive "research", will no longer be the most viable option.

ANNOTATED BIBLIOGRAPHY
JAN-FEB 1992

Angradi, T.R., J.S. Spaulding, and E.D. Koch. 1991. Diet/food utilization by the Virgin River spinedace, Lepidomeda mollispinnis and speckled dace, Rhinichthys osculus, in Beaver Dam Wash, Utah. Southwest. Nat. 36(2): 158-170. Life history data on threatened spinedace (Little Colorado R. spinedace, L. vittata, a closely-related species).

Atlantic magazine, Jan. 1992. This issue of the Atlantic (an influential publication on a wide range of topics) is devoted to the changing climate of opinion concerning endangered species protection in conflict with needs of society. The subtitle of this issue is : Playing God, why we shouldn't try to save every endangered species.

Baltz, D.M., B. Vondracek, L.R. Brown, and P.B. Moyle. 1991. Seasonal changes in microhabitat selection by rainbow trout. Trans. Am. Fish. Soc. 120(2): 160-176. Re. problems of defining habitat parameters (such as constructing habitat models for flow-habitat analysis) when the fish change habitat preference throughout the year--a dynamic process that cannot be represented by static suitability indices. See comments in report and enclosure regarding my review of IFIM flow-habitat study in Green River.

Brown, L.R. and P.B. Moyle. 1991. Changes in habitat and microhabitat partitioning within an assemblage of stream fishes in response to predation by Sacramento squawfish (Ptychocheilus grandis). Can. J. Fish. Aquat. Sci. 48(5): 849-856. Illustrates another aspect of the dynamics of changing habitat preference (or utilization) similar to above reference, but these changes result from presence or absence of a predator: presents similar problems for flow-habitat models.

Colorado Water. Feb. 1992. Colo. Water Resource Research Inst. Contains review of symposium on the South Platte River. I presented talk at this symposium on riparian vegetation and the concept of naturalness.

Doerksen, H.R. 1991. Two decades of instream flow: a memoir. Rivers 2(2): 99-104. Harvey Doerksen was head of USFWS Fort Collins Office of Biological Services (now integrated into National Ecology Center) when instream flow modeling was first developed and institutionalized as IFIM. Two decades of change from naive enthusiasm to somber maturation in regards to efficacy of flow-habitat models and conflict resolution.

Harvey, B.C. 1991. Interactions among stream fishes : predator-induced habitat shifts and larval survival. Oecologia 87(1): 29-36. Another verification of uncertain or unpredictable habitat changes as demonstrated in above citations to Baltz et al. and Brown and Moyle. I cite these three papers to illustrate point made in my enclosed review of IFIM Green

River study that such "flexibility" in habitat utilization which invalidates HSI curves of IFIM, has been long known and abundantly documented in the literature--but still commonly overlooked or not comprehended by most IFIM practitioners.

Nestler, J.M., R.T. Milhous, and J.B. Layzer. 1989. Instream habitat modeling techniques. Pages 296-315 in J.A. Gore and G.E. Petts (eds.). Alternatives in regulated rivers, CRC Press. Although employed by USFWS as advocates of IFIM, these authors do point out that IFIM should not be substituted for common sense.

Minckley, W.L. and J.E. Deacon (eds.). 1991 (my copy received from publisher, Feb. 1992). Battle against extinction : native fish management in the American West. Univ. Arizona Press: 517p. Papers from a 1988 symposium, mainly devoted to southwestern endangered fishes.

Romesburg, H.C. 1991. On improving the natural resource and environmental sciences. J. Wildlife Mgt. 55(4): 744-756. Critique of general low level of competence in natural resource-environmental disciplines and lack of successes in resolving complex resource issues (such as endangered species conflicts). I also addressed this issue in talk to Colorado R. Endangered Fishes Researches meeting (Feb. 12, Moab, Utah). Romesburg's solution to problem is to attract brighter students. I doubt that more bright people will be sufficient to effect meaningful change for the better. Virtually all natural resource-environmental management and research is controlled by federal and state agencies (bureaucracies). The inefficiencies and administrative structure inherent in socialistic systems act to suppress innovations, changes, creative thinking, etc. of the brightest people, in favor of muddling through without sinking the ship.

U.S. fish and Wildlife Service. Recovery Program for the Endangered Fishes of the Upper Colorado. Winter 1992. Copy of this issue enclosed.

BIMONTHLY REPORT FISHERIES-AQUATIC BIOLOGY
March-April 1992

The U. S. Fish and Wildlife Service sent a report reviewing the endangered species program to congress. A total of 581 species (or parts of species) are listed under the Endangered Species Act. Of the species on the list, more are continuing to decline than are recovering, and 2% became extinct. Environmental groups use this document to argue that the lack of success for recovering species is due to the lack of funding for recovery programs. On the surface this would appear to be a logical and legitimate conclusion. However, if empirical evidence is critically evaluated, using the USFWS recovery program for four fish species of the upper Colorado River as an example, serious doubts are raised that recovery problems can be successfully resolved by a government agency simply by providing more funds.

Only limited amounts of federal endangered species funds have gone into the upper Colorado recovery program, and, on that basis, it might appear to be underfunded. The overwhelming majority of the funds have come from "depletion fees" from water development projects in return of nonjeopardy opinions and from other federal agencies, particularly the Bureau of Reclamation. In recent years, annual expenditures for the upper Colorado River recovery program (for four species) have approached or exceeded the total annual funding for recovery programs of the 581 species covered by ESA allotted by Congress to the FWS. If increased funding for recovery programs dramatically improve the record of successful recoveries of listed species, then the four Colorado River fishes should be fully restored and delisted by now. Why this hasn't happened and what went wrong has been discussed many times in my bimonthly reports as an example of continual increased funding resulting in a continual increase in administrative complexity and an enlarged and entrenched bureaucracy taking on a life of its own, independent and diversionary to its primary goal of recovery of endangered species. An example to be aware of and avoided.

A recent meeting of the Upper Colorado River Recovery Program brought out some legal points of the Endangered Species Act that left representatives of water user groups feeling betrayed and outraged. They were informed that payments made for nonjeopardy opinions might not exempt a project from further review and potential modification to conform to ESA (also old projects, completed before the ESA might not have exemptions to the Act grandfathered). The situation is as follows. When, during "biological consultation", a project is deemed to cause "jeopardy" to the "continued existence of an endangered species" or to its "critical habitat", the FWS must offer "reasonable" alternatives and conservation measures which if carried out, would avoid jeopardy. Typically, this matter is resolved by mitigation-enhancement measures whereby a proposed

urban development or a golf course might infringe on the habitat of an endangered species. As a reasonable alternative and conservation measure, the developer agrees to purchase or set aside similar habitat for the species to compensate for the loss and then receives a nonjeopardy opinion.

In 1981, I was involved as an advisor to the Northern Colorado Water District for a biological consultation with the FWS concerning a transbasin diversion that would annually deplete, on average, about 50,000 acre feet of water from the head of the Colorado River basin. The FWS representative was visibly perplexed. He had been instructed, through his superiors, from James Watt, not to issue a jeopardy opinion. He took me aside and asked if the water district would agree to a payment of \$500,000 for a nonjeopardy opinion. I told him that they almost certainly would as a one year delay would add at least 5 million dollars to the project's costs. Thus, began the outside funding for the upper Colorado River recovery program, which if projections are accurate, will reach about 70 million dollars by the year 2003.

Evidently someone became aware of the question of legality of such nonjeopardy payments and a solicitor's opinion was requested. In 1989 a solicitor's opinion was given that such payments were legal under ESA if they result in "real progress toward recovery, not just the taking of money." That is, the nonjeopardy payments have been used for conservation and recovery measures and have resulted in "real progress" toward recovery. If this is true then the nonjeopardy payments conform to the stipulations of ESA as a "reasonable alternative". Obviously this is not true, the official pronouncements of the FWS recovery team constantly emphasize no improvement in status or continued decline of the four fish species, which raises the issue that the nonjeopardy payments did not prove to be a reasonable or viable alternative to a jeopardy opinion, and as such, the projects which paid into the conservation fund for nonjeopardy opinions, might not be guaranteed exemptions (or have exemptions revoked) because the FWS didn't do as they promised to "recover" the species. I doubt there is a money-back guarantee that went with the original nonjeopardy opinions.

The FWS has developed a clever position. The claim is they are still involved in "basic research" obtaining the necessary "data", as a foundation for a recovery program that will make "real progress" toward recovery. As I have previously discussed, the funding for the recovery program is in the hands of committees of middle level state and federal employees who have little understanding of the subject matter of the "research" they fund. Millions of dollars have been and are being spent on various "gimmick", "state of art", type of research which has little or no relevance to "real recovery."

Why no one has blown the whistle and demanded reform concerns the fact that the people involved--state and federal agency administrators, attorneys, consultants and representatives of water development, are quite ignorant of what can be achieved by "scientific research" and why complex natural biological systems, with the degree of inherent uncertainties and randomness, are resistant to precise interpretation and

prediction. In a citation to Colorado Water in the bibliography, I use the statements of the legal counsel of the Colorado Department of Natural Resources as a typical example of the type of thinking that leads to and encourages such endangered species recovery fiascos--a naive faith in "science", "research", more "hard data", "better models", etc. which will result in the "knowledge" that can precisely tell us what flows are needed for the endangered species. Such faith leads only to the squandering of more money and no "real progress" towards recovery.

If a Congressional review of Upper Colorado River Recovery Program were to be conducted to address the question of "real progress", it would likely be made up of people with similar backgrounds, knowledge, and mindsets as the above mentioned legal counsel--that is, people with a naive faith in "science", "scientific method", "data", etc. Such a committee would likely conclude that everything is fine, the program is following sound scientific protocol, conducting the necessary basic research to establish a firm foundation of knowledge and data for "real progress". No one would ask the right questions to expose the basic failure of the program: Precisely how the information and data would be used to make "real progress"? A question to which no one has adequate answers.

The longer a controversy exists, the more polarized positions become and the more difficult it becomes to find a resolution. I have often mentioned that attempts at resolution should begin at the earliest stage--get all the information and points of view out for open discussion before polarization sets in. I would like an opportunity to test this belief but all of my involvement in controversial environmental and endangered species issues have come at an advanced stage of polarization. Earlier this year I was contacted by a Texas law firm to advise them on a long simmering, highly polarized issue that was recently brought to a head by a law suit filed by the Sierra Club. It concerns endangered species (Texas wild rice, a salamander, and a fish, the fountain darter) whose existence depend on water flowing from Comal and San Marcos springs. The flow in the springs is determined by the water level in the Edwards aquifer, which in turn, is governed by the amount of annual recharge minus the amount of groundwater pumping. In drought years, pumping greatly exceeds recharge and aquifer levels drop and flows in Comal and San Marcos Springs decrease. In 1956 Comal Springs went dry and San Marcos Springs dropped to 35 cfs. In recent years Comal Springs has dropped to lows of 35 and 50 cfs during droughts.

Opinions and attitudes in Texas appear to become more intensely polarized than in other states and two water user groups have long been in an intense conflict that has not been resolved by Texas water law or by the Endangered Species Act. The position of the group pumping water from the Edwards aquifer (including the major user, the city of San Antonio) is that no restrictions should be placed on pumping. The cities of New Braunfels and San Marcos and downstream water users who use the flow from the springs obviously favor restrictions to maintain aquifer levels and flows in Comal and San Marcos springs. The

endangered species aspect of the issue has been ongoing for about 15 years. The U.S. Department of Interior and its agency, the Fish and Wildlife Service, intimidated by Texas politicians has not invoked the Endangered Species Act to maintain some level of spring flows to avoid jeopardy to the endangered species and their critical habitat. The FWS has only conducted "research" and developed contingency plans to rescue and artificially propagate the endangered species when the springs go dry.

Last year the Sierra Club filed a law suit claiming violation of the ESA by current groundwater pumping. Recent depositions by expert witnesses claim that "taking" and "harassment" of the fountain darter will occur (the ESA will be violated) when the flow in Comal Springs drops below 300 cfs. I can make a reasonable case that this is not true, but there can be no doubt that if both Comal and San Marcos springs cease to flow, the endangered species will be gone and the Act violated. An aquifer level that maintains some continual spring flow must be argeed upon, otherwise a federal judge will make a determination on restriction of groundwater pumping to avoid lowering the aquifer below a specified level. It is certainly to the benefit of the whole state to Texas to resolve the issue be agreeing to maintain some annual minimum and average level of spring flows. The impending threat of having this determination made by a federal court should stimulate and in-state resolution of the controversy. Such a resolution should have been arrived at many years ago. In the meantime, millions of dollars have been expended on attorneys, consultants, and "research".

I heard from a knowledgable source in the Fish and Wildlife Serviec that members of congress, in an election year, want to avoid any stigma of being against saving endangered species, thus the Act will be reauthorized for one year without any major modification. The attempts to change the Act will come in 1993.

Enclosures: 1. Rocky Mountain News, Apr. 7. The massive kill of Colorado River endangered fishes at the Dexter, N.M. hatchery, lost the razorback suckers, humpback chub, and squawfish that were to be used for the genetic analysis. Although a great waste of money was involved the genetic research had little or nothing to contribute to "real progress" toward recovery.

Enclosure: 2. Copies of pages from a monograph I wrote for publication by the American Fisheries Society. In the monograph, I attempt to impart some wisdom gained from 35 years of experience. This particular example attempts of make clear that predictive accuracy should not be expected from natural systems no matter how much research is done, how much data collected, how scientifically sound the methods or how sophisticated the models. It also explains my ideas on professional judgement.

3. Most fishery and wildlife biologists and administrators are not cognizant of the points I raised on limitations for predictive accuracy. William McConnell is a

retired FWS biologist who is also disturbed by naive faith in models, data, and scientific method. He frequently visits to discuss such matters. Enclosure 3 is page form a McConnell essay. He writes essays and distributes them among state and federal biologists in an attempt to educate them to a higher level of thinking. I doubt he has much success but his essays act to mitigate for guilt he feels for his participation in so many dumb FWS programs over the years.

4. List of committees of the Colorado River Recovery Program. A bureaurcratic nightmare.

ANNNOTATED BIBLIOGRAPHY
March - April 1992

Bean, M.J., S.G. Fitzgerald, and M.A. O'Connell. 1991. Reconciling conflicts under the Endangered Species Act: The habitat conservation experience. World Wildlife Fund, Wash. D.C. 109p. Attempt to demonstrate by successful examples that ESA conflicts can be reasonably resolved. Many or most conflicts, however, are not typical of cited examples.

Colorado Water, Apr. 1992. Comments by Peter Evans, Legal Counsel for Colo. Dept. Nat. Res. reflect typical misconceptions in regards to "science", "research", "data", and resolution of instream flows and endangered species problems. Makes case for more scientific research to obtain more "hard data" so we can "know" what flows endangered fishes "need". The fact is that we can never "know" with any precision what flows the fishes "need". We can never expect much precision in predictions from flow-habitat-fish models no matter how much "hard data" is obtained or how sophisticated are the methods or models used. Limitations for accurate predictions are determined by uncertainties and unpredictable random events over which we have no control-- an inherent characteristic of natural biological systems. It is understandable that nonbiologists will have a naive faith "that science" and "hard data" will resolve complex issues such as determining instream flows to enhance endangered species survival with great precision; they are encouraged to have such faith by biologists and administrators of resource agencies who constantly request funding for more research and more data.

Conservation Biology, 1992, 6(1). Continuing debate on why Endangerds Species Act doesn't work very well. Viewpoints on political constraints vs. "idealized" implementation of the Act.

McAda, C. and L. Kaeding. 1991. Movements of adult squawfish during the spawning season in the upper Colorado River. Trans. Am. Fish. Soc. 120(3): 339-345. Squawfish may move considerable distances to find the relatively few suitable spawning sites.

Tyus, H.M. 1991. Movements and habitat use by young Colorado squawfish in the Green River, Utah. Jour. Freshwater Ecol. 6(1): 43-51. After hatching young squawfish move considerable distances downstream, utilizing backwater habitat along the way.

U.S. Fish and Wildlife Service. Endangered Species Bulletin 1991, 7 (7-8, 9-12) (budget restrictions delayed publication and two or three issues are combined into one). An endangered subspecies of bobwhite quail reintroduced into Arizona (on Buenos Aires National Wildlife Refuge). Record

number of squawfish (84) sampled in Colorado R. near Colo.-Utah border in 1991.

Recovery Program for the Endangered Fishes of the Upper Colorado. Summary of March, 1992, meeting. Anxiety and some animosity expressed by representatives of water user groups. Feeling of betrayal that money paid for nonjeopardy opinions might not automatically exempt project from ESA. Issue centers on a 1989 solicitors opinion that mitigation payments for "conservation and recovery" made to the Recovery Program must demonstrate "real progress towards recovery, not just collect money." Matter discussed in this bimonthly report.

Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin: organization and mission, Nov. 1991. Examination of this document detailing the administrative structure of the Recovery Program with its many committees and subcommittees each with missions, rules, etc., makes understandable why "real progress" hasn't been made to recover the endangered fishes--virtually all effort has been diverted to establish a beauracritic nightmare.

Habitat Evaluation Notes and Instream Flow Chronicle, 1992, 11(2). New model developed, Habitat Management Evaluation Method (HMEM), designed to find most cost-effective mitigation.

Recovery Plans completed on Arizona threatened species: loach minnow (Tiaroga cobitis) and spikedace (Meda fulgida).

Zircone, L.H. and R.A. Rulifson. 1991. Instream flow and striped bass recruitment in the lower Roanoke River, North Carolina. Rivers 2(2): 125-137. Long standing conflict re. C.E. dam relicensing was finally resolved by simply agreeing to maintain flows in median 50 percent range (>25%-<75% of average flow) during spawning season--methods, models, and data could not support any other option--a common sense resolution.

[Oct, 1992]

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QUARTERLY REPORT FISHERIES-AQUATIC BIOLOGY
May-July 1992

As per Fy 1992-1993 work order, the bimonthly report is now a quarterly report with dates of issue of July 31, October 31, January 31, and April 30.

Recently, I helped develop a monitoring program for a large corporation with a problem of PCB contamination of the Housatonic River in Massachusetts and Connecticut. This has been a long term problem and my input mainly concerns assuring the public (anglers, environmentalists) that no additional benefits to fish and wildlife will occur with further reduction in PCB levels---present levels of PCB's create no impairment of any life history stage of any species of vertebrate and invertebrate animals or plants. This project is comparable to the EPA's "use attainability analysis"--what "use" (species abundance and diversity) might be attained if there were no water quality problem? I became aware of large regional differences in attitudes and "reasonableness" among state (fish and game and public health departments) and federal (EPA, USFWS) personnel. In Massachusetts, all agency biologists agree that at current PCB levels there is no problem of "impairment" of any life associated with the Housatonic River; the problem concerns a human health hazard from consumption of fish with more than 2 parts per billion PCB (currently only trout exceed this level). They agree there is no need for an elaborate "use attainability" analysis or fish health assessment analysis (see below re. different EPA response in Denver region). In fact the sport fishery, for bass in Massachusetts, and for trout in Connecticut, would rapidly deteriorate if PCB's disappeared and anglers kept the fish they caught. For several years anglers have learned to release all fish caught and populations of trout and bass have increased by several fold. The quality of the angling is such that these fisheries now support two to three times more angler use than in pre "health hazard" awareness times.

Attorneys for the corporation, anticipating public comment that Massachusetts anglers will demand a trout fishery comparable to that currently maintained in the Connecticut portion of the river and that a common belief would be that PCB's are limiting trout in the Massachusetts section of the river, wanted to have evidence compiled and a spokesperson to explain the evidence that PCB's play no role in limiting trout in the Massachusetts section of the river; trout are limited by habitat and temperatures.

After years of experience dealing with EPA and USFWS personnel of the Denver regional offices and Colorado Public Health re. endangered species, use attainability, etc. where it is very proper to be "environmentally correct"---protectors of the environment are not doing their duty unless they can continually raise the most incredulous issues to stifle reasonable resolution of potential problems--I was pleasantly surprised to find agency people in Massachusetts in completely in agreement that there is no real issue over use attainability and PCB contamination at current levels (which are steadily

declining).

The contrasting attitude of the Denver EPA office (or at least one mid level biologist) has been previously discussed in relation to use-attainability of a stream receiving sewage treatment effluent and my use-attainability analysis, strictly following EPA protocol, which found much more species diversity and 10 to 100 times species biomass in the effluent canal itself compared to the receiving stream because the canal was the only site with adequate habitat. The environmentally correct attitude, however, could not accept the very obvious evidence.

This same EPA person has struck again in a North Dakota case of potential heavy metal pollution from a mine. The mining pollution has been essentially cleaned-up. All sampling and monitoring shows no impairment of the fish and invertebrate fauna in the receiving stream---no further improvement can be reasonably expected with further reduction of metal concentrations, which are below "impairment" levels. Reasonable resolution of this case is not at hand however because the EPA biologist now has heard of a new method to assess fish health with which he believes might indicate "stress" or impairment not detectable by other methods. The citation to Adams (1990) in the bibliography refers to an American Fisheries Society publication "Biological indicators of stress in fish". One of the chapters in this publication, "Organismic indices and an autopsy-based assessment as indicators of health and condition of fish", describes a technique of "fish health assessment". This method dissects fish to obtain data on blood parameters, gills, gut, thymus, spleen, fat deposits, kidney, liver, and many other physiological indicators. The fact is that all of these indicators vary during the life of a fish, they vary seasonally and for many reasons. A dilligent environmentally correct investigator can be sure to find some indication of stress or impairment even in the healthiest of fish if they keep looking. The EPA biologist now wants the fishes in the North Dakota stream to be given the "fish health assessment" after all other methods failed to find impairment. When environmentally correct extremists with public agencies, needlessly prolong assessment and monitoring studies resulting in no benefits to the environment and greatly increase costs (benefits to consultants and attorneys), a question of ethics is raised.

The citation to Reeves et al. (1992) is a Forest Service publication based on a conference on ethics and resource management. The main thrust is that agency biologists should maintain ethical standards to resist political pressure--for example, Forest Service suppression of data on spotted owls when conflicting with planned timber harverst. The ethics publication would benefit from a chapter on the ethics of agency biologists who take extreme obstructionists positions in a belief that it is their duty to protect the environment at all costs, even if they must fabricate a nonexistent issue.

The general public, the news media, and the courts typically have a perception that state and federal agency biologists are protecting the public and the environment from ruthless degradation of natural resources. There is a strong bias of "good" and "right" in their favor, which encourages

further abuse. My suggestion is to have an environmentally correct position written as a scientific paper with all supporting evidence and submitted to a journal for publication and peer-review. This would demonstrate how untenable a position might be when exposed to the scrutiny of peer-review and make the proponent of such a position more reasonable if threatened with exposure and embarrassment by ones peers.

The annual meeting of the Western Division of the American Fisheries Society was held at C.S.U. July 13-16. Sessions were held on current trends and legal status of water use--ecological values in conflict with traditional uses and values. Several papers on Colorado River endangered fishes; including a study on humpback chub in Little Colorado River by people at Arizona St. Univ., which typifies Colo. R. "research". After two years and \$250,000 (the ASU was only one of three interrelated humpback chub studies. Total costs around a million \$) it was concluded that not much is really known about humpback chub--but for few more million \$, they might learn something useful. Several papers on habitat modeling, especially instream flow incremental methodology (IFIM). Same problems--in developing habitat suitability curves it was found that substantial differences were obtained if fish were observed during the day or at night. Typical problems of lack of positive correlation between where fish are predicted to be and where they are. The Electric Power Research Inst. has long funded IFIM testing by E.A. Engineering Co. and several of these studies were reported on. One intensive 7 year study in a small California stream tested 32 IFIM physical habitat simulation models (PHABSIM) in attempt to correlate model output (weighted usable area, WUA) with fish density. One model gave weak correlation in some sections of the stream. The other 31 models showed no correlation or negative correlation.

Some papers indicated some insights into how models might be made to reflect more biological reality. For example, a West Virginia study with IFIM found no relationship between flow habitat-fish abundance, but produced some evidence that the relationship is indirect--flows influencing fish abundance by influencing food supply of fishes (a facet not considered by IFIM). The trend apparent from annual meetings where leading IFIM practioners get together to discuss why IFIM lacks predictive capabilities is a gradual transition from naive certainty based on ignorance to more reasoned uncertainty based on a better understanding of the uncertainties inherent in natural biological systems. In relation to what was discussed above regarding obstructionist agency biologists who are still maintaining what they believe is an environmentally correct position, such biologists are operating on a certainty based on ignorance position. It would be helpful to identify such people at an early stage of an assessment-negotiation process. I noted that none of the people on the Arizona instream flow subcommittee were at the meetings. Papers on Arizona fisheries concerned a habitat structures program for Verde and Salt river reservoirs (evidently successful and popular) and the trout fishery below Glen Canyon dam.

Enclosures. 1. Cover and page of text from IFIM video. Ms. McGraw was my graduate student, she produced a text and video promoting IFIM (an official FWS production). I am responsible for the disclaimer that IFIM really doesn't predict fish biomass from its habitat model--we now have an official statement on the matter.

2. Cover page (of 9 page policy) re. stocking of game fishes in upper Colorado River basin and negative response of Colorado Div. of Wildlife and outdoor columnist. Actually, attempting to prevent negative impact of non-native fishes on endangered species by limiting further stocking is comparable to keeping the horse in the barn after the door is left open and the barn burned down.

3. News item of attempt to remove red wolf from protection of Endangered Species Act because recent genetic study on DNA shows hybridization with coyote. Citation to De Marais et al. (1992) concerns DNA studies by biologists at Ariz. St. Univ. and hybrid origin of endangered Virgin River chub. It is likely that hybrid DNA could be found in razorback sucker also if enough specimens examined. The USDI opinion on hybrids and ESA is still open to interpretation and the FWS proceeds on a case by case basis. It is doubtful that the red wolf or the Virgin R. chub (or razorback sucker) will be removed from ESA listing because of hybridization.

4. After the accidental kill of most endangered fishes at Dexter, N.M., FWS hatchery (mentioned in last report), attempt to propagate razorback sucker (and squawfish) now being made by Colorado Div. Wildlife. This endangered species propagation program also provides for renovation of Colorado hatcheries (where mostly sport fish are raised) with federal endangered species funds.

ANNOTATED BIBLIOGRAPHY
May-July 1992

Adams, S.M. (editor). 1990. Biological indicators of stress in fish. Am. Fish Soc. symposium 8. Thirteen chapters discuss various biochemical, immunological, and physiological techniques to monitor "stress" in fishes. One particular technique, "fish health assessment", is currently gaining favor as a monitoring method which can find "stress" or "impairment" when all other methods fail. Discussed in quart. rep.

De Marais, B.D., T.E. Dowling, M.E. Douglas, W.L. Minckley, and P.C. Marsh. 1992. The origin of Gila seminuda through introgressive hybridization: implications for evolution and conservation. Proc. Nat. Acad. Sci. U.S.A. 89(7): 2747-2751. The roundtail chub native to the Virgin R. of Utah, Arizona, and Nevada, is protected as an endangered species under the E.S.A. This study, analyzing DNA, found that the origin of the Virgin R. chub was from hybridization between roundtail chub and bonytail chub. The U.S.D.I. policy on E.S.A. protection of hybrids is not yet resolved. See enclosure on lawsuit to remove red wolf from E.S.A. because it is hybrid between wolf and coyote.

Fisheries 17(3) (May-June 1992). This issue is devoted to biodiversity. Most articles by EPA biologists and administrators and denote a proper "environmentally correct" attitude toward carrying out EPA mandates as they interpret them. Quart. Rep. mentions regional differences in environmentally correct attitudes among EPA administrators.

Layher, W.G. and K.L. Brunson. 1992. A modification of the habitat evaluation procedure for determining instream flow requirements in warm water streams. N. Am. J. Fish. Mgt. 12(1): 47-54. An empirical method to recommend "minimum desirable stream flow" (MDS). Kansas legislature has adopted MDS standards for state.

McGraw, J.F. 1992. Instream flow incremental methodology: IF 200 overview using video format. Professional paper (fulfillment of requirement for plan B M.S. degree), Dept. Fishery and Wildlife Biol., Colo. St. Univ. Jenny McGraw was one of my graduate students. For her M.S. degree she wrote text and produced a video to familiarize audiences with how IFIM works - what it does, etc. My influence as Major Adviser for the project can be noted among enclosures--P. 15 of text clearly states that IFIM "does not claim to equate habitat to fish biomass".

Oberdorff, T. and R.M. Hughes. 1992. Modification on an index of biotic integrity based on fish assemblages to characterize rivers of the Seine basin, France. Hydrobiologia 228 (2): 117-130. IBI exported to Europe.

Reeves, G.H., D.L. Bottom, and M.H. Brookes (technical coordinators). 1992. Ethical questions for resource managers. USDA Forest Service, Gen. Tech. Rep. PNW-GTR-288. Articles mainly concerned with ethical considerations of state and federal biologists in relation to political or organizational pressures for expedient decisions. These same biologists, however, also should have same ethical standards apply to situations where a position is maintained beyond all credulity and common sense to be "environmentally correct" and support a preconceived point of view.

Rojas, M. 1992. The species problem and conservation: what are we protecting? Conservation Biology 6 (2): 170-178. Article points out that there is no general agreement on the question: what is a species? Non systematists, non taxonomists are not aware of the great contemporary divergences in opinions and philosophies on the species question. Any attempt to modify definition of species under E.S.A. will have to address this problem.

U.S.B.L.M. 1992. Special status fishes: habitat management (part of BLM's "fish and wildlife 2000" and "bring back the natives" programs). This publication propagandizes BLM effort to protect and restore habitat of endangered and threatened species. These BLM programs make BLM appear more like the National Park Service than the BLM we all know. As mentioned above for EPA, there are often great differences in how BLM carries out its mandates at the state, regional, and district levels.

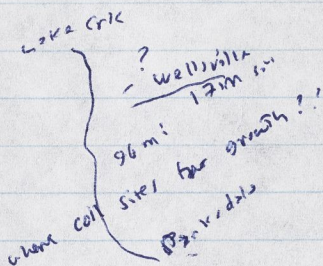
Waite, I.R. and R.A. Barnhart, 1992. Habitat criteria for rearing steelhead: a comparison of site-specific and standard curves for use in the instream flow incremental methodologys N. Am. Jour. Fish. Mgt. 12(1): 40-46. Compared habitat suitability index curves developed by three previous IFIM studies to predict where juvenile steelhead would be found in Big Creek, California, to where young fish were actually found. The three IFIM habitat models were in error by up to 3-4 fold magnitudes in relation to predicting the fish-habitat-flow associations.

Impact Analysis of a flow augmentation program on the brown trout fishery of the Ark. R., Colo. - CDOW Aug. 13, 92 -

no water) Denver

Wellsville - 1962-91

	cf/s	S.P.
"native" water 430,000 c.f. - 600 cfs	\bar{x} ann. 717 ± 180	358 (1977) 1135 (1984)
"imported" water 115,000 c.f. - 117	peak \bar{x} 3273 ± 1204	1230 " 5950 (80)
	low flow \bar{x} 204	110 (63) - 307 (55)
	July \bar{x} $1511 \text{ cfs} \pm 666$	340 (77) 3068 (83)
	Aug \bar{x} $911 \text{ cfs} \pm 334$	278 (77) - 1589 (84)
	Sept. 513	267 - 1031
30 yr. median \bar{x}	- 693 cfs	
" "	July 1351	
" "	Aug. 848	
" "	Sept. 473	



1987-91 w/o augmentation - flows would \downarrow 4700 cfs by Aug. 6, July 12, Aug. 25, July 14, July 28.

1982-86 - 5 yrs. - flows exceed -- 700 cfs till Aug 15 w/o augmenting

flow - Temp. - correl. - higher flow, lower temp. Sure July Aug but what temp.?

Lake Crk. \rightarrow Parkdale = 96 miles.

if 700 cfs for 15 days in Aug. growth \downarrow 3.5% -

* but med. \bar{x} Aug. for 848 cfs.

300 cfs peak WVA - 26% loss of 700 cfs (> adult 5" \geq) due to velocity? Data from Wellsville station

* - p. 22 - temp. -

Aug. Temp. highest = higher metabolism = bad - but \uparrow flow, \downarrow Temp. -

higher runoff = higher heavy metals

- Most benefits in spawning - incubation - emergence flow
- add large woody debris.
- reduce erosion fr. trib. (fence livestock)
- increase spawning habitat
- " public access -

- E.C. - w/ goal of extracting 'extra' - mitigation but 8-10 + 1M
(start durb
2nd 5)
 NB - CNPPID - GTR-DEC - ATRN Co. - June (4.8) - 5M
 'early life stages' coldwater - decline white sucker Temp. 85° F
ids
 as cold water sp. - but \$-pay to kill? - if rotenone - a
 positive \$ - neoptin var
 - 3600 a.f. extra used - invest - grow sun - 8. power fences
 - real problem Neb. trout - 10% return for white sucker which
 - 50% - low no early life stages

- Ark. R. CDOW - Bur Roe. -

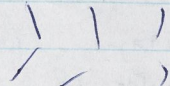
- SAN Quartz Rly

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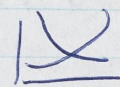


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(A)



(B)



factory
component

was
error

QUARTERLY REPORT : FISHERIES AQUATIC BIOLOGY
AUG - OCT 1992

The citation in bibliography to USFWS (C) concerns a list of candidate species considered for listing under the Endangered Species Act. A total of 38 vertebrate species plus many invertebrates denote Arizona as part of the species past or present distribution. Only a few of the candidates are likely ever to be listed because of the numbers involved and the information required for listing. Some candidates such as the flannelmouth sucker, which is very common in upper Colorado River basin, don't make sense to me. The Desert Fishes Council meeting will be held in Mesa, AZ, Nov. 18-21, this year and I should learn more about the candidate fish species at this meeting (also about how the ESA is a new method of genocide on the Apache tribe --see enclosure 1).

In August, I and attorneys representing the Central Nebraska Public Power and Irrigation District met with the state's assistant Attorney General. The issue would appear to be an extreme example of environmental correctness on the part of the Nebraska Dept. of Game and Fish, but, in reality, it was a clever ploy to extract further concessions and mitigation from a hydropower project. In 1988 after two years of study demonstrated an excellent trout fishery could be maintained in Lake Ogallala, the regulating reservoir receiving water from the Lake McConaughy hydro plant, a special oxygen standard was granted to CNPPID which allowed instantaneous oxygen levels less than the class B cold water standards (6 ppm) during the months of July, August, and September. During the rest of the year, class B (6 ppm) standards would apply. Several years of drought greatly lowered the surface level of Lake McConaughy. This resulted in much less storage volume and the hydro intake began to draw water of lower oxygen content from the depths of McConaughy at a much earlier date in 1992. Neb. G. and F. biologists recorded O₂ levels in L. Ogallala every day in June and finally documented a reading of less than 6 ppm. Soon after, CNPPID received a notice of violation from the state's Attorney General. To be a violation, however, the natural reproduction of a coldwater fish species, which might be affected, must be documented (or claimed to be). Since trout do not reproduce in L. Ogallala, the G. and F. Dept. declared the longnose sucker to be (officially) a coldwater species. This same longnose sucker is often eradicated from reservoirs by costly chemical treatment to enhance sport fisheries. Our long term fish collection data show that only three large longnose suckers have ever been recorded from L. Ogallala and there has never been any evidence of their reproduction (the fish came with water from L. McConaughy). No matter, the A.G. has a legal basis to charge CNPPID with water quality violation as a serious threat to encourage an out-of-court settlement with the Game and Fish Dept.

This farcial situation can be understood from a long history of bad relations between CNPPID and N G and F people. The "violation" is really a desire to settle some old scores. I

suggested that, in the long run , it would be more economical for CNPPID to take over the fishery of L. Ogallala and get N G and P out of the picture.

The citations to USFWS (A) and to Van Horne and Weins refer to continuing attempts by the U.S. Fish and Wildlife Service to improve their image and the credibility of their methods and models--but it's all "smoke and mirrors". Last month I was in communications with a Texas law firm on the matter of endangered species and flows from Comal Springs. Four plant and animal species dependent on spring flows from Comal and neighboring San Marcos springs are listed as endangered under ESA. A long history of acrimonious litigation has characterized the fight for water between upland groundwater pumping interests and water users dependent on spring flows. Last year the Sierra Club filed a law suit to enforce the provisions of the End. Sp. Act. This year the USFWS declared an emergency measure claiming a minimum flow of 100 cfs from Comal Springs to protect endangered species. When asked about the "scientific" basis for the 100 cfs, it was admitted that there is no "sound scientific" basis, but "research" will provide the basis. I was sent a copy of the proposed "interdisciplinary research" program. All sorts of cliches and acronyms such as guilds, HEP, IFIM, GIS, PVA, IBI, etc., etc. are thrown around in the research proposal (smoke and mirrors) to give the illusion of "scientific research" and a factual basis for flow recommendations.

Although it is now widely recognized that the proposed methods and models lack predictive accuracy and credibility, FWS administrators believe it necessary to go through the motions of conducting a "scientific study". I suggested to the Texas attorney that if the FWS methods and models were to be challenged in court they could use the testimony of the FWS' own resident expert, Dr. David Anderson, leader of the Colorado Cooperative Wildlife Unit and world recognized authority on mathematical modeling.

The USFWS has, for many years, provided instructors for a course offered to Colo. St. Univ. students on habitat evaluation procedures (HEP), in which students learn how to develop habitat suitability indices (HSI) for simulation modeling, applying FWS methods of environmental analysis. When this matter was brought up at a faculty meeting last month,,Dr. Anderson demanded we cancel the FWS' HEP course because it is the antithesis of our educational goals--we try to teach students how to gain "reliable knowledge" and the teaching of a FWS methods and model course is a direct contradiction according to Dr. Anderson--all agreed and the course was cancelled, despite the fact it didn't use any university funds (see enclosure 2 as example of new emphasis in undergraduate teaching).

I cautioned the attorney, however, not to attack the FWS "research" program. It is likely that the opposing water user groups will reach a compromise and, for example, a 100 cfs minimum flow from Comal Springs is agreed upon. The USFWS can then claim they have a scientifically sound basis for this settlement (there are so many unknowns and uncertainties

involved in attempting to associate any specific flow to the well-being of the endangered species that the models can be played around with to give any desired output.) The Sierra Club (which claims 300 cfs is necessary to avoid jeopardy) might then file suit to claim the FWS "research" is not a scientifically sound basis for flow recommendations. As I have pointed out, it is the environmental groups who have most often attacked the use of FWS models such as IFIM and HEP.

Last week I received a call from the National Research Council of the National Academy of Science requesting that I serve on a panel to write an in-depth report on the End. Sp. Act, which could serve as a basis for congressional reauthorization (and modification) of the Act.

Enclosures: 1. I expect that the "bigwigs" at SRP have already seen this Sept. 16 article from the Apache Scout. ESA as Apache genocide -- should be interesting case.

2. Pages from information packet for students in C.S.U. undergraduate course in wildlife methods and techniques. Note strong emphasis to teach students to understand the limitations and constraints of any methods or models to understand biological relationships or to make accurate predictions. Unfortunately, most current employees of natural resource agencies never learned these fundamental truths of nature.

3. Pages from book "Watershed Management." The authors find strong agreement with my points of view.

4. I finally "published" my views (cited as unpublished in 3) in book on western North American trout (released Sept. 1992 by Am. Fish. Soc.)

Much of what I wrote in book can be found in my SRP reports, but now they have additional weight and credibility because they are published.

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AUG-OCT 1992

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- Behnke, R. J. 1992. Native trout of western North America. Am. Fish., Soc. monograph 6:275 p. In this work I give much advice and many examples similar to what found in my SRP reports. Examples enclosed.
- Brown, T.C. 1991. Water for wilderness areas: instream flow needs, protection, and economic value. Rivers 2(4): 311-325. Discusses problems from lack of basic information in regards to recommending and justifying instream flows.
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- Dinan, K. E. 1992. Application of the stream network temperature model to the Central Platte River, Nebraska. Report for M.S. degree, CSU. I served as graduate advisor to Mr. Dinan, a USFWS employee, whose task was to develop a flow-temperature model for Platte River fishes. The fishes serve as food for a threatened species of bird.
- Stanford, J.A. and J.V. Ward. 1992. Management of aquatic resources in large catchments: recognizing interactions between ecosystem connectivity and environmental disturbance. Pages 91-123 in R. J. Naiman (ed.) Watershed Management. Springer-Verlag. The authors found my comments on the "illusion of technique" most appropriate, especially in relation to the predictive capabilities of IFIM. Copies of pages enclosed.
- U. S. Fish and Wildlife Service.
- A. 1992. Habitat evaluation notes and instream flow chronicles 2(4). Aquatic habitat appraisal guide (AHAG), a new acronym for model for large river systems using habitat suitability curves (HSI), for "guilds" of fishes (species sharing similar habitats).
- B. 1992. Recovery Program for the Endangered Fishes of the Upper Colorado, summaries of meetings. Dissension over E.S.A. and "historical

depletions" of upper Colorado River water projects (those projects completed before 1973 ESA and believed by water users to have "grandfathered" exemptions.

C. 1991. Candidate species for listing as endangered or threatened (published in Federal Register Nov. 21, 1991). Arizona candidate species of mammals include 17 species of bats and rodents plus subspecies of otter and mountain lion; 8 bird species; 6 reptile species (snakes and lizards), 6 amphibian species (salamanders, frogs, toads), and 5 fish species (flannelmouth sucker, Mexican-stoneroller, Gila chub [Gila intermedia], Virgin spinedace, and roundtail chub, besides a load of invertebrate species. Candidate species are not proposed for listing until more information is obtained.

Van Horne, B. and J. A. Weins. 1991. Forest bird habitat suitability models and the development of general habitat models. USFWS, Fish and Wildlife Research 8. Recognizing problems of their habitat suitability indices (HSI, used in USFWS HEP and IFIM models) and aware of intensifying criticisms attacking the logical basis of such models, the FWS has contracted with some "big name" highly respected ecologists (such as the husband and wife team of Weins and Van Horne) to critique models and offer advice on improvement, in hopes of saving face and polishing a badly tarnished image derived from poor model performance. I do not foresee significant improvement.

ORIGINAL INVOICE

Robert Behnke
3429 E. Prospect Rd.
Fort Collins, CO 80525

~~July 31, 1992~~

TO: M. Byron Lewis ~~Oct~~ Jan. 31, 1993
Jennings, Strauss, & Salmon
One Renaissance Square
Two North Central
Phoenix, AZ 85004-2393

Re: Gila River Adjudication
Task Z Quarterly report.

20 h	x \$50/h	\$1000.00
	typing	15.00
		<hr/>
TOTAL		\$1015.00

QUARTERLY REPORT FISHERIES AQUATIC BIOLOGY

November 1992 - January 1993

As mentioned in previous reports, I was retained by the Dallas law firm of Haynes and Boone to advise on an endangered species, water law case in Texas. Attempts to settle the case failed and it went to trial in federal court in Midland, Texas in November. The trial concerned a bitter controversy between two water-user groups. One group obtains its water from the underground Edward aquifer, the other ("downstream") group receives water from large springs, whose flow volume depends on the level in the aquifer. The Texas Water Board attempted to resolve the dispute by declaring the aquifer to be an "underground river" (the Board has jurisdiction over surface water ["rivers"] but not ground water under Texas law), and promulgating restrictions on ground water use (presently, more than 500,000 acre feet is annually removed from the aquifer and the proposed regulations would gradually reduce this to 350,000 a.f. over a period of years).

This fall, a Texas court ruled that the state water board has no control over ground water and the case moved from state court to federal court because the "downstream" water users and the Sierra Club invoked the Endangered Species Act. The endangered species directly involved is a small fish, the fountain darter, with a maximum size of 1 1/2", which lives in the area of the upper springs (Comal Springs). Three other endangered species would be affected in the lower springs (San Marcos Springs) after Comal Springs ceased to flow.

The Sierra Club (and the downstream user group) made a claim that 300 cfs is a minimum flow needed from Comal Springs to avoid "take" and "jeopardy" of the fountain darter. After analysis of available data, I noted that, based on an intensive inventory of fountain darters, about 70% occurred in an old channel (now a bypass channel) which has an average flow of 7 cfs. This old channel area is only about 25% of the total water surface area

inhabited by the darter. Obviously, the old channel site would be the "critical habitat" dependent on flows from Comal Springs (one proposal was to pipe in water to maintain the critical habitat if Comal Springs ceased to flow).

Needless to say, the testimony at the trial by expert witnesses had little to do with "scientifically sound" evidence.

The judge has not yet rendered his decision but I expect the bottom line will be that if the state legislature gives jurisdiction over ground water to the state water board, and if the board's plan to control and reduce the volume removed from the aquifer is implemented, then there will be no violation of the Endangered Species Act. In the interim the USFWS has invoked an emergency minimum flow of 100 cfs from Comal Springs and is undertaking "research" (using IFIM, HEP, GIS, etc.) to provide a "scientifically sound" basis for flow recommendations (which is so much nonsense).

This case could have been settled "in-house" except for the long and bitter hostilities among the various user groups. A total of 32 attorneys were involved and legal fees exceeded \$5 million. It is not in the self interest of law firms and their consultants to seek early resolution, but I doubt that this could have been settled outside of federal court--the controversy had raged on for many years.

After the Texas trial I attended the annual meeting of the Desert Fishes Council in Mesa, Arizona, for updating on southwestern fishes. Many papers were presented on endangered and threatened fishes (squawfish, humpback chub, pupfish, Gila topminnow, razorback sucker, spikedace, loach minnow, etc.). Razorback sucker stocked in the Verde River evidently survive quite well if they are sufficiently large (>14 inches) to avoid predation by catfish. Some of these razorback suckers were implanted with radio tags to follow movement. They moved both upstream and downstream with a trend for net downstream movement; averaging 1.1 km/week downstream and .76 km/week upstream. The limiting factor for establishing a viable self-reproducing

population of razorback suckers in the Verde River appears to be predation by non-native fishes, especially catfishes (channel catfish and flathead catfish).

I expect there will be changes in administration of the Endangered Species Act and in emphasis on environmental vs. economic values of public lands with the new administration, originating at the highest levels (from top down), for example, the views and backgrounds of V.P. Quayle vs. Gore and Secretary of Interior Lujan vs. Babbitt. No matter which party is in power, however, it can be assumed that politicians will seek win-win situations and vote to expend large sums of money which may, temporarily, appear to achieve the desired goal, but, in reality, do little good. An example of this is found in citations in bibliography to Fisheries, USFWS Habitat Eval. Notes, and to Wild Fish, concerning laws and funding designed to restore the abundance of West coast salmon runs. Over a 10 year period, \$1.34 billion was spent on salmon restoration and the salmon, especially in the Columbia River, continue to decline. Almost half of this money was spent on hatcheries which have long been an obvious win-win mitigation measure despite the evidence of their abysmal failure to increase abundance (some salmon of hatchery origin represent investment costs of \$500 per fish or more, because of extremely low survival, and have a wholesale value of \$20 to \$30 per fish). New hatchery construction, despite the factual economic evidence, is still politically popular.

Last summer, a legislator in the state of Washington introduced a bill instructing the fisheries department to "double" salmon abundance, mainly by appropriating funds for new hatcheries. One of my graduate students was in Washington and wrote a letter which was published in a Seattle newspaper saying that the achievement of such a goal was as likely as if a law was passed to double the IQ of all state legislators. To believe that complex environmental problems can be resolved by simply passing laws and spending money is comparable to mythical King

Canute commanding the tide to cease and desist. My favorite example of this, of course, is the recovery program of the endangered fishes of the upper Colorado River basin. Thus, no matter which political party is in power, I expect another decade or more of great expenditures with little actual benefits to the fishes.

A review of the latest "recovery implementation program", meeting summaries, and newsletter, reveals for FY 93, a budget of \$2.92 million, which is only part of the planned expenditures. As mentioned in previous reports, concern has been expressed, especially by water users, that former nonjeopardy opinions might be voided. This is because the FWS has made more than 50 nonjeopardy opinions for projects which deplete 168,000 acre feet of water annually and the basis for the opinions has been (since 1981) that payment into the recovery program (a water depletion tax) was a reasonable and prudent alternative that would avoid jeopardy, somehow, by expenditure of the "tax" paid for a nonjeopardy opinion. It has remained vague just how spending of funds would lead to recovery of the endangered species and there are no tangible results to consider that the "reasonable" alternatives have been successful. After 12 years the original three species, squawfish, humpback chub, and bonytail are still endangered, the bonytail is now extinct in upper basin, and the razorback sucker has been added to the list. If someone challenged these former nonjeopardy opinions it might be decided by a court that "sufficient progress" has not been made and the nonjeopardy opinions voided.

Thus, much thought was given in 1992 by many people in the recovery program to come up with a legally defensible argument that sufficient progress has been made toward recovery and the taking of money (depletion tax) is a reasonable and prudent alternative (to a jeopardy opinion, which would raise no funds and generate bad public relations). The concept of "milestones" received most attention at recovery team meetings in 1992. "Milestones" would be defined in such a way that it could be

shown that some have been achieved (setting basis for recovery) and others will be achieved according to a time schedule. (It was also estimated that the recovery program would need \$100 million to achieve the milestones).

The bottom line is: What is being done for the endangered species? Is there any tangible evidence of recovery? There are 32 items identified in the FY 93 budget that, ostensibly, contribute to recovery. Most of the funding has little or no relevance to recovery, such as the \$263,000 for "Gila taxonomy" and \$156,400 for "genetics management". Once new programs get started they tend to grow uncontrollably and new sources of funding are needed. The Flaming Gorge flow studies were designed to last 5 years with an expenditure cap of \$300,000 per year. By the third year, it was decided that six years of data would be needed and the FY 92 costs ballooned to \$434,000. The Aspinall Unit flow studies began in FY 92 (also for five years and cap of \$300,000 annually). They increased to only \$316,100 but with the Flaming Gorge studies as a guideline, \$500,000 is proposed for FY 94 Aspinall expenditures.

The recovery team has developed into an effective lobbying group. Members go to Washington, D.C. each year and lobby environmental groups and state congressional delegations for additional funds (not identified in annual budgets). In FY 1992, Congress appropriated \$1,000,000 for acquisition of water rights. In the first place, the recovery team has not yet determined the "necessary" flows for "critical" river section (i.e. how much water needs to be acquired), and, secondly, very few water rights have been "acquirable" (very few rights for sale). Thus, for FY 93, the lobbying team will seek to get permission to spend the \$1,000,000 on "flow related" items.

For a "sound scientific" basis for flow recommendations (after many years of IFIM and other methods proving futile) in 1992, \$120,000 was appropriated to hire a "senior scientist" for one year. This senior scientist, commonly referred to as the "instream flow guru" was naively assumed to have some magical

solution to the problem of flow recommendation; he would have some hitherto unknown foolproof method to produce "scientifically sound" recommendations. Dr. Jack Stanford, Director of the Flathead Lake Biological Station, was hired as the instream flow guru. I know Jack very well. Many years ago he was one of my undergraduate advisees. In his career, he has been a very successful biopolitician. In my last report enclosures included pages from a book chapter by Stanford and Ward (Watershed Mgt.) which gave a highly negative view on the usefulness of IFIM for flow recommendations (citing personal communication from me on the matter).

The instream flow guru report is due in May. It should be interesting.

To address the problem of water rights acquisition, a second senior scientist, a water rights guru, will be hired in 1993.

In summary, complex biological problems, such as recovery of Columbia River salmon and recovery of Colorado River fishes, cannot be solved by throwing money at them. The human "instinct" for committees to grow uncontrollably into teams, taskforces, and programs readily absorbing more and more funding take on a life of their own and little or no progress is made toward resolving the original problem. This is an inherent human and political reality irrespective of the political party in power.

Enclosures 1 and 2. Items regarding endangered species listing and continuation of approved water projects are examples where changes might be expected with the new democratic administration. Also in Colorado, after intervention by republican senator Brown, the Secretary of Agriculture, by decree, exempted municipal storage reservoirs on U.S. Forest Service lands from review in regards to releasing water for instream flow (how USFS mandates are interpreted). I expect a different interpretation by new administration.

Item 3 concerns critical habitat the USFWS must designate after Sierra Club law suit. As mentioned, this will require flow

recommendations and will likely make it more difficult for the recovery program to continue to make nonjeopardy opinions.

Besides opposition to the ramifications of critical habitat and endangered species protection by water user interests, angling groups and some Colorado Division of Wildlife Commissioners are not happy with restrictions on stocking non-native fish (item 4).

Item 5, the new and improved Verde River.

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result of natural movement among the sections and not caused by any unnatural disturbance. Index values which could be interpreted as denoting some drastic disturbance had occurred, were entirely due to natural phenomena in fish behavior.

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U.S.F.W.S. 1. Endangered Species Bull. Sept.-Nov. 1992. Arizona items include reports on Verde River bald eagles and Mt.

Graham red squirrels: 28 breeding sites with eagles produced only 14 fledglings. High turbid flows in Verde may have reduced amount of fishes caught by eagles, resulting in poor reproductive success.

2. Habitat Evaluation Notes and Instream Flow Chronicle. Jan. 1993. Report on Trinity River Calif., where 1970 project diverted 90% of flow to Sacramento basin. Mitigation by construction of large hatchery to maintain salmon runs was a failure. Congress passed law to "restore salmon to original abundance". FWS now trying to figure out how to do this (see Wild Fish citation below and Fisheries above).

3. Recovery Program for Endangered Fishes of the Upper Colorado. 1992. Includes newsletter, summaries of committee meetings, and latest implementation plan. Discussed in text of report.

Wild Fish. Sept./Oct. 1992 and Jan./Feb. 1993. A newsletter published by the Wilderness Society devoted to news (bad news) regarding declining runs of salmon in rivers of the Pacific Coast. It is obvious that the magnitude and multitude of the problems, besides dams, will not be readily resolved despite the Endangered Species Act and the spending of enormous sums of money. Politicians seeking a win-win situation will get it only by semantics.

QUARTERLY REPORT FISHERIES AQUATIC BIOLOGY

February - April 1993

The citation in bibliography to the January 29 issue of Science concerns a case that has reached the Supreme Court to determine standards for qualifications of expert witnesses. The specific case involves a suit by a woman against the Dow Corp. claiming their drug, benedictin, caused a birth defect in her child. The defendant's experts presented the results and conclusions of 30 published studies to support their contention that benedictin does not cause birth defects. The problem concerns the fact that the type of birth defect in question occurs naturally in from 20 to 30 births per 1000 and if a drug taken by pregnant women caused birth defects in only one or two births per 1000, how could this increase be detected against the natural background of defects? The plaintiff's expert reanalyzed the data using a different statistical method and concluded that the drug caused birth defects (at a rate of one or two per 1000 instances). Although the methods and mathematics of this expert were critically scrutinized and were found to be valid, the defense objected on the basis that the study was not published and therefore not valid as expert evidence in court. The courts, to date, have upheld the defendant's objection and disqualified the testimony of the plaintiff's expert.

This case has stirred great interest in the scientific community regarding standards of quality of scientific evidence presented in court. Advocacy groups represented by eminent scientists have formed on both sides of the issue. All agree that high standards are necessary but disagree on the question of publication as a sole or major criterion for a standard. The appeal to the Supreme Court is based on the contention that publishing per se is not an objective criterion for what is quality science and the evidence should not have been dismissed out-of-hand without fair evaluation of the expert's testimony.

Presently, federal courts follow a standard known as the "Frye Rule" that "an expert witness should be permitted to give evidence only if their conclusions derive from a principle that is sufficiently established to have gained acceptance in the particular field in which it belongs." Rules of evidence enacted by Congress better define an expert but say nothing about the quality of the science presented in court. A brief filed by the Carnegie Commission on Science, Technology, and Government, claims the Frye Rule is too vague, simplistic, and misleading. A judge should ask of a scientific claim, is it testable? has it been empirically tested? and has it been tested according to scientific methodology?

In previous reports I have commented on blatant misrepresentations by expert witnesses to support predetermined objectives. For example, an opinion that an endangered species of fish requires a certain flow without any substantive evidence to support the opinion, or on evidence from a method or model lacking a valid scientific basis for predictive accuracy. It is true that for natural resource assessment and environmental science, yes, no, right, wrong, type of certainty is rarely possible due to the uncertainties and unknowns inherent in complex natural systems. A high degree of precision cannot be expected. Environmental court cases are often similar to determination of a defendant as legally insane--style and reputation can be more effective than substance and reality. I have suggested that when conflicting expert testimony is given, the judge should have each expert write up their evidence as if it were to be submitted to a scientific journal for publication and then have the papers "peer reviewed" by an impartial panel. Evidently, this will be done to finally resolve the Mono Lake case in California. The amount of flow that Los Angeles must allow to reach Mono Lake has been determined but the restoration of the riparian environment along the stream is still in contention--natural restoration or "hands on" restoration. After hearing experts on both sides of the argument, the judge admitted

he could not reach a decision because he lacked knowledge of the subject matter and said he would appoint a panel of three "impartial experts" to review the evidence and advise him. A few weeks ago I was contacted by an attorney requesting permission to submit my name as a potential panelist. The selection of the three impartial experts must be agreed upon by both sides.

This type of peer review by impartial experts should be a major step towards improving standards for expert witness testimony in environmental cases, but true impartiality may be difficult to find. One side is likely to be perceived as the bad guys, profiteering despoilers of nature who deserve to be punished.

The citation to the journal Ecological Assessment in the bibliography is also highly pertinent to themes developed in my SRP reports--that throwing money at a complex environmental problem is not likely to resolve it. A critique was made of the National Acidic Precipitation Assessment Project (NAPAP), a 10 year program costing about \$600 million ostensibly designed to obtain answers to guide public policy on the acid rain problem.

Funding was through the EPA and DOE. The project began in 1980 when Ann Gorsuch was head of EPA and the agency was staffed with political hacks committed to a point of view that acid rain was no problem. It seems surprising then that so much money was so freely lavished on the project. I suspect that someone in the Reagan Administration had a much better understanding of "science" and how scientists operate than do most scientists. By stimulating diverse and uncoordinated research projects by many research groups, the competition and jealousies among the groups, each promoting their own interests, was almost certain to lead to inconclusive results--which was the outcome of NAPAP despite enormous concentration of highly recognized scientists and enormous spending.

One reviewer titled his critique "Megaprojects and megamodels: how to blow \$570,000,000". Another concluded: "Overall, it represents a mediocre return for a large amount of

investment and is a poor model for future large, interdisciplinary science projects." Much of the funding and expertise were devoted to construct a computer model, the Regional Acid Deposition Model, whose predictive accuracy proved no better than an educated guess (professional judgment).

The similarities of the failures of NAPAP and those of the recovery program for upper Colorado River fishes are inescapable. Thus, some recommendations of the NAPAP critique as they apply to endangered species "research and recovery", are pertinent. To keep projects on track towards a goal, to be sure the right questions are addressed and uncertainties defined at the start, independent, external review is needed--an oversight review board (impartial panel of experts) functioning as a professor guiding and directing a graduate student's research, continually critiquing, criticizing, and evaluating progress. The project should have a strong science program advisor who is a practicing scientist with a record of success and recognition.

In one way or another, in my SRP reports I have raised these points to illustrate how the recovery program for Colorado River fishes could have had more success for far less costs. After 14 years of foundering along, the recovery program hired a "strong science program advisor" (for six months)--Jack Stanford, the "instream flow guru". In February, Jack met with the recovery team and handed out a paper "Review of instream flow methods and recommendations for the endangered fishes of the upper Colorado River basin." When the idea of hiring an instream flow guru was originated, there was a naive assumption or hope that a guru would have some magical method to precisely define necessary flows in all sections of the Colorado and Green rivers to recover the endangered species. At the February meeting, Jack made clear that no one should retain such an idiotic notion. He stated that recovering endangered species must be approached from an ecosystem perspective, and ecosystems "cannot be described by simple deterministic models". Jack's paper is laced with such phrases as "...theoretical construct that is robust in terms of

the inherent complexities of N-dimensional biophysical systems"; "...serial discontinuities extend the rhithron environment" ... but the endangered fishes required a "potomon environment". I could envision the scientifically naive team members sitting in awe of this master of scientific semantics. Anyone who talks like that must know what he's talking about even if they don't understand him.

Also at the February meeting the team members received a report "Population viability analysis of the Colorado squawfish in the upper Colorado River basin", and a video displaying a four color digitized illustration of the analysis. It is a classic example of the illusion of technique and of the axiom, garbage in, garbage out. The computer "analysis" cost \$25,000 and is completely worthless as a contribution toward squawfish recovery or anything else except as an example of how to con money from the recovery team.

Enclosure 1 is an agreement reached by the recovery team regarding section 7 endangered species consultation and sufficient progress. This concerns a problem of taking money for nonjeopardy opinions with the money to be used in such a way to make a reasonable alternative to jeopardy--but without "sufficient progress" towards recovery these nonjeopardy opinions would not be valid. If one reads about "RIPRAP", it must be concluded that the people who wrote this are also masters of semantics.

Enclosures 2A and 2B concern the endangered populations of salmon in the Columbia River, resulting law suits and lack of any significant progress or agreement on what action is needed.

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QUARTERLY REPORT: FISHERIES

AQUATIC BIOLOGY

MAY - JULY 1993

In recent months I had requests for advice from consultants performing routine assessments for water projects. The EPA raised the issue of "ecological" or "biological integrity" in assessment studies. This topic is now prominently highlighted at fisheries meetings (mainly concerning the question, What is "ecological integrity"?). The origin and implications of "ecological integrity" is found in EPA's "Biological Criteria: National Program Guidance for Surface Water" which states that assessment of water quality be based on "ecological integrity", which maintains a "healthy, balanced, ecological community". This new basis for water quality assessment reflects the common problem of moving from generalities to specifics, from the intent to the implementation. How do we define ecological integrity, how do we assess it, and then what? Obviously, the EPA needs some "standard methods" for assessing "ecological integrity". The most widely used method in the Index of Biotic Integrity (IBI) which assesses fish species composition and the relative abundances of various ecological groups of fishes such as omnivores, insectivores, predators, etc. to arrive at a score (index). The assumption is that the composition of fish species at any particular site or river section is an accurate integration and reflection of past water quality. Sometimes this index is true, sometimes it is grossly in error. Many examples have been cited in my SRP reports documenting that fishes move for all sorts of reasons unrelated to water quality (or flow). Species may be abundant in an area at one time and absent during the next sampling. Depending when sampling is done very different IBI values can be obtained at the same site with no change in water quality. Another problem concerns regional differences in species richness, in representative species used to classify the ecological groups, and in the proportion of non-

native species. In the Mississippi basin species richness is high, non-native species are few, and IBI works best here. Towards headwaters of river systems of the West and particularly in all basins of the arid Southwest, species richness sharply declines and non-native species typically are the dominant species. Also in Arizona, the natural annual hydrograph typically fluctuates wildly from intermittent flows to raging floods. Under these conditions, IBI, unless highly modified for site-specific conditions, is useless as an indicator of "ecological integrity" or water quality.

To address this problem, the EPA has established "ecoregions" based on geographic areas assumed to contain similar types or drainages and similar fishes. Assessment of a stream within an ecoregion compares the actual species composition (all fishes listed to occur in the ecoregion). This is comparable to the EPA's "use attainability analysis". A problem called to my attention by a consultant assessing a stream in the Arkansas River basin of Colorado, concerned the EPA list of fishes for the Front Range ecosystem, many of which were not found in the Arkansas basin sampling. The compiler of a species list for Front Range Colorado fishes failed to realize that there is a sharp break in species composition between the Platte and Arkansas basins. Many (about half) of the fishes native to Platte are not native to Arkansas in Colorado. Such problems can be resolved but I cannot envision any "standard method" which can truly reflect "ecological integrity" and "healthy, balanced, communities" for Arizona waters. Citations to Blinn et al. and to Cain in the bibliography describe the typical situation in Arizona streams. Those streams, or stream sections, having the best flows, habitat, and water quality (which should indicate ecological integrity and a healthy, balanced community) are inhabited by non-native fishes which have driven out and eliminated the native species, many of which are endangered or threatened species. The best habitat of East Clear Creek is a special trout fishes zone stocked with non-native trout. These

trout have eliminated the threatened Little Colorado spinedace from the best habitat and forced it to exist in marginal, degraded habitat, unsuited for non-native species (also they have eliminated the Gila chub in the best habitat in E. Clear Creek). In other sections of the Salt, Verde, and Gila rivers with adequate perennial flow, good water quality and habitat, non-native fishes such as smallmouth bass and catfishes have eliminated native fishes--such sites would probably have the highest IBI values, but in view of the Endangered Species Act, I don't believe this is the kind of ecological integrity the EPA intends for Arizona.

Another troublesome aspect regarding specificity of a general term concerns the word "ecosystem". There is much effort to revise the Endangered Species Act to conserve whole ecosystems on which species depend rather than the species themselves. This sounds very logical but it will not work very well in practice. A species of insect or plant dependent on old growth forest for continued existence could persist on a much smaller fragment of the old growth "ecosystem" than could a mobile species such as spotted owl--or salmon which might spawn in a stream in old growth forest but to complete its life cycle and continued existence must use the whole river basin "ecosystem" and the ocean "ecosystem" of the North Pacific Ocean. In practice, the present ESA accounts for "ecosystem" protection by "critical habitat" designation. The designation of "critical habitat" for Colorado River basin endangered species is scheduled for November, but I expect it will be delayed.

In my last quarterly report I mentioned that \$3.7 million was spent on Colorado squawfish recovery in 1992. In 1993, almost \$8 million will be spent by federal agencies to control (kill) northern squawfish in Columbia River reservoirs by bounty payments (to increase survival of young salmon migrating to the ocean). To date, despite the large expenditures, neither program has had much success to increase or decrease the abundance of the respective squawfish species.

I learned the outcome of the endangered species trial in Texas (Sierra Club vs. Lujan, No. MO-91-CA-069) concerning conflicts between ground water use of Edwards Aquifer and flows in Comal Springs. It was as I expected. The USFWS (Lujan) was held in violation of the Endangered Species Act by not enforcing the provisions of the Act to maintain spring flows and habitat for endangered species. FWS people very much wanted the suit because Texas politicians had prevented any active intervention for many years. As it turned out, the attorneys for the Sierra Club and downstream water users did the work and private interests paid the bills. The judge ruled an interim 100 cfs of the spring flow must be maintained until the FWS "determines the necessary flow to avoid jeopardy". The ultimate resolution will be when the Texas legislature gives control of groundwater to the State Water Board and the Board implements its plan to limit and reduce groundwater extraction from the Edwards Aquifer. If the state doesn't implement the Water Board's plan, federal jurisdiction over Texas water rights will result. The judge's verdict was upheld by the Appellate Court.

In 1986, when a movement was on in Arizona to establish a "standard" instream flow method, I wrote a report for SRP "Critique of instream flow methodologies" to explain the limitations of any method, methodology, or model to predict the consequences of changes in flow. Before sending this report to SRP, I sent out copies to various biologists to review. Recently, I've received requests for copies and seen it cited as the basic paper to understand the limitations of instream flow methods. It's been cited as "Bureau of Reclamation, Denver". I have no idea how a copy found its way there.

I could not find a copy of this report in my files. I finally had one duplicated and sent to me from a FWS office in Leavenworth, Washington. I assume SRP files are in better order than mine and a copy of this now "significant" document is on hand if needed.

Enclosure 1. EPA spokesperson explaining "ecological integrity" -- it's still not clear. Also how some of my CSU colleagues are capitalizing on the uncertainty surrounding "ecological integrity".

Enclosure 2. Abstracts from annual meeting of ichthyologists and herpetologists, Austin, TX, May 25-29. Ecological integrity, ecoregions and IBI are even discussed at this meeting which historically has been concerned with evolution and classification.

Enclosure 3. More on ecological integrity and National Water Quality Assessment. University administrators and faculty are excited when a federal agency comes up with a new term such as "ecological integrity" which has great implications for obtaining large grants for "research".

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residents agreed that: "we should do everything we can to preserve Arizona native fishes, even if it means restricting the stocking of game fish."

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QUARTERLY REPORT: FISHERIES-AQUATIC BIOLOGY

Nov. 1993 - Jan. 1994

I have heard no serious rumblings regarding problems resulting from Colorado River basin critical habitat determination for endangered fishes. I was informed that the administrations' current priorities has "downlisted" environmental issues and related matters such as reauthorization of the Endangered Species Act. Environmental issues will be handled by federal agencies in a manner to avoid confrontations and controversies (avoid unfavorable media attention).

As a scientific adviser to Trout Unlimited, I've been kept informed on a current issue of U.S. Forest Service permitting of irrigation reservoirs on Forest Service lands in northern Colorado. These long established reservoirs were originally permitted without provision for providing instream flow below the reservoirs. In 1992 when the permits were up for renewal, the USFS, conforming to a new "vision" of ecosystem management and greater environmental sensitivity, made a provision for instream flow, especially winter bypass flows, as part of the new permits. The water-users complained to Colorado congressmen who took the complaints to the Secretary of Agriculture. In late 1992, lame duck Secretary Madigan issues an order to the USFS to issue new permits without instream flow requirements. Environmental groups assumed this order would be quickly rescinded once the Clinton-Gore administration assumed power. One year later, the order has not been rescinded and Trout Unlimited sent a delegation to talk with people in the office of the Department of Agriculture. They learned a lesson in contemporary politics. It was explained that environmental issues in relation to the administration's priorities, were far lower than world crises, health care, and crime. It was also explained that current strategy is to avoid or mollify controversial issues such as reforms in livestock grazing, timber cutting, and water-related matters, especially in

the West. For example, there is still no definition of "wetlands" nor clear guidelines for wetland protection.

This go-slow, conciliatory-compromising strategy reflects the effect of well-organized opposition to the reforms proposed during the 1992 political campaigning and also political realities of the 1994 congressional elections. The opposition is mainly concerned with the reauthorization of the Endangered Species Act. The issues of "taking" of private property and economic impacts are the focus of ESA reauthorization. Many ESA horror stories have been featured in the media in recent months. One TV program (60 Minutes or 20/20) had a segment on the great tragedy and economic loss from the wildfires around Malibu, California, which showed a highly unfavorable view of the ESA. The homeowners were prohibited from bulldozing fire breaks around the perimeters of their properties because such action would destroy habitat for an endangered subspecies of kangaroo rat that lived in canyons around Malibu, and thus would violate the ESA.

The opposition forces attempt to make such incidents well-publicized and the administration's strategy is to go slow on reauthorization and other environmental issues while trying to come up with win-win, "user-friendly" policies to gain broader support. During this period to avoid or mollify controversy, I expect that controversial ESA jeopardy opinions that could add fuel to the opposition fire will be avoided and ESA consultations will reflect a more conciliatory attitude.

There is always the possibility that what might be called "mid-level bureaucrats" engaged in ESA consultation have not been properly instructed on administration policy or are encouraged to act "courageously" for the sake of environmental correctness to resist political pressure and cause a high profile incident. Ironically, the administration is currently manipulating a biological opinion in regards to expansion of a goldmine in Nevada and a subspecies of cutthroat trout listed as threatened under ESA, evidently, to gain leverage for reform of the 1872

mining act (the goldmine has already extracted \$8 billion in gold and has paid no royalties).

To mine the pit, groundwater must be pumped out. The present pit has been pumped for several years and hydrologists have monitored the ground water table. The nearest population of cutthroat trout occurs on the other side of a mountain range where the water table, according to the "best available scientific data", is not connected to the water table being drawn down by the mine. In November, the BLM (mine is on BLM land) wrote an environmental assessment for permitting the "proposed action" (mine expansion) for ESA consultation with the USFWS. The assessment, following the rules, states that "according to the best available scientific data", the mine expansion and continued pumping of ground water will not affect stream flows on the other side of the mountains and therefore would not "jeopardize the continued existence" of a listed species--thus, the "proposed action" to permit mine expansion would not violate the ESA.

Before the BLM entered into formal consultation with USFWS, jurisdiction for mine permits was transferred from the state level to the USDI in Washington, and the issue is "on hold". Administrators of the mining firm and their attorneys contacted me to be an "adviser" on the matter. I expect that a simple matter of delay and harassment is involved. According to the ESA, the USDI must come up with "better" data than the "best" data used by the BLM in their conclusion of no jeopardy and no violation of the ESA in regards to ground water pumping; or, come up with some far-out theory as a basis for jeopardy. In either case, the opinion must be based on "best scientific evidence". I wouldn't make a personal judgement on the rightness or wrongness of politics influencing agency actions and decisions, or questions on end results and the means used to get the results, only that this is political reality.

In regards to legal standards of scientific evidence, the Sept.-Oct. issue of American Scientist contained letters to the

editor about the U.S. Supreme Court ruling on the matter (June 28, 1993; Daubert vs. Merrel-Dow Pharmaceuticals). The Supreme Court ruled that the legal basis of the reliability of scientific evidence depends on the validity of the methods used to develop the evidence. That is, have the methods or methodologies used to develop the scientific evidence been empirically tested and found to be valid for making accurate predictions? If, for example, the USFWS were to make a biological opinion that jeopardy would occur to a listed species in the Verde River unless a certain flow regime was met, and the proposed flow as determined by IFIM analysis, the validity of IFIM as a scientific method of prediction could be challenged (and found wanting).

Enclosures. 1. Further information on USFS permits and instream flow below reservoirs on FS lands.

2. Ecosystem Management. Examples of attempts to explain ecosystem management (how federal resource agencies are to interpret this goal and the implications). I might add that, in my opinion and the opinions of others I talked with, the CSU conference "Ecosystem Management: Beyond the Rhetoric", was essentially rhetoric. The sessions on "Ecosystem Management-Cutting Through the Bull" and "Ecosystem Management: What Does It Mean?", were no more enlightening--more bull, more rhetoric. I believe I have an obligation to make students aware of problems encountered in the natural resource management field such as moving from a broad, ill-defined goal as ecosystem integrity, etc.--to actual implementation of a program to achieve the goal. Also enclosed are examples of a test question given to students in my conservation biology class and an announcement for a fall seminar where pertinent questions will be addressed.

3. An Alston Chase column (an antienvironmental hatchet person) mocking the National Biological Survey. NBS was discussed in my last report but is currently "on hold" because it has been attacked as another ploy to "take" or impair the use of private property. Chase does grasp the significance of natural fluctuations of natural biological systems and the limitations

this natural variation places on methods and models used to make decisions.

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U.S.F.W.S. Recovery Program for Endangered Fishes of Upper Colorado. Spring 1993. One of the more rational projects of the upper basin recovery efforts is discussed--creating or providing access to off-channel ponds for razorback sucker spawning. Main problem is to keep such habitats free of non-native fishes.

QUARTERLY REPORT: FISHERIES-AQUATIC BIOLOGY

Feb.-Apr. 1994

I assume that SRP received a copy of the Federal Register section on the final rule for critical habitat for endangered fishes. It appears to be similar to what was proposed in the draft with exception that a few tributary streams of Verde-Salt-Gila rivers were excluded and the headwaters of the Verde to Perkinsville is excluded from critical habitat designation. I note that of more than 1,000 written and oral comments made during the public input process, 50 were favorable (pro) and 947 unfavorable (anti) to critical habitat. Many of the pages are taken up with summarizing and responding to the "anti" comments.

I don't expect much will happen in the near-term to seriously interfere with water management in Arizona due to critical habitat designations. The USFWS is promoting "partnerships" of government and private interests for "restoration" of ecosystems by "ecosystem management" (see citation to USFWS 1994). I do foresee some potential problems in the future if ill-informed, mid level federal agency people begin to practice what they assume to be "ecosystem management" on critical habitat river sections (discussed below).

In my last quarterly report I mentioned my advising on a permit to expand a gold mine in Nevada. By late January, the USDI would have to issue a permit unless some "far-out theory" could be used to invoke a "possible jeopardy" to a listed species.

A far-out theory was invoked for possible jeopardy and resulted in a 90 day extension for a final jeopardy or nonjeopardy opinion on the permit for mine expansion. The theory consisted of the possibility that after mining was terminated and the great excavation filled with water, an unscrupulous person would stock non-native fishes in the waters and then another unscrupulous person would transport them to neighboring streams where the listed species (Lahontan cutthroat trout) existed--thus a "possible" jeopardy could occur.

An endangered species consultation was held at the Reno office of the U.S. Fish and Wildlife Service (March 3). I made a tour of the mine area and surrounding drainages where the cutthroat trout occurs before going to Reno to represent the mine corporation. At the consultation I pointed out the virtual impossibility of the far-out scenario on which the "possible jeopardy" was based. I also pointed out that the possible jeopardy posed by non-native fishes stocked in neighboring waters could be empirically evaluated. The Rock Creek drainage, immediately to the north of the mine area, has populations of native cutthroat trout in a few, tiny headwater tributaries. Farther downstream the drainage is impounded by an irrigation reservoir that has been in place for about 100 years and has long contained non-native fishes--bass, crappie, catfish, etc. Has there ever been a problem with unscrupulous people transporting these non-native fishes and stocking them in the trout habitat? And, if they were stocked, what chance would a warm-water fish species have for becoming established in the tiny, cold habitat of a headwater stream? I then asked if anyone had any serious concerns about "possible jeopardy" from some future excavation waters (which would be fenced and closed to the public) acting as a source of non-native fishes? No concerns were expressed. I also pointed out that for more than 20 years, there has been unanimous consensus that the major threat to the "continued existence" of Lahontan cutthroat trout is livestock grazing. The mining corporations, Newmont and Barrick, by buying ranches and contributing to the USDI "Return of the Natives" program, which purchases riparian easements and protects them from livestock, have initiated the first major restoration project for the Lahontan cutthroat trout--and their good work has been recognized by the U.S. Fish and Wildlife Service. A final "nonjeopardy" opinion was issued in April.

In my recent quarterly reports I have addressed the topic of federal agencies adopting new goals or initiatives and what the implications might be. Ecosystem management is currently the "white hope" of the present administration. By practicing ecosystem management, biodiversity is maintained because ecological integrity is maintained (which means a health-balanced ecosystem) and most

endangered species problems would go away. The problem is that, especially at the higher levels of federal agencies and of the administration, the people involved in decision-making don't have much of an understanding of what ecosystem management is all about nor just how it would be implemented--they haven't gone "beyond the rhetoric". The accompanying annotated bibliography highlights some of the key literature on the subject.

Recently, an assistant dean from our college participated in a workshop-brainstorming session in Washington, convened by Vice President Gore. We were told that Gore is very determined to have federal agencies practice ecosystem management to "avoid train wrecks". The train wreck simile refers to the crisis of old growth forest and spotted owls. The fact is, however, that the U.S. Forest Service has "officially" practiced "ecosystem management" since 1992 (see USFS 1992 citation), but nothing really changed in their old growth forest management until they were brought to court. The assumption that if only the USFS had a better understanding of "old growth ecosystems" and practiced ecosystem management, the spotted owl "train wreck" would have been averted, doesn't hold up to scrutiny.

Several years ago, a USFS wildlife biologist was assigned to our college for a year of "academic enrichment". The real reason for his transfer from the Pacific Northwest to CSU was that he was regarded as a trouble-maker because he had been critical of the accelerated cutting of old growth forests, claiming the USFS was heading for a catastrophe--he warned of the impending "train wreck", but his message was not well-received at the time.

For a discussion on ecosystem management and its ramifications, a starting point is a definition of ecosystem. It's a term that has been commonly used in the literature for many years, essentially defined as interrelated, interconnected species of plants and animals (biotic component) occurring in a certain area (the habitat, or abiotic component). Thus, for razorback sucker critical habitat, one might consider the Verde, Salt, and Gila river ecosystems.

The U.S. Fish and Wildlife Service (1994) defines ecosystem as: "Dynamic and interrelating complex of plant and animal communities and their associated non-living environment." The terms community or biotic community are considered synonymous with ecosystem by this definition. The USFWS defines the "ecosystem approach" as: "Protecting or restoring the function, structure, and species composition of an ecosystem, recognizing that all components are interrelated." This "approach" (or ecosystem management) assumes that by "restoring the function, structure and species composition" endangered species would be "restored" or rare species protected so that ESA listing would not be necessary.

In practice, however, ecosystems are defined by situation and a species of concern. For example, the "Greater Yellowstone Ecosystem" basically was developed in regards to grizzly bears. The boundaries of Yellowstone Park do not contain all of the essential habitat used by grizzlies. To encompass all habitat used by grizzlies, the "Greater Yellowstone Ecosystem" concept and spatial boundaries evolved. However, the Greater Yellowstone Ecosystem contains several diverse types of communities (or ecosystems) such as aquatic (feed on fish), forest, montane, alpine, etc. Thus, in practice, the definition and boundaries of ecosystems are specific to specific situations--one size will not fit all.

A problem I find with all federal agency discussions on ecosystem management is that there is no indication that important differences between aquatic and terrestrial ecosystems are understood. A major difference concerns the role of non-native species. The implication of "restoring the function, structure, and species composition" is that the species composition to be "restored" are native species. Non-native species are assumed to be disruptive for ecosystem function and structure. Many species of non-native terrestrial plants are widely established and some are actively controlled as pest species, but for terrestrial vertebrate animals, non-native species only flourish in urban or agricultural areas (Norway rat, English sparrow, starling, pheasant)--i.e. where new "ecosystems" have been established. If farmland is abandoned and nature allowed

to take its course, the original ecosystem of plants and animals can be expected to be "restored" and revert to its original structure and function. Many aquatic ecosystems, however, have been massively transformed by impoundments, river regulation and non-native fishes. The non-native fishes in the Colorado River basin, in species diversity and abundance, vastly exceed native species; i.e. the "structure and function" of aquatic ecosystems such as the Verde, Salt, and Gila rivers, are mainly determined by non-native species--and not much can be done about it. For public perception and acceptance of aquatic ecosystem management it must also be recognized that non-native fishes have enormous recreational and economic values--and they often exist and flourish in vastly transformed, "non-native" aquatic ecosystems, comparable to the niche filled by the asiatic ringneck pheasant in corn field ecosystems.

The report from Washington brought back by our assistant dean was that the administration would push ahead with ecosystem management with its newly created National Biological Survey (an attempt to avoid interagency conflicts), which is currently made up of research biologists from the USFWS, BLM, Bur. Reclamation, and Park Service. Evidently, the NBS will have no regulatory power but will advise federal agencies on implementation of ecosystem management. This has led to fears expressed by commodity interests on federal lands that land under BLM jurisdiction would be administered as National Park lands or wilderness areas. To allay this fear, the USFWS and USFS reports I've read on ecosystem management claim it will be for the benefit of all people--ecosystem management will provide a sustained supply of commodities from the land and public input for decision-making will be an integral part of ecosystem management. A "principle" of the USFWS "ecosystem approach" is: "Full participation of all partners (Federal, State, local, Tribal, public, and private) in setting and achieving resource goals is imperative." I would suggest that if and when the "ecosystem approach" is proposed for managing critical habitats in Arizona rivers, SRP should become a "full participating partner".

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Science was requested by Congress to address the issue of defining a species under ESA and a report is due this year on the matter (next month I serve as a session chairman at a conference in Monterey, CA, on defining "evolutionary significant units" for ESA--I don't expect unanimous endorsement of the conclusions of N.A.S. or the E.S.U. conference, however).

Keiter, R. B. 1989. Taking account of ecosystem in the public domain: law and ecology in the Greater Yellowstone Region. *Univ. Colo. Law Review* 60(4):933-1007. This and following citation concern legal aspects of ecosystem management.

Keiter, R. B. 1990. NEPA and the emerging concept of ecosystem management on the public lands. *Land and Water Law Review* 25:43-60.

Moyle, P. B. and R. M. Yoshiyasu. 1994. Protection of aquatic biodiversity in California: a five-tiered approach. *Fisheries* 19(2):6-17. An ecosystem approach to protect "clusters" of rare, threatened, or endangered species by watersheds.

Perclasepe, R. 1994. EPA's watershed approach to ecosystem management. *Fisheries* 19(4):4, 27. EPA's "ecosystem management" of aquatic ecosystems would manage watersheds (under the Clean Water Act) by involving "all levels of government and the private sector".

Rodda, G. H. 1993. How to lie with biodiversity. *Conservation Biology* 7(4):959-960. How "biodiversity" is interpreted and the methods and models used to assess biodiversity can lead to any desired preconceived conclusion. Mr. Rodda is a USFWS biologist in Fort Collins. We discussed his article and I am impressed with his critical mind and his understanding of how nebulous concepts such as "biodiversity" or "ecosystem management" can be grossly misused and abused.

USDI. Federal Register, March 21, 1994. Determination of critical habitat for four Colorado River endangered fishes; final rule.

USFWS. 1994. An ecosystem approach to fish and wildlife conservation: an approach to more effectively conserve the nation's biodiversity.

This and following (US Forest Service) definitions and implications of ecosystem management by federal agencies are big on rhetoric and short on

specifics. Emphasis is that ecosystem management will benefit the American people and our society and full support and cooperation of the public and private interests are vital to success--"without these strong partnerships, initiatives will continue to be disjointed, competitive, and ineffective."

US Forest Service. 1992. Ecosystem management of the national forests and grasslands. Memorandum 1330-1. USDA Forest Service, Washington, D.C. The USFS has, "on paper", officially practiced ecosystem management since 1992. Has anyone noted any dramatic changes in their programs? By 1994, old growth forest management was determined by the courts and at the top level of the Clinton administration--is this a new form of ecosystem management?

QUARTERLY REPORT

FISHERIES - AQUATIC BIOLOGY

MAY - JULY 1994

In my last report I mentioned the hot item for all federal agencies dealing with natural resources is ecosystem management, a concept strongly pushed by V.P. Gore and Sec. Int. Babbitt. A problem is that the agency people involved have little idea of how to implement a vague concept, or worse, they are confident it can be done by following a simple set of rules or application of simplistic methods or models.

The crux of the matter concerns just how nature works; by the stability-equilibrium paradigm (deterministic processes which can be accurately modeled and outcomes predicted with confidence) or the chaotic nonequilibrium paradigm (unknown, uncertain, stochastic processes which defy any rules, methods or models to predict outcomes). Obviously, I lean toward the latter paradigm as ^{the} playing ^{the} dominant role. Flow-habitat-fish models (such as IFIM) or ecosystem integrity models (such as IBI) simply do not have the predictive accuracy as Boyle's Law which is based on deterministic properties of atoms and molecules in relation to temperature, pressure, and volume. The components of natural ecosystems do not respond in a comparable deterministic manner and agencies applying simplistic rules and methods in attempts to implement ecosystem management can do great mischief.

There are also two virtually irreconcilable viewpoints on what ecosystem management (EM) means and how it should be implemented. One, the politically correct (PC) views endorsed by federal agencies is anthropocentric--that EM is for the benefit of people by maintaining "ecosystem processes and functioning" a sustained supply of goods and commodities (resource exploitation) can be assured. The other view, or the environmentally correct (EC) vision is nonanthropocentric (ecocentric) arguing for more pristine areas, uninfluenced by man and maintaining all native species of the ecosystems of pre-European man. Often I find the EC view quite naive. Recently I reviewed a proposal from a

wilderness alliance in Utah to create a pristine "Yellowstone" ecosystem (this Yellowstone River is a tributary of the Duchesne River, a tributary to the Green River in Utah). They believed that "ecosystem management" would restore the native cutthroat trout in the Yellowstone drainage (the environmentally sensitive cutthroat trout would be a good example of an "indicator species" to monitor "ecological processes and functioning" to assess how EM is working). The problem is that during the past 100 years, nonnative brook, brown, and rainbow trout have usurped the niche of the native cutthroat and eliminated it from all but a few isolated headwater segments of the drainage. This fact of natural ecological process, the displacement of one species niche by another species, cannot be reversed by a pristine natural environment.

Similarly in Arizona, if all human influence (except for introduction of nonnative fishes) could be erased from the Gila, Salt, and Verde rivers and their virgin flows, temperatures, and water qualities restored, nonnative fishes would still dominate, excluding the presently rare native species to the peripheral parts of the drainages much as occurs today.

This spring I was in Chile advising a fishery agency on how to attract more foreign tourist anglers. On my return I stopped off at a meeting on tailwater fisheries in the Missouri Ozarks. In both instances, the basis for my travels was nonnative trout. In Chile, all foreign anglers come to fish for nonnative trout. In the Ozarks, the nonnative or artificial environments of reservoirs and tailwaters have created conditions which consistently produce the largest trout in the world for anglers (and great economic benefits to the region). The PC view of ecosystem management, I assume, would not interfere with artificial ecosystems which produce great benefits to people. The strict EC viewpoint, based on ecocentric reasoning, would be to operate dams to favor native species of minnows and suckers and eliminate the nonnative trout as the most moral and ethical form of EM. I doubt that these two views on EM can be reconciled, but where endangered species are concerned, both

viewpoints will play a role. The ultimate flow-temperature regime for the Colorado River below Glen Canyon dam is currently under discussion (several talks at West. Div. Am. Fish. Soc. meeting in Flagstaff, June 19-23, were on this topic). The endangered or EC species is the humpback chub of the Little Colorado River and the nonnative trout or PC species in the tailwaters make for possible conflicts. I suspect a compromise might benefit both species as the present water released from the dam is too cold for optimum trout growth and daily fluctuations have been too great for successful trout reproduction--a possible win-win situation, except for lost electrical generation.

For our college's May graduation ceremony we had Dr. Carl Walters as our honor alumni address the graduating students. Carl was a graduate student when I first arrived at CSU in 1966. Since then he has attained international fame for his mathematical modeling work. Carl fully understands the problems of deterministic and stochastic processes for models and is the "father" of "adaptive management" whereby one admits ignorance and tries various approaches--learn by doing, learn from mistakes; use models as a learning tool--a means, not an end. He has also been frustrated by the bureaucratic mindset seeking simplistic solutions to complex problems (Carl is professor at the University of British Columbia and the bureaucratic mindset, evidently is a human phenomenon not determined by political boundaries). He warned the students who will be employed by federal resource agencies to expect disillusionment. They will discover "the Peter Principle: many of the people around you will have risen in the agency to positions that they are not competent to fill. Next you will discover a profoundly important symptom of incompetence: people who box themselves in with rules and procedures to avoid the discomfort of having to make judgements and hard decision choices." I enjoyed Carl's talk and say Amen.

Enclosures

Enclosure 1 concerns the Peter Principle and incompetence. Recovery plan schedule and budget for upper Colorado River endangered fishes. The Recovery Team held a meeting on campus last month and I briefly attended to learn the latest on "Gila taxonomy". A wonderful example of incompetence and the need for outside oversight review. First, there is no basic need for "Gila taxonomy" in relation to "recovery". The roundtail chub occurs relatively ubiquitously in the upper basin and overlaps with the endangered humpback chub in the deepwater canyon area around the Colorado-Utah border in the Colorado River, but the two species can be clearly separated by looking at them. In the lower basin, humpback chub occur in Little Colorado River and in confluence area of Colorado River. No roundtail chubs occur here and there can be no possible confusion. The bonytail has no natural populations. They are maintained in hatcheries and some have been stocked in Lake Mohave and Lake Havasu (where there are no roundtail or humpback chub). That is, there is no real need to "identify" or classify (taxonomy) the roundtail, bonytail, and humpback chubs as a basis for "recovery". In addition to the Peter Principle which provides the "direction" to the recovery program, the principle that no matter how much funds an agency has, ways will be found to spend it (Murphy's Law?), comes into play. No doubt the three chub species are closely related and a better understanding of their relatedness and evolution is of academic interest. Thus, the recovery team decided about 10 years ago to be sure no surplus funds went unspent and began lavish funding on Gila taxonomy funding state-of-the-arts techniques (what I refer to as the illusion of technique). First, a researcher at the University of Utah studied their chromosomes (to no avail), then at least three universities got on the bandwagon to study proteins (electrophoresis), still with no clear-cut results. Finally, the era of mitochondrial DNA arrived. Dr. Tom Dowling at Arizona St. has a fine DNA lab and is a highly competent researcher; he would be a logical choice to

continue the original DNA project began three years ago. The original DNA project was sold to the recovery team by a fast talking fellow at BYU. He took the money, paid himself a handsome salary, celebrated his good fortune by buying a sports car, crashed the car and was killed before getting any DNA analysis done (but after spending all the money).

With this historical background, I can't blame Tom Dowling for taking the vast amounts of money the recovery team is eager to dole out. Over a three year period, \$570,000 is scheduled to be spent on the DNA aspect of Gila taxonomy. I asked the team members if any of them had any idea what DNA analysis is all about and how much such research costs? (Recently I helped a graduate student write a proposal to fund a DNA study on South American fishes which would include more specimens than the Gila taxonomy study--our request was for \$5,000). Needless to say, the team members all admitted complete ignorance of mitochondrial DNA and costs of doing the work. There is no accountability for their spending.

Enclosure 2. Continuing with above, in my contribution as a session chairman at recent symposium to define as "evolutionary significant unit" (ESU) for the Endangered Species Act, I raise the idea that people such as those involved in the Colorado fishes recovery team should be required to have a license to practice.

Enclosure 3. Contents of latest issue of Environmental Law. Article by Rohlf (see bibliography) also concerns the ESU and what should be protected by ESA.

5 ~ Enclosure 4. Sec. Int. Babbitt visits Fort Collins (Midcontinent Regional of National Biological Survey, formerly National Ecology Center, Western Energy and Land Use Team, etc.) explains ecosystem management and the National Biological Survey.

Enclosure 5. Indian tribes intent to sue re. San Juan River flows, Animas-LaPlata Project and squawfish.

ANNOTATED BIBLIOGRAPHY

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Aadland, L. P. 1993. Stream habitat types: their fish assemblages and relationships to flow. N. Am. Jour. Fish. Mgt. 13(4):790-806. Article points out shortcomings of flow-fish habitat models such as IFIM in relation to maintaining "ecosystem integrity"--preservation of species diversity--because such models typically focus on a single "high profile" game fish. This study grouped 114 fish species into six habitat guilds each associated with a certain range of depth and velocities. Recommends that a representative species from each habitat guild should be used for flow recommendations designed to maintain ecological integrity.

American Fisheries Society Western Division. Abstracts of annual meeting, Flagstaff, AZ, June 19-23, 1994. Meeting keyed around ecosystem management--keynote address (USDI) "How does policy interface with ecosystem management?" Intergovernmental panel on ecosystem management. Sessions on ecosystem management in regulated rivers (several papers relate to native Colorado River fishes and operation of Glen Canyon dam), large river ecosystems, and riverine and reservoir ecosystems. Several papers on Arizona threatened and endangered fishes such as movement of squawfish and razorback suckers in Verde R.

Beard, D. P. 1994. Bureau of Reclamation revamps efforts to help fish. Fisheries 19(7):6, 7. USBR Director discusses changing mission of agency from public works construction to water resource management. BR is sensitive to endangered species; has nursery ponds on Lake Mohave for raising endangered razorback suckers and bonytails.

Colorado Water. June 1994. Items include lawsuit over proposed reservoir on Gunnison River which would sell water to Las Vegas. Bureau of Reclamation proposed regulation change to allow five Indian tribes in Arizona and California to see their federal reservoir^e water rights.

Fisheries 19(5). News item on the Great Gila Biodiversity Project (GGBP) lawsuit to force critical habitat listing for loach minnow and spikedace in Arizona and New Mexico (would extend present critical habitat for razorback sucker and squawfish in Verde River upstream above Perkinsville). GGBP also filed intent to sue to force upgrading of these two species from threatened to endangered. GGBP joined with the Southwest Center for Biological Diversity to notify the Bureau of Reclamation of intent to sue in regards to Central Arizona Project potential impacts on loach minnow and spikedace. "Biodiversity" legal initiatives from environmental groups are flourishing. I receive two-three calls a month from one group or another.

Lackey, R. T. 1994 (draft). The seven pillars of ecosystem management. Symposium: Ecosystem Health and Medicine: Integrating Science, Policy, and Management, Ottawa, Canada, June 19-23, 1994. Dr. Lackey, deputy director of EPA's Environmental Research Laboratory, Corvallis, OR and former CSU student, sent me this paper for review and comment. His attempt to explain the real meaning of ecosystem management and its implications sounds good the first time around, but my impression is its more style than substance--he has always been a very verbal person with grandiose ideas.

Osborne, L. L. and six other authors. 1992. Influence of stream location in a drainage network on the index of biotic integrity. Trans. Am. Fish. Soc. 121(5):635-643. As discussed in previous reports, the index of biotic integrity (IBI) has become a quasi-official method of EPA to "measure" ecological integrity, but requires considerable critical thinking for interpretation. Many examples show how IBI scores can be unrelated to water quality and ecological integrity. This paper demonstrates quite different scores (based on number of fish species and relative abundance) in streams of similar size and water quality in relation to their position in a drainage network. Those directly connecting to a main river have much

higher IBI scores because they contain numerous species which move short distances from the main river.

PEERreview (Public Employees for Environmental Responsibility), Spring 1994. Attack on USDI Chief of Staff, Tom Collier for pushing pro-business, anti-environment agenda. Collier was partner with Bruce Babbitt in law firm of Steptoe and Johnson.

Rohlf, D. J. 1994. Pacific salmon. Environmental Law, 24:617-671. Reviews and critiques history and implications of definition of "species" in the Endangered Species Act and varying interpretations of what qualifies for listing by US Fish and Wildlife Service (terrestrial and freshwater species) and by National Marine Fisheries Service (marine and anadromous species such as salmon). For intraspecific diversity such as races of salmon, the term "evolutionary significant unit" is now used, but its definition is controversial (see enclosure of my paper for recent ESU conference). This issue of Environmental Law devoted to issues of ESA reauthorization.

Scoppettoni, G. G. 1993. Interactions between native and nonnative fishes of the upper Muddy River, Nevada. Trans. Am. Fish. Soc. 122(4):599-608. An endemic genus of lower Colorado River basin, the Moapa dace, has been reduced to about one mile of habitat by competition with nonnative mosquitofish and sailfin Molly.

USEPA. Nonpoint Source Newsnotes. May-June 1994. Review of contemporary water quality issues.

USFWS. Endangered Species Technical Bulletin. May-June 1994. Proposed listings for an Arizona snail known only from a 50 x 100 ft. section of a talus slope near San Xavier, Pima Co. and for Parish's alkali grass, 7 of 10 known populations of which occur on Navajo and Hopi lands in Arizona.

Waddle, S., J. Kay, and G. Francies (eds.) 1993. Ecological integrity and the management of ecosystems. St. Lucie Press. Several chapters by different authors on various topics.

Warren, M. L. and B. M. Burr. 1994. Status of freshwater fishes of the United States: overview of an imperiled fauna. Fisheries 19(1):6-18. A plea for recognition of "ecosystem rights" for fishes.

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Young, C. 1994. Colorado revival. Colorado Outdoors July-Aug. 1994. Ms. Young is PR person for upper Colorado fishes recovery team and article is typical PR job: "Colorado River recovery program is now in place...research has shown us what needs to be done; we're now aggressively implementing actions needed to recover the fish." So much deja vu all over again.