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April 22, 1993

Dr. Robert J. Behnke
Department of Fishery and Wildlife Biology
Colorado State University
Fort Collins, CO 80523

Dear Dr. Behnke:

I recently obtained a copy of the monograph, *Native Trout of Western North America*, that you authored. I wanted to compliment you on your work. Over the years I have read many of your articles and scientific publications. These works were of value to me professionally but also of great interest because I am an avid trout fisher.

I haven't had the monograph long enough to have read all of it, but I have read Part I: Classification, and Origins and Distributions; and Part V: Preservation of Trout Diversity. I read Part I to satisfy by immediate curiosity about the origins and relationships of trout. Part V came next because I am very concerned about the conservation of intraspecific diversity in salmonid populations (as well as other creatures and plants) and I'm always looking for new information and understanding.

I was particularly encouraged by your comments in Part I about the need for action in the face of scientific uncertainty. The Northwest Power Planning Council has followed an adaptive management approach in developing recovery measures, that is, learning while doing. There is considerable concern about some of the measures in the Council's program because of the lack of scientific proof that they will work and the cost involved. Many of the actions called for in the plan are an attempt to move the river system back towards "a species' optimal range." I am enclosing a copy of the Council's *Strategy For Salmon* that describes proposed actions to help recover weak stocks of salmon and steelhead in the Columbia Basin.

Your discussion of preservation of trout intraspecific diversity was very eloquent and provided useful guidance to fishery managers and others. The conservation of intraspecific diversity has been and continues to be one of the guiding principles of the Council's program.

I have also enclosed an article I wrote in 1979 when I was a biologist with the Oregon Department of Fish and Wildlife. I wasn't well schooled in evolutionary biology and genetics but I understood enough to know that existing hatchery and transfer practices and policies needed to be changed despite cries from the public, private hatchery operators, the legislature and some fishery managers that the Department needed to stock more fish in more places to restore coho salmon fisheries. Some important changes were made in the salmon management program, but obviously not enough was done in other areas, for example habitat protection and harvest management, to insure recovery of the stocks.

I am anxious to read the rest of the monograph, especially those sections dealing with trout populations that have been a long time source of enjoyment, fascination and concern to me. Your work is very important and I look forward to reading future publications. Your greatest contribution may be in educating the public about the value of intraspecific diversity and the need for action in the face of uncertainty.

Sincerely,

Harry Wagner

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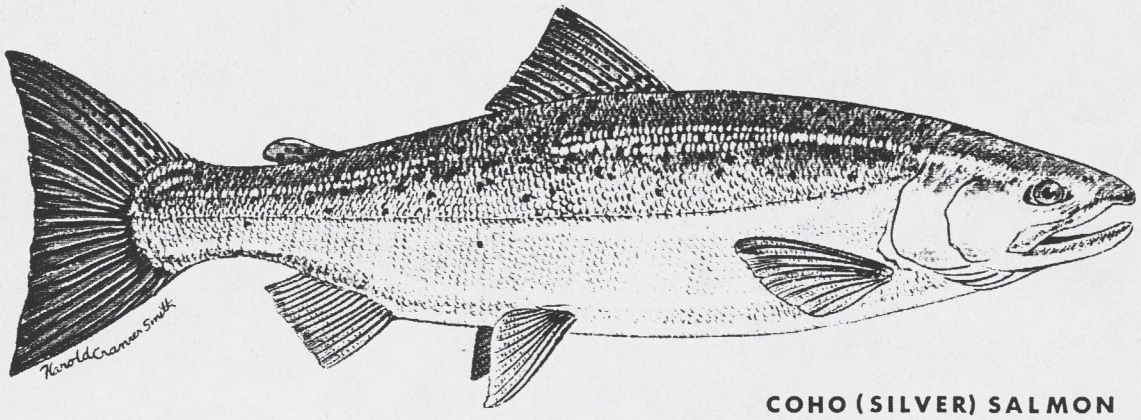


COHO (SILVER) SALMON
Oncorhynchyus kisutch (Walbaum)

WHY WILD COHO?

By Harry Wagner
Assistant Chief
Fish Division

There has been much talk in the past year about wild coho. This has caused people to ask, "What's so special about wild fish?" Let's take a look at the reasons why Oregon's remaining wild coho stocks are an important natural resource. The reasons discussed most often fall into three general categories: cultural and aesthetic, economic, and biological. Most of the discussion that follows relates to why the maintenance of wild stocks is a biological necessity to insure the long-term abundance not only of naturally but artificially produced runs. Other reasons for wanting wild coho will be discussed briefly to help put the biological concerns in perspective.

I would like to make a distinction at the start between wild coho stocks and runs of coho produced from the natural spawning of hatchery fish. The difference will become more apparent as you read on, but basically wild coho are more diverse genetically and are better adapted – more fit for survival, growth, and reproduction in the stream and ocean – than are the progeny of hatchery fish. The degree to which the progeny resulting from the natural spawning of hatchery fish differ from the progeny of wild fish will depend on the amount of selection that has taken place in the hatchery and the number of generations that the stock has been exposed to the hatchery environment.

LAWS AND POLICY

Before discussing the reasons that wild coho are needed, we should perhaps define the Department's responsibilities for the conservation of wild populations of fish (coho salmon in the present discussion) and wildlife.

Oregon law provides for the conservation of all our wild fish and wildlife resources. Statutes say that "fish and wildlife of the state shall be managed to provide optimum benefits to present and future generations of Oregonians; that all species of fish and wildlife shall be maintained at optimum levels; and that indigenous (native) species shall not be depleted or made extinct." The Oregon Fish and Wildlife Commission was created by the Legislature to implement the intent of the above statutes. The Commission has further defined and emphasized the need for and value of wild fish generally in a written policy. The policy states in part: "The protection and enhancement of wild stocks will be given first and highest consideration in the fish management program of the Department of Fish and Wildlife. Hatchery or foreign stocks of fish will be released only where deemed necessary to provide optimum benefits from the resource."

Laws are really not reasons why we need wild coho; instead they represent a way to insure that wild coho continue to exist at a level to meet society's needs and desires now and in the future. The statutes and policies already mentioned were adopted only because of concerns of Oregonians about the cultural and aesthetic, economics, and biological aspects of maintaining wild populations. Also, laws and policies can be changed or interpreted differently as society's needs and values change.

The current wording of the various statutes and policies allows the Department considerable flexibility in interpreting and providing for the needs and values of Oregonians. For example, the wording "optimum benefits" and "optimum levels" are value judgments and consequently mean different things to different people. The difficult task that the Department faces is not only to manage for the needs and desires of various user groups today but to manage in a way that maintains options for future users.

CULTURE AND AESTHETICS

Wild coho stocks are important to many Oregonians for cultural, aes-

One coho looks much like another, but there are important differences between strains that aren't visible to the naked eye. Wild fish have adapted over the centuries to the living conditions in their particular stream and may not do well when placed in another stream with differing conditions.

thetic, and even moral reasons. The preamble to the Wild Fish Policy addresses these and associated reasons: "Native wild fish are a heritage that merit being preserved in natural habitat in at least part of their original range. Managing for wild fish encourages man to do what is best for the resource and it places environmental concerns ahead of proposed trade-offs. The presence of cold-water fish usually indicates good water quality and a healthy environment not only for the fish but for man. The aesthetics of fishing for, seeing, or at least having the potential to catch or see, wild fish is widely treasured; the fewer wild fish there are, the more they will be valued."

How many Oregonians support a management program for wild coho for cultural or aesthetic reasons only, and how much they are willing to pay directly or indirectly for the maintenance of these populations, is not known. This justification for maintaining wild coho probably would be the first to be compromised when it comes to "push and shove" as society reorders its priorities.

ECONOMICS

Probably the most obvious reason for Oregon to maintain wild coho stocks is so that the available habitat will be producing as many fish as possible. Oregon has been blessed, on the coast alone, with over 6,000 miles of stream capable of producing large numbers of coho salmon. Naturally produced coho are not "free" because of the cost associated with stream protection. While not all the benefits and cost associated with maintaining water quality and quantity in our streams can be assigned to wild coho production, there is no doubt that this production is an important economic factor in maintaining streams in a condition so that fish can grow and reproduce.

BIOLOGICAL

The "biological" reason for preserving wild coho stocks is the most important. The availability of wild stocks is fundamental to achieving our socioeconomic goals in coho salmon management now and in the future.

It is now recognized that the narrow genetic base of our highly selected coho hatchery stocks can make them dangerously vulnerable to disease, competition, predation, and fluctuations in the physical environment that would limit their survival – and wild stocks that provide the genetic base for diversification have been severely reduced by man's activities. In a real sense, our scientific achievements in aquaculture have put us in a vulnerable position in which a rather narrow genetic base – represented by our hatchery stocks – currently makes up the bulk of the coho produced and harvested. A relatively few hatchery stocks have been widely adopted, resulting in a uniformity that makes broad areas susceptible to the same destructive forces.

The problems associated with monocultures are well recognized in agriculture but less so in aquaculture. Agricultural monocultures are characterized by marked fluctuations in abundance and require the constant attention of man (e.g., development of new strains or varieties), as well as high energy input (e.g., fertilizer, herbicides, and pesticides) to maintain production. Considerable effort by horticulturists is occurring worldwide to preserve basic genetic resources, particularly the collection and conservation of wild species and primitive varieties of plants that carry the genes for traits we may desperately need in the future. Fortunately for the agriculturist much of the genetic material can be preserved in the form of seeds that are more easily stored than the reproductive products of fish. Aquaculturists will have a much more difficult problem in preserving salmon gene pools; that is, maintaining wild stocks over a wide range of environmental conditions.

In recent years the Department either directly or indirectly by funding research at Oregon State University has attempted to inventory some of our salmon and steelhead stocks for genetic differences and determine the significance of some of the differences observed. To support the notion that wild coho salmon exist that are distinct genetically and that these stocks are a biological necessity, three things must be established:

1. The wild (and hatchery) coho stocks returning to various streams (and hatcheries) have to possess different traits, and the traits are inherited and are not an immediate response to the environment. If the stocks are all the same, then they should be interchangeable among river systems (and from hatchery to stream) and

all show similar responses to environmental conditions.

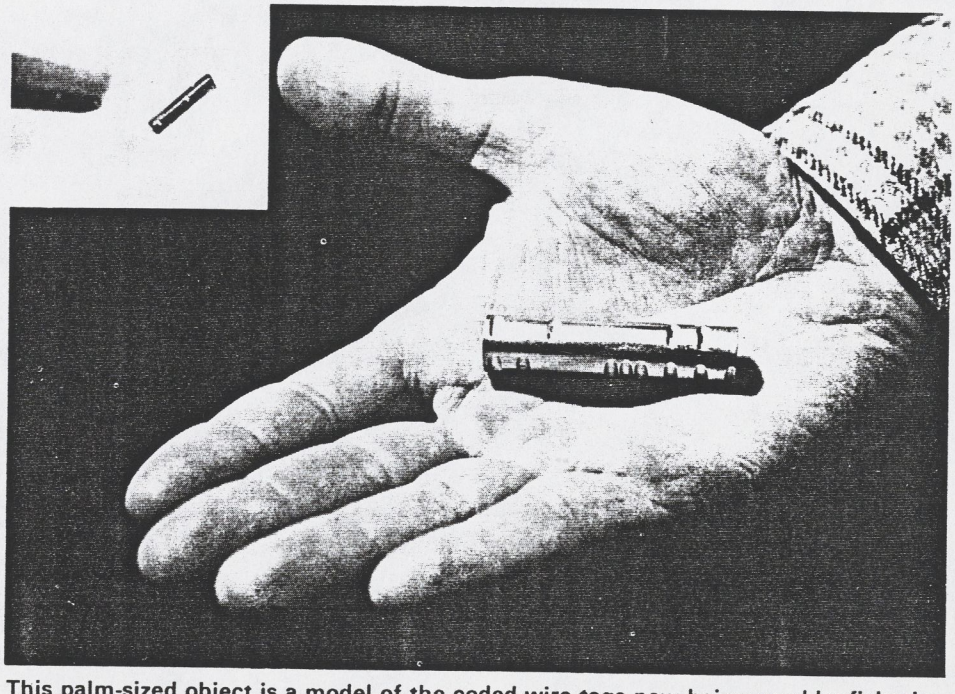
2. The inherited traits are important to our use of those stocks now (and in the future). It does not make sense to go to the expense and effort of preserving various stocks if the inherent differences are not important with respect to man's use of those stocks.
3. Many of the differences will be lost when a given stock is artifically cultured generation after generation for part of its life in a hatchery.

The characteristics (phenotype) of all living things are a response of inherited traits (genotype) to the environment. For example, if you take young fish from a distinct stock known for large body size and place them in an environment where food is scarce, the fish will be smaller than those grown under conditions more favorable for growth. Fish in both groups inherited the same capacity for growth but the environment controlled the response in this example. Perhaps not so obvious is the fact that if you take young fish from another stock known for small body size (inherited trait) and place them in the environment that is favorable for growth, they will not achieve the same size as the fish from the stock known for its large body size.

Many people believe that we no longer have distinct stocks of wild coho, only fish that are the result of natural spawning of hatchery fish. In other words, a coho is a coho. Evidence shows this is not true. Despite the earlier management practice of stocking fish originating from one stream into another watershed – a practice, by the way, that led to the decline and/or extinction of some stocks early in this century – Oregon coastal streams continue to have coho salmon that possess different inherited traits. For example, a study completed recently at Oregon State University showed a number of differences. The traits evaluated included two enzyme gene frequencies, the life history characters of time of peak spawning and proportion of females in the population, and the meristic characters of scales in the lateral series, scales above the lateral line, anal rays, gill rakers, branchiostegal rays and vertebrae. Coho salmon stocks from similar environments were found to be phenotypically similar for these traits. The groups of stocks found to be similar by analysis were: (1) wild stocks from the north Oregon coast; (2) wild stocks from the south Oregon coast; (3) stocks from hatcheries using wild coho salmon for an egg source; (4) stocks from large stream systems; and (5) hatchery stocks from the north Oregon coast. There were three trends involved with these patterns: (1) stocks that are geographically close tend to be similar; (2) stocks from large stream systems were more similar to each other than to stocks from smaller stream systems, independent of geographic nearness; and (3) hatchery stocks were more similar to each other than to wild stocks, even those in their respective stream systems, and wild stocks were more similar to each other than to hatchery stocks, even those in their respective stream systems.

The reasons differences remain despite some of our past stocking practices is in part I believe explained by the fact that in many situations the young coho that were released did not survive to reproduce, particularly prior to the 1960's. In many cases this was due to stocking fish at the wrong time and/or size; stocking fish that were of poor quality because of disease and diet problems that existed earlier; stocking fish into streams that were already seeded to capacity with salmon and trout, or nearly so; and, last but not least, stocking fish that were poorly adapted genetically for the environment into which they were placed.

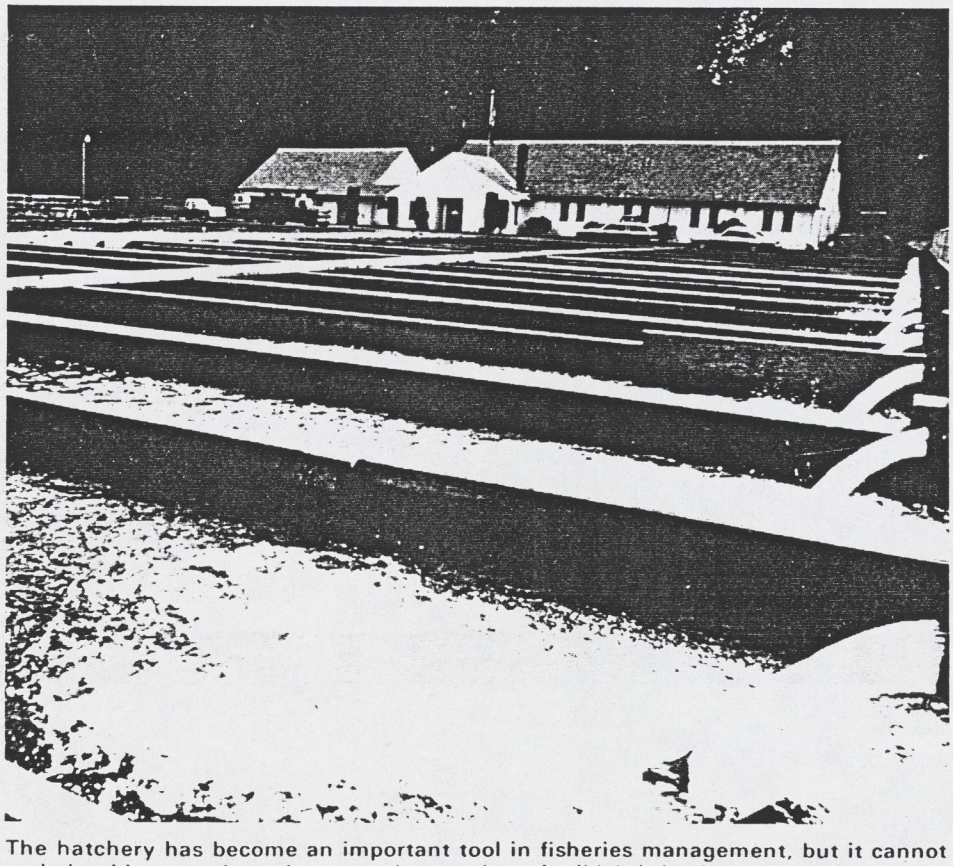
We have some recent examples where we attempted to stock fish adapted to one environment into a river system where conditions were different. For example, the Nehalem River contains a protozoan parasite, *Ceratomyxa shasta,* that is common in the Columbia River system but has been found in only one other coastal stream, the Rogue River. Attempts to augment the coho and steelhead runs in the Nehalem River using stocks from the Alsea River failed. We now know that fish from the Alsea River are very susceptible to the parasite. An analogy would be the devastation of the Indian people when exposed to smallpox, measles, etc., brought to this country by Europeans. Indians had not evolved any resistance because of the absence of these disease organisms in their environment.



This palm-sized object is a model of the coded wire tags now being used by fisheries managers to learn more about salmon populations. The inset photo shows an actual coded wire tag compared with the point of a sharp lead pencil. Tags are inserted into the snouts of young fish before they migrate to sea and are recovered with use of metal detection devices upon their return.

All coho, or for that matter all salmon, may look alike to the casual observer, but there are differences recognized by fishermen and biologists alike. Some of these differences are important to us now. For example, some coho stocks have different ocean migration patterns and consequently differ in how well they contribute to Oregon fisheries; some stocks differ in their resistance to various diseases; and some stocks differ in their time of entry into fresh water and when they spawn. We do not know the significance of some of the biochemical differences (e.g., enzyme patterns) that have been demonstrated recently and there are no doubt important differences among stocks that we are not even aware of yet.

Coho salmon are closely related to other Pacific salmon, such as chinook, chum, pink, and sockeye. But coho are considered a distinct species as are the chinook, chum, etc. While most stocks of coho may look alike there are important biological differences as discussed above. Most of these differences are not readily apparent (e.g., disease resistance). The fact that we cannot "see" or "feel" some of these differences does not mean they are not important. In contrast, we are not only readily able to distinguish between breeds of cattle or dogs based on visual traits but we also recognize the breeds as being different with respect to traits we wish to use. No one looking for a sheep dog would go out and buy a Pekingese, although both the Pekingese and sheep dog belong to the same species. Nor would someone starting a dairy farm accept a truckload of Hereford beef cattle as a substitution for Holstein dairy cattle. Nor, based on past experience, would we want to put Alsea coho in the Nehalem River for purposes of restoration or enhancement of the natural run.



The hatchery has become an important tool in fisheries management, but it cannot and should not replace the natural spawning of wild fish in the streams.

The differences between Holstein and Hereford cattle are extreme and the result of years of selection, mostly by man. Some of the differences between coho (e.g., disease resistance) are just as extreme biologically and are the result of thousands of years of selection by nature.

The question that must be asked now is how effective can the hatchery be in maintaining genetic diversity. Most people would agree that we need this "genetic insurance" but can't we do it simply by diversifying our hatchery brood stocks? The answer is, yes to some degree. We can increase the genetic diversity of our existing hatchery stocks, and are doing so now by collecting locally adapted fish for brood stock at new hatcheries, and modifying other hatchery practices. It is the "to some degree" that needs to be questioned. Taking a given wild stock of coho and dividing it into two components, one that will continue to be reared in the varied environment of the stream and the other to be reared for part of its life cycle in the more uniform hatchery environment, will result in two populations differing in certain traits in time. Selective pressures in the hatchery are different than those that occur under natural conditions. Changing our hatchery practices will not only help to maintain genetic diversity in the stock and make the hatchery fish resemble a wild fish more but will also make the hatchery product more expensive over the short term because many of the changes result in higher operational costs. However, the long-term cost could be considerably greater if we do not carry out a program to increase the genetic diversity of our hatchery stocks.

Our current understanding of genetics and hatchery practices leads us to believe that the only practical and ecologically safe way to preserve genetic diversity is to maintain wild stocks – the natural spawning and rearing of stocks adapted to local conditions.

Currently, fishery biologists are wrestling with the problem of whether or not surplus hatchery coho (adults, released for natural spawning; presmolts, released for natural rearing in the stream; and/or

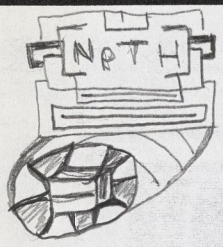
smolts, released in a stream where upon their return as adults they will spawn) can be used to reseed streams to capacity immediately, or in the next cycle, where the escapement of wild coho in recent years is believed to be inadequate. The inadequate escapement of wild stocks is a serious problem where we have wild and hatchery produced fish intermingled and subjected to a common fishery.

We can probably maintain some level of production if we are careful about the hatchery stock we use (e.g., cannot put Alsea stock in the Nehalem River). The degree to which the indigenous stock will be changed to resemble the hatchery stock will depend on the level of stocking and eventual opportunities for interbreeding, the status of the wild population (it will usually be low, otherwise we would not be stocking the stream in the first place), and the degree to which the wild and hatchery fish differ in characteristics. The outcome will probably be a stream that is dependent on annual stocking and whose population is at best only one generation removed from the donor hatchery stock. The above will lead to the widespread loss of genetic diversity.

We have no doubt lost much of the genetic diversity present in our coho stocks, but there is still much that remains. This material is the "genetic insurance" or legacy that must be maintained for future use, if not in our generation then in those to follow. I do not believe that society will condone or can afford the continued loss of this genetic material in our remaining wild stocks. Again, it is this genetic resource that future generations of Oregonians will (1) reinfuse into existing hatchery stocks, (2) use to develop new hatchery stocks, (3) use to try to reestablish natural runs where opportunities occur, and (4) use to optimize the natural production of coho in streams. The intensive and extensive stocking of surplus hatchery fish in all forms (adults, presmolts, and smolts) away from the hatchery streams is ecologically dangerous as well as impractical and should not be substituted for a management program that allows adequate escapement of most wild coho stocks. □

The coho is an important resource, both to the sports fisherman and to the commercial industry. There have been many long and often heated discussions about its management in the last year.

The end of one generation marks the beginning of another. Nature's marvelous cycle of salmon reproduction insures the natural selection over many generations of those traits that best adapt a fish to its home stream. Unwise use of hatchery fish can dilute naturally selected characteristics.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