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MUSEUM OF ZOOLOGY
ANN ARBOR MICHIGAN 48109

February 22, 1989

Bob:

Enclosed is your text on the name changes. It looks fine to me. The question about the art aspect of taxonomy is something that can be considered another way. As long as we were working with paraphyletic groups, such as Salmo in the old sense, it is true that the art was to choose a happy compromise between similarity,i.e, clarki to trutta and branch relationships, e.g., clarki to nerka. The purpose of cladistics is to take the art and subjectivity out of it. I wish it were true that we could depend on cladistics to do this unambiguously all of the time, and I am sure it can't, but at least it gives us a more objective set of decision rules about how to classify things. Ideally, no art or subjectively would be involved. Realistically, I am sure you are right, at least for the present. I guess I question giving any emphasis to art in this case, because this is one of those examples in which we are putting our necks out on the block in an attempt to get away from a subjective classification.

One way to help fisheries biologists acceept the change is to emphasize that these particular name changes are based on objective evaluation of the evidence that, on a smaller scale, is leading to a step much like classifying whales not as fishes but mammals, and dinosaurs away from lizards and next to birds. Our first reaction is negative because we had learned names and associated them with similarities. But there is a significant potential gain in association of the new names with more and more fundamental similarities. These kinds of analogies might help, some, but there will be considerable negative reaction for us to try to mitigate.

On another subject, can I contact Cavender and try to borrow your dissected specimen of Platysalmo? I suspect that we should not do any but the most minor dissection of the specimen you have sent here. I look forward to seeing it. I will keep you posted.

Best wishes,

Jerry

1 Bob

CLASSIFICATION

Classification is the science (or art) of arranging the results of evolution in a heirarchial scheme, ~~which ideally~~ that ~~should~~ reflect ~~degrees of~~ relationships -- an interpretation of phylogeny. The science or art of classification is known as taxonomy -- a term which generates little enthusiasm among most fisheries biologists. Although stability and standardization of nomenclature is a goal of taxonomy, many biologists would likely disagree with this statement. Often familar names, long in use, are changed for what is perceived as obscure and arcane reasons.

For a better understanding of the subject, and for resolving some of the confusion that may surround classification, it is helpful to consider two aspects of classification. The rules of nomenclature can be considered as taxonomy in a strict sense. The evidence of evolution used to reconstruct phylogenies can be considered as systematics. For example, when systematic studies revealed, beyond reasonable doubt, that the rainbow trout of Kamchatka and the rainbow trout of North America are indistinguishable and should be recognized as a single species, the rules of taxonomy dictate that the first name published to describe the rainbow trout species is the valid name for the species. Thus, the name mykiss given to Kamchatkan rainbow trout in 1792 is the first name published for the species, and by the rule of priority, it becomes the valid species name. Names published subsequent to 1792 for rainbow trout are "synonyms" of mykiss at the species level, but they are available for use as

subspecies. In this respect, I use the name gairdneri as a subspecies of mykiss to designate the redband and Kamloops forms of rainbow trout native to the middle Columbia and upper Fraser river basins (but gairdneri is a synonym of mykiss at the species level).

When systematic studies, based on diverse methods, all clearly agreed that rainbow and cutthroat trout are more closely related to Pacific salmons of the genus Oncorhynchus than they are to brown trout or Atlantic salmon of the genus Salmo, then a change in nomenclature at the genus level is necessary to make classification better reflect phylogenetic relationships. In this situation, three equally valid options are available (as mentioned, there is an "art" or qualitative aspect of classification). The genus Salmo can be expanded to include Oncorhynchus as a subgenus; an option I suggested many years ago (Behnke 1968). The rainbow and cutthroat trout and their allied forms and immediate ancestors (= "Parasalmo") can be grouped with fossils described in the genus Rhabdofario as a separate genus (which would be Rhabdofario based on rule of priority). Or, the genus Oncorhynchus can be expanded to include all native western trouts ("Parasalmo"). The American Fisheries Society Committee on Common and Scientific Names has chosen the latter option. Rainbow trout become Oncorhynchus mykiss and cutthroat trout O. clarki.

G. R. Smith-FISH DIVISION
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Classif.
O. S. etc.

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

HG

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DEPARTMENT OF WILDLIFE AND FISHERIES BIOLOGY
UNIVERSITY OF CALIFORNIA
DAVIS, CA 95616-5270

Feb. 24, 1989

R. J. Behnke
Dept. Fish. Wildl. Bio.
Colorado State Univ.
Fort Collins, CO 80523

Dear Bob,

Please understand that this is not meant to be an imposition - but -

Would you take a look at the enclosed rainbow trout subspecies nomens and make whatever comments you feel are appropriate.

I really do value your opinion and look forward to your thoughts.

Thanks.

Sincerely yours,

Bill

P.S. Please note my new address. I do not have a phone in my office yet. When I do, I will send it along. I am setting up a genetics lab for Peter Moyle and Jack Williams. Our first projects will concern the Klamath Basin suckers and the Owens tui chub. More later.

SUGGESTED NOMENCLATURE FOR RAINBOW TROUT SUBSPECIES

Scientific	Common
Oncorhynchus mykiss mykiss (Walbaum)[1]	Kamchatkan rainbow trout
O. m. gairdnerii (Richardson)[1]	coastal rainbow trout (1)
O. m. aquilarum (Snyder)	Eagle Lake rainbow trout
O. m. nelsoni (Evermann)	San Pedro Martir rainbow trout
O. m. gilberti (Jordan)	Kern River rainbow trout
O. m. aguabonita (Jordan)	Volcano Creek golden trout
O. m. whitei (Evermann)	Little Kern River golden trout
O. m. gibbsii (Suckley sensu Jordan & Evermann)	inland redband trout (2)
O. m. ssp.[2]	McCloud River redband trout (3)
O. m. ssp.[2]	Goose Lake redband trout

[1] Diagnosed as spawning west and east of 170° W and having an ocean distribution west and east of 165° E respectively.

[2] Application of the available nomen *O. m. newberrii* (Girard) awaits electrophoretic analysis of upper Klamath basin redband trout.

W. J. Berg
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MUSEUM OF ZOOLOGY
DIVISION OF FISHES

July 8, 1987

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

Bob:

The enclosed abstract may be of interest. Until we determine whether Rhabdofario, including mykiss, clarkii, etc., is the sister group of all of Oncorhynchus, or just a part (Ankenbrandt 1987), we won't be able to make a definitive decision. We will let you know as soon as we feel confident of a cladogram that is consistent with the biochemical as well as the osteological information.

In the meantime, calling this rainbow and cutthroat Salmo is not wrong. Oncorhynchus or Rhabdofario might be preferred when all of the data are in, but Salmo might be the best, even then.

Best wishes,

Gerald R. Smith

Gerald R. Smith
Curator of Fishes

Encl.

FOSSILS AND THE CLASSIFICATION OF TROUT AND SALMON

STEARLEY, R.F., and SMITH, G.R., Museum of Paleontology, U. Michigan, Ann Arbor, MI 48109

Extant Pacific-area trouts (rainbow, cutthroat, etc.) were referred to the subgenus Parasalmo (genus Salmo Linnaeus 1758) by Vladykov (1963). They are the sister group of the Pacific salmon (Oncorhynchus Suckley 1862), therefore the Holarctic genus Salmo is paraphyletic. The Miocene-Pliocene trout Rhabdofario was described by Cope (1870) from SW Idaho. It shares derived osteological characters with Pacific-area trouts and is probably the precursor of at least one of them. Thus Rhabdofario is a senior synonym of Parasalmo. Three classifications would be equally consistent with the relationships of these taxa: (1) one genus, Salmo, including all trout and salmon (Regan 1914); (2) two genera, Salmo and Oncorhynchus (the latter including Rhabdofario and the Miocene salmon Smilodonichthys); and (3) three genera, Salmo, Oncorhynchus, and Rhabdofario. Choices 1 and 3 are supported by strong characters.

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February 2, 1989

Dr. Robert J. Behnke
Department of Fisheries and Wildlife Biology
Colorado State University
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George Sterling
Box 3008
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(403) 723-2838

Dear Dr. Behnke

I have, with considerable interest, read your articles in the last dozen or so issues of Trout magazine. Of particular interest were the articles on Redband trout (Autumn 1986) and most recently, Kamloops trout (winter 1988).

You recently made reference (American Fisheries Society Symposium 4:1-7, 1988) to cutthroat trout as the only trout native to East Slope drainages (including Alberta). Undoubtedly you are aware that in Alberta, in portions of the Athabasca river watershed, there is an endemic strain of rainbow trout. Some years ago you had corresponded with Mr. Don E. McAllister (Research Curator, Canadian National Museum of Natural Sciences) with respect to type specimens of this salmonid, described by Bajkov (1927) as Salmo irideus morpha argentatus (= Salmo gairdneri; renamed beginning 1989 as Oncorhynchus mykiss).

My association with the 'Athabasca' rainbow stems from work with the Alberta Fisheries Branch as Fisheries Biologist for a logging impact study (1971 to 1987). The study was focused on three small headwater tributaries of the Mcleod river, a major tributary to the Athabasca river.

With respect to your writings, there are many similarities between 'Athabasca' rainbows and desert redbands described from small streams in the Sacramento and Columbia river basins. I realize this is an oversimpification, but the painting in the Autumn 1986 issue of Trout is so similar to an original painting I have of 'Athabasca' rainbows by a local artist, I had to make the comparison. Certainly, the selective pressures during evolution in harsh environments have contributed to the outward expressions of similar phenotype. I believe however, that the 'Athabasca' rainbow represents a unique divergence from the mainline of rainbow trout evolution with respect to the Sacremento, Columbia and Fraser river basins.

Distribution of the 'Athabasca' rainbow is limited to the upper mainstem reaches of the Athabasca, McLeod and Berland rivers and the small tribuaries within these watersheds. As far as I am aware, nowhere within this distribution are there established lake populations. They occupy habitats above the distribution of Arctic grayling in these watersheds, are found in association with mountain whitefish and bull trout in the mainstems, and are commonly the only species found in small headwater tributaries.

Typical habitats are small streams (< 4th order) of moderate to high gradient, with a short growing season (June to October), and severe wintering conditions. Males and females mature at age 3 and 4, respectively, and have a life expectancy of 8 to 10 years. Retention of parr marks throughout life, yellowish body color, heavy spotting, white tips to pelvic, anal, dorsal and caudal fins, red lateral band and faint reddish/orange gill slashes are typical expressions of phenotype. In some populations I've observed trout (< 0.1 % of population and never older than age 4) that exhibit only a pale yellow body color and white tipped fins. Maximum size is generally less than 300 mm in typical habitats, however, growth (and perhaps expression of some phenotyic characteristics) is a function of environment and not heredity. Reared in fertile pond environments, increased growth (350 to 400 mm in 3rd growing season) and silver body coloration were evident.

Awareness, with respect to this endemic and possibly unique, salmonid, is only now beginning to grow. My own concerns encompass management strategies which are subservient to angler demands for increased rainbow trout stocking and hatchery development within the distribution range of the endemic strain. Stocking of rainbow trout within Jasper National Park (headwaters of the Athabasca river) has a long history, and has been curtailed only in the last few years. What remains of endemic populations is unknown. Outside the Park, the Provincial Fisheries Branch annually stocks rainbow trout into a number of isolated lakes (no effluent streams) and several streams (beaver impoundments) within the Athabasca drainage that is encompassed by the Edson Region. The upper McLeod watershed (also Edson Region) has a single lake (Mary Gregg) that is stocked every second year, and is of concern because escapement from the lake is possible. Brook trout introduced in the 1930's and '40's became established in the stream below the lake and are now found in many streams in the upper McLeod watershed. Stocking of rainbow trout in streams of the central and easterns portions of what is now the Edson Region (Athabasca and McLeod watersheds) occurred prior to 1960 but records are sparse. Stocking of rainbow trout is currently limited to lakes, some of which permit escapement. In the Berland watershed, stocking of rainbow trout (late 1960's and '70's) occurred in several lakes drained by Jarvis creek, and more recently, into a single small isolated lake in the lower watershed. The upper watershed remains untainted.

Evidence of a refugium during Wisconsinan glaciation is discussed by Crossman and McAllister (1986) and provides interesting thought. Although they suggest an ice-free corridor (at times) between the Wisconsinan, Cordilleran and Laurentide ice sheets, the extent of a refugium with respect to endemic rainbow trout may have been very limited. The presence of glacio-lacustrine silts, to an elevation of 1400 masl, in portions of the upper McLeod, Athabasca and Berland watersheds indicates the existence of a glacial lake(s) in this region at some point in time. To the south, rainbow trout are not endemic to the headwaters of the Pembina river (tribuary to the Athabasca river) which lie adjacent to the headwaters of the McLeod river. Nor do they occur to the north in the Smoky river drainage (tributary to the Peace river) which lies adjacent to the Berland watershed. Apparently, endemic populations of rainbow trout also exist in headwater tributaries of the Peace river in British Columbia.

In 1983, type specimens of endemic rainbow trout (collected from Wampus creek, upper McLeod river watershed) were shipped to the Pacific Fisheries Research Lab in Seattle, Washington, for electrophoretic screening and identification of their genetic relationship to other strains of rainbow trout. "The origins of the Wampus creek stock is certainly of interest considering its relationship to other native rainbow and steelhead trout populations" (Seeb and Wishard, 1984). The analysis showed that, if they originated from Fraser river stock a substantial amount of genetic drift had occurred; suggestive of isolation prior to Wisconsinan glaciation. The population did not lack variation, showing a heterozygosity value of approximately 0.05. I've included the phenogram from the report by Seeb and Wishard.

I've rambled on a bit and touched down a few times on ground I'm not familiar with (that happens on occasion and is purely unscientific). I would be most interested to hear from you with regard to the 'Athabasca' rainbow. If you wish detailed life history information or a copy of the report by Seeb and Wishard (unpubl.) let me know. Another sample of Wampus creek trout has been sent to eastern Canada for electrophoretic screening, but as yet we haven't received any results.

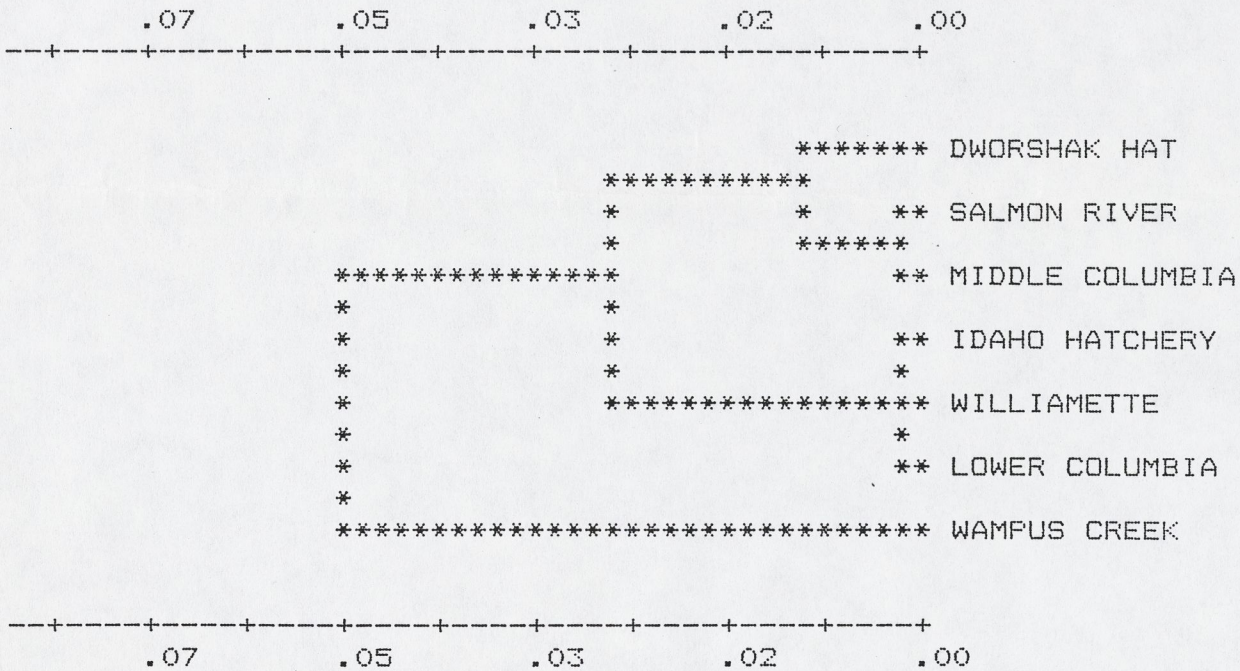
Looking forward to hearing from you.

Sincerly,

George Sterling

George Sterling

Figure 1. Phenogram depicting the relationships of selected rainbow trout populations.



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Athabasca
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Freshwater Fisheries Centre
Ministry of Agriculture and Fisheries
P O Box 8324
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February 2, 1989

Dear Bob

I much enjoy your light hearted letters and papers, and also the contact with you and other like you. I'm working in a bit of wilderness here and really don't have time to do much research, and the stimulating contact with people like you is very important to me. I try to keep up a trickle of bits of science and do lots of writing at home, in lieu of doing research. I now describe myself as a 'bureaujunkie' with an addiction for 'bureaucrap'. But it can't go on for ever.

The problems you have with Arctic char are really fascinating. It seems to me that some of your struggle is really the tension between theoretical and practical systematics. In a theoretical sense, once a population has become reproductively isolated, it is a species. Potentially, it has made the genetic 'break' that is needed to permit divergence, adaptation, development of distinctive characteristics, etc. But when you are dealing with a polyphyletic situation that results from repeated landlocking of a diadromous species, then in practice this becomes practically impossible, for two reasons: 1. the various lake stocks are probably inseparable and unidentifiable; 2. The nomenclature becomes a shambles. One further aspect that you don't seem to dwell on is the situation where you have say sp. A and sp. B reproductively isolated in a lake, but in which both would probably hybridise, introgress with populations of the same ancestry elsewhere. This only makes the issue that much harder to deal with, in practice.

I face a bit of the same issue with the diadromous Galaxias maculatus, which has landlocked in a modest number of lakes in Australia, New Zealand and Chile, always diverging from the diadromous stock in the same sort of way. Hugo Campos, a fish man from Valdivia in Chile is pushing to recognise these 'polyphletic' lake populations as a distinct species, but to me it is nonsense.

I had a bit of correspondence with Reeve Bailey about gairdneri(i) recently, Actually, I put my foot in it with a little article in Freshwater Catch, in which I misinterpreted the Code, which has caused a little confusion and am about to correct it with another. It has always seemed to me that the original usage should stand unless a mandatory rule in the code is contravened. And my current reading of the code says that a Latinised personal name is a valid formation, hence - Gairdner = gairdnerius which becomes gairdnerii in the genitive. Reeve is making it an argument around whether Richardson was or was not a

good Latin scholar, and knew enough to Latinise Gairdner, but it seems to me that we have to accept on face value what he did and assume he knew what he was doing. Reeve wrote of old Englishmen not being as skilled in the Classics as we might assume, etc etc., but it seems to me that is irrelevant. Your comments confirm my 'feeling' that what was basically going on was a rearguard action to maintain what had already been 'codified' rather than address the issue as covered by the ICNZ.

Finally, you might be interested in extracts from a recently (1989) published book in New Zealand that allude to me and the response of saome anglers to catch and release, and also trout farming. It has almost become a spiritual issue!

Best wishes

R M McDowall

The New Zealand Encyclopaedia of Fly Fishing

Bryn Hammond

ACKNOWLEDGEMENTS

I have had a great deal of help from others in the preparation of this book. The source books are listed in Appendix 1, but even this list must be incomplete because my views and attitudes have been shaped in part by every book on fish and fishing I have ever read.

I wish to thank my good friend John Parsons for his kindness in reading the manuscript, as well as for many hours of fishing talk, as well as fishing, we have shared. John, however, bears no responsibility whatsoever for any of the personal views expressed throughout this book, or for the manner in which they are expressed. These are my own. Additionally, I wish to thank John Parsons for making available to me original and hitherto unpublished material he has researched into the lives and characters of Alan Pye, and Ernest de Lautour. It was he, too, who did so much to stimulate and encourage my interest in these matters, and who provided much otherwise unknown material.

I wish to thank my good fishing companion Bill Crawford from whom I have learned so much — although he, too, is absolutely dissociated from all such personal views. To him my sincere thanks are given for many of the photographs.

Thanks are given to Dr Nick Bradford with whom I have shared with Bill Crawford so many magnificent and memorable fishing forays into wild and lovely places in quest of brown and rainbow trout.

I wish to thank Dr Donald Scott of the Department of Zoology, University of Otago, for his kindness in providing me with his paper *Migration and the transequatorial establishment of salmonids*, previously unknown to me, and for his kindness in permitting me to use material from other published papers.

My sincere thanks are given to Dr R.M.McDowall for his kindness in allowing me to use material and extracts from his published works and from *Freshwater Catch*. It will be obvious to readers that I have the utmost respect and admiration for Dr McDowall, and regard him as New Zealand's foremost freshwater fisheries scientist. He did ask, however, that I should not quote him out of context. This I have endeavoured to do. It is, however, exceedingly difficult, in the following A to Z format to place everything in the original source sequence. In this respect I sincerely regret any apparent mis-quotation from Dr McDowall's writings. Dr McDowall, no doubt, has sometimes written (for anglers) somewhat tongue-in-cheek, no doubt to stimulate often otherwise apathetic attitudes. If so, then this may be an angler's response.

My thanks are given to Brian Turner for the use of several previously unpublished photographs, and for his permission and that of the Otago Acclimatisation Society and Millwood Press to use extracts and material from *The Guide to Trout Fishing in Otago*.

I wish to thank Norman Marsh and Millwood Press for permission to use extracts and material from *Trout Stream Insects of New Zealand* and for his kindness in providing photographs.

Thanks to Keither Draper for permission to use material from his published works.

My thanks to Dr J.C. Pendergrast and Dr D.R. Cowley for their permission to use material from *An Introduction to the Fresh Water Insects of New Zealand* (1969).

Every effort has been made to contact copyright holders and to obtain permission to quote or paraphrase copyright material.

The author wishes to thank or acknowledge the following writers, publishers and literary representatives for their permission to use copyright material:

Extracts from Trout Flies in New Zealand by Keith Draper published by A.H. & A.W. Reed, Wellington, 1971. © 1971 Keith Draper.

Material from *Mr Hundred Per Cent — Fred Fletcher's Taupo Tales* by Keith Draper published by A.H. & A.W. Reed, Wellington, 1969. © Keith Draper.

Extracts and material from *Trout Stream Insects of New Zealand* by Norman Marsh published by Millwood Press, Wellington, 1983. © 1983 Norman Marsh.

Material from *A Fisherman's Year* by John Parsons published by Collins, Auckland & London, 1974. © 1974 John Parsons.

Material from *Parsons' Glory* by John Parsons published by Collins, Auckland & London, 1976. © 1976 John Parsons.

Material from *A Taupo Season* by John Parsons published by Collins, Auckland & London, 1979. © 1979 John Parsons.

imitates no more than a blowfly maggot.

Alan Pye's Nymph, while designed to imitate the rising pupa of the larger sedges, is still a most killing pattern.

As for imitations of the adult they are legion. One can hardly beat the good old-fashioned Invicta wet fly — especially fished drowned, just under the surface film — while a G & H Sedge will float all day — until taken by a fish.

One thing is certain: the range of caddis larvae and adults is so large and diverse, that exact imitation is rarely possible and probably never necessary. For caddis imitations impressionism in artificials is far more important. Representing the most important trout food — whether cased or uncased species — trout are very partial to them.

Caffin, David David Caffin died tragically young. Well embarked on what was already a distinguished career in the New Zealand Diplomatic Service he would, undoubtedly, have reached the highest office.

Perhaps less well known was that he was a distinguished fly fisherman. A member of the London Flyfishers' Club since 1973, he was as much at home among the trout streams of Normandy, the chalkstreams of England, the limestone rivers of the eastern United States, as he was on his native New Zealand rivers.

Had he lived, it is highly probable that David Caffin would have become New Zealand's most distinguished angling writer. I, for one, can only speculate on the kind of books he would most certainly have written.

Calderwood, William L. Appointed Inspector of Scottish Fisheries in 1898. Author of several significant books: *The Life of the Salmon* (1907), *The Salmon Rivers & Lochs of Scotland* (1909), *Salmon & Sea Trout* (1930), *Salmon Hatching and Salmon Migrations* (1930), *Salmon! Experiences and Reflections* (1938).

His work contains many references to New Zealand — particularly in regard to his study of the migratory instinct in brown trout in this country: whether it was hereditary due to their stock, or whether as a result of opportunistic behaviour in their new antipodean home.

Catch and Release A contentious issue in New Zealand at present, and one that causes hackles to rise. There are many who defend the angler's almost God-given right to go out and catch and kill fish up to the allowable limit. Other anglers view the present situation as impossible to continue; that unless restraints are imposed by edict or personal conviction — and soon at that — trout fishing, as we know it, is doomed.

Slogans abound: A trout is much too valuable to be caught only once; trout are a self-renewing exploitable resource; to release trout after capture is cruelty in itself: either they should be killed and eaten, or the angler should not be fishing in the first place — that, quite apart from needlessly tormenting poor fish, he plays God in releasing them after their ordeal, instead of dispatching them cleanly with a sharp blow on the top of the head. All good gutsy, emotive stuff, but unlikely to assist any but the extreme believers on both sides.

Looked at as factually as is possible, there seems no doubt that there is far too much mindless slaughter and unnecessary killing of trout in New Zealand today. That it has gone on since trout fishing began here, is no justification in itself that it should continue, as seems to be a much heard argument, despite the capacious maw of the family deep-freeze. But in that respect it is difficult to believe that any more than a small fraction of the trout one sees being carted away from our rivers ever even get as far as the deep-freeze, often hundreds of miles away.

Many people liken fishing itself to man's primitive urge to hunt: to hunt, not only for food as such, but even more importantly to satisfy a basic urge that should not be too much repressed, as our modern way of life tends to do. This argument is really saying that the true hunter is more interested in the kill than he is of the act of hunting itself; that the kill itself is of more significance and should not be trifled with, or denied.

If that sounds too ridiculous to be true then consider the committed Christian attitude — fundamentalist to be sure, but still advanced as being provable by biblical authority — that man is lord of creation and that the fishes were created for his purposes. By this argument it can be said that an angler is not only justified in killing his entire catch, but furthermore should do so in order to avoid inflicting cruelty and playing with one of God's creatures.

But what of the advocates of Catch and Release? To start with, much of the debunking one hears these days, is that what it says is that *all* fish caught *anywhere* by *whatever* method should be released back into the water unharmed. That this is not so should be obvious. Trout caught by legal trolling methods in such a place as Lake Taupo obviously ought not to be released in order to comply with Catch & Release philosophies. To begin with they are more or less dead anyway having been hooked at 5 knots and towed around at the end of 100 yards of wire or lead line, then unceremoniously dragged in to the boat. Secondly there seems little point in fishing for trout by such means in the first place unless the object is to kill and eat them. Most importantly, a vast lake and self-sustaining fishery like Taupo can withstand the sort of trolling fishing pressure it gets, provided that the regulations are

not broken — and even does good by culling what might become over-population.

The Catch and Release principle is an entirely different matter when applied to year-round permissible fishing — including spinning — on small and comparatively frail streams like the Rangitaiki which tend to support small populations of average to rather better than average fish, all competing for dwindling food supplies due to forestry, run-offs, pesticides, pollution and the like. In once remote wilderness rivers such as the Rangitikei, upper Mohaka, Ngarururoro, etc. — once truly wilderness experiences but now only twenty minutes by aircraft or helicopter from that same Lake Taupo — the rivers support small populations of larger than average fish that are far from being a seasonably renewable resource to be exploited like a crop. Herein lies the difference, and herein lies the heart of the matter of Catch and Release.

We live in an age of buzzwords, so shouldn't be too surprised that they have crept into fly fishing, although I can't help but feel such jargon puts more people off than their use attracts. "Limit your kill — Not kill your limit" is one such much bandied around expression, although it is direct and honest as well as being both sensible and essential advice.

In any case it is a good thing and good for a fly fisherman's soul (especially if he presses down the barbs of his dry flies and nymphs) to release *all* of the trout he catches in such places, and *most* of the trout he catches elsewhere.

Fisheries scientists often advance ideas less to do with straightforward scientific truth than with complying with the wishes of their political or bureaucratic masters in telling them what they want to hear. In any case, science never was especially noted for its monopoly of wisdom.

Dr McDowall subscribes to the idea that much of catch and release is sheer snobbery, encouraged by anglers who have so much time to fish and catch so many that they are sick of eating trout, never liked it anyway, or wouldn't know what to do with the fish if they kept them.

Somewhat tempering such a view he admits - uncomfortably, one feels — that catch and release can be a useful management tool, or where there are small populations of very large, very old fish. He stretches the egalitarian bit by saying that only overseas tourists or wealthy New Zealanders can afford to fly in to these headwaters for the fishing experience of a lifetime, and — unless these small populations of large trophy fish are preserved by catch and release — disaster lies ahead in the collapse of a little industry. He states that, in such cases, it is the fishing guides who take anglers into such wilderness rivers who insist on releasing all the trout their clients catch, or allow them to kill one for the taxidermist, and others only sufficient to eat at the camp — presumably as being an essential part of the total wilderness experience. This, he argues with some truth, is not for altruistic or conservational reasons, but simply to foster the continuance and preservation of their business by providing money over and over again in catching the same trout over and over again.

Dare I suggest it's not really like that at all: the sort of (mostly American) anglers who do helicopter in to such places with professional New Zealand fishing guides have long been catch and release fly fishermen by total conviction; not by imposition. More than one American angler has told me of their horror on discovering that guides themselves want to bring out dead fish — at least that some do; and enough to give their numbers a blemished name. Another point is that catch and release — as a matter of conviction — is much practised by many New Zealand anglers who are neither snobs, nor wealthy, as Dr McDowall has suggested.

Catch and release should be a state of mind. It should be a matter of getting an angler's priorities right; of sorting out the real reasons for going fishing in the first place. Of course it can be regulated by imposition but, like bag and size limits imposed by regulations, they only affect honest fishermen who willingly abide by such decrees. Catch and release should be practiced by total conviction, in the places where it usually is, when the fly fisherman is quite alone.

Catlins River, Otago Flows south-eastwards entering the sea south of Nugget Point. Named after Edward Catlin, a master mariner of Sydney, NSW, who, on February 15th 1840, purchased a block of 1000 square miles here from Tuhawaiki for £60.

The Catlins is a rain-fed stream, rising out of a swamp, with several tributary streams in a small catchment area. Ironically, because of the life-blood swampy source, the river has, so far, suffered less than might have otherwise been the case at the hands of 'developers'. From its headwaters the stream meanders through Catlins Forest Park and out into the Catlins Lake.

Brian Turner has described the upper reaches as 'challenging' fishing, with a good population of brown trout, some in the trophy class but averaging about 1.5 kg. Like so many other streams (and contrary to the popular view) there is often a good hatch of mayfly during dull, drizzly weather, when the trout will often fall for a well presented dry fly, although local anglers are reputed to resort to a creeper or worm, and nymph fishermen favour a heavily weighted Hare's Ear.

In the estuarine area of Catlins Lake smelt patterns are particularly effective in early January when larger sea run fish enter the river.

Chapman, Ann & Lewis, Maureen joint authors of *An Introduction to the Freshwater*

season, on December 1st, 1874. The size of the fish was not recorded. Brown trout were first liberated in these waters in 1870, only four years earlier.

In 1881, a Mr Deans landed two trout, each weighing 18 lbs, from the Fulton Creek on the Taieri. Records show that this creek was first stocked with young trout in 1870.

See also Begg, A.C.

Fish Farming The proposers and opponents of fish farming in New Zealand have long been at loggerheads. Economic pressures, political lobbying, woolly thinking, sadly divided angling groups, the proliferation of Government regulatory bodies all seeking bureaucratic expansion and power, career-motivated fisheries scientists, and the New Zealand problem-solving way of forming still more committees, quangos, study groups, together with the now irreversible Government thrust towards User-Pays philosophy and the maximum exploitation of every resource, adds up to a dismal future.

Up to the present there has been a general compromise in official circles that salmon and trout are separate species and should be considered separately in all matters pertaining to their possible farming; and that the North Island and the South Island are to be considered as being separate places.

While it is not generally remembered — or understood - that the attempted acclimatization of Atlantic salmon, and the successful acclimatization of Pacific (quinnat) salmon in New Zealand, always did have a strongly commercial thrust and intention, there can be no doubt that for fifty or more years most New Zealanders were convinced there would never ever be any commercialization of either trout or salmon in New Zealand — as if it was Holy Writ entrenched as a right of the people.

That first late-Victorian thrust towards the profit motive got lost in the balmy days of the Angler's Eldorado. Trout had never been seen other than as a sport fish; now the quinnat seemed safe in that category.

In more recent years, however, the issue of trout farming became (in Dr Bob McDowall's words) 'the issue-of-the-day for many anglers'. Refusing to get involved in the issue, it was sufficient for Dr McDowall to say he was neither for nor against the issue 'as the Government has spoken very clearly on this issue by explicitly rejecting trout farming in the Fisheries Act 1983.' To my mind this is rather like a policeman or lawyer or judge saying they have no personal opinions as to whether murder, or rape, or robbery with violence, or theft is right or wrong, because the Government have clearly stated their views on the matter. What, indeed, is even odder about Dr McDowall's remarks is that — as a scientific and expert servant of the Crown — surely it was his and his colleagues' bounden duty to advise the Government what was in the best interests of the country?

To be fair to Dr McDowall he does say that his main concern was that anglers were so preoccupied with the trout farming issue they were losing sight of the far more important question of dwindling and deteriorating habitats. Anglers, angling associations, Acclimatisation Society councillors, the Wildlife Service, and the like, may have long been guilty of astonishingly blinkered and ill-informed attitudes and ideas — as well as crass ignorance — but does not this seem a little bit like a scenario in which a fisheries scientist from a blatantly commercially orientated Government agency says to the general public, 'Go away, go and tidy up your own polluted and despoiled backyards while we are left in peace to lobby the Government for whom we work to permit the total commercial exploitation of the resource that will provide jobs and careers for people like us, as well as increasing our power and authority in addition to improving our own jobs'.

One of these so-called angling meddlers was O.S.'Budge' Hintz. He contributed an article to the prestigious Anglers' Club of New York *Bulletin*, Vol.59, No.2, 1980, entitled *Trout Farm Troubles*, in which he reasoned against the proposed idea of permitting commercial trout farming in New Zealand.

The gist of Hintz's case was of the inestimable boon of open waters throughout New Zealand (with the exception of two or three places with Maori property rights where access fees were charged). To Hintz the boon lay not so much in the open waters, but rather in the early legislation totally prohibiting the sale of trout; which law still applies. (*See also* Poaching.) Thus trout cannot appear in any New Zealand hotel or restaurant unless they are supplied by an angler for consumption by himself and his guests.

With none of the fence-sitting coyness of Dr McDowall's statements Hintz went on to say that for the preceding ten years or more a battle royal had been taking place between two government departments seeking diametrically opposed goals. On the one hand the Ministry of Agriculture and Fisheries were actively campaigning to legalize the establishment of commercial trout farms. On the other hand, another government department, the Wildlife Service, was totally opposed to the idea.

Expert advice received from 26 American State and 7 Canadian Provincial government authorities stated categorically that, because of trout farming, problems exist throughout North America which New Zealand would do well to avoid. With one or two exceptions, notably in Oregon and possibly in Washington, trout farming to raise pan-sized fish for human consumption was regarded as uneconomic, wasteful and dangerous as a source of both fish diseases and water pollution. In the majority of

American States private trout farms were operated mainly for the stocking of wild rivers and fish-out ponds.

In many instances fish diseases had been introduced from trout farms into wild stock. Of the 200 to 300 fish farms and hatcheries operating in the United States, fewer than a dozen were certified as being disease-free at any one time.

A personal comment to Hintz came from Donald Barrer, Secretary of the National Chapter (Washington, DC) of Trout Unlimited: 'Trout farming,' he wrote, 'is not an economic venture. In the States, frozen trout has a very limited market. It is an expensive product, and it is not an exceptional table fish . . . American trout farms just cannot exist by producing frozen trout or fresh trout for the market. They need the support of fish-out ponds where you pay perhaps $6 a day (1979) to catch a trout on a pole with a piece of string attached and a baited hook. They also provide young trout for liberation in put-and-take fisheries.'

There seems little doubt that trout farming anywhere in New Zealand menaces trout fishing everywhere in New Zealand. Fish diseases would spread rapidly from the excessive stocking which alone can make trout farming possibly viable. There is the real risk of gross pollution in open rivers and lakes. There is the threat of illicit taking and sale of wild fish by organized gangs of poachers for pecuniary gain.

Additionally, farmed trout are far from being a gastronomic delight. Budge Hintz spoke of eating farmed trout in expensive restaurants in San Francisco, New York and London, and 'found that they taste rather like the felt innersole of a wader boot, only not as nice.' The present writer likewise has eaten farmed trout in the United States and Britain, but to him they tasted of soggy blotting paper.

There we have it. At present (1988) fish farming in New Zealand is confined to the South Island and restricted to salmon, where Atlantic and quinnat salmon are bred in stewponds and brought on in marine enclosures. The companies so engaged appear to have erratic fortunes in the share-market, making it likely that some people at least are making money out of it. Entrepreneurial whizz-kids affirm that all the world will be queueing up to buy the product, whole fish and smoked sides. That remains to be seen.

As for trout farming and the freeing up of fish farming in both islands, despite the present Fisheries Act, the signs are plain for all to see. There is little doubt that MAF scientists and administrators, together with commercial interests, and money-men are already working upon and influencing Government with a declared and heady objective to maximise its revenue and to exploit every possible resource, even to its extinction.

And that, as far as trout are concerned, would be a distinctly real possibility.

It was an American, Aldo Leopold, who wrote — as long ago as 1925 — 'Our tendency is not to call things resources until the supply runs short. When the end of the supply is in sight, we *discover* that the thing is valuable. The next resource . . . is the wilderness.'

Fish Farming — not to be confused with Salmon Ranching: *see also* Salmon Ranching.

Fishing Districts Most Acclimatisation Society and Conservancy District fishing licences state where and when the holder of the licence may fish, but not always clearly. The boundaries of such districts are complicated enough, anyway, without having to further complicate the issue by regulations so worded one would need to have a detailed geographical and cartographical knowledge of the area before daring to start fishing almost anywhere, for fear of contravening them.

New Zealand badly needs rules and regulations people can understand with clarity and ease. It should not be impossible. By way of example of needless complications, the Rotorua District almost completely surrounds the Taupo District. Most local anglers in this area are often unsure as to the validity of one or other of these licences in certain streams; even of which bank on certain rivers fishing is permissible where the stream itself forms the boundary between two districts. This itself is additionally complicated in that the Central North Island District is itself surrounded by no fewer than six separate acclimatisation society districts.

Fletcher, The Rev. H.J. Parson Fletcher of Mannering's early recollections of the Taupo trout fishing scene, although Mannering may not always have got his facts straight, and clearly less than fully appreciated a remarkable man who loomed large on the early days of Taupo trout fishing. Indeed in this and many similar ways one is left to wonder about Mannering's often surprising lack of discernment in what was going on around him, and the people he met.

Henry James Fletcher was born in Kent in England in 1868. He came to New Zealand with his parents when he was six years old. He went to school in Bulls and was apprenticed to a wheelwright by the time he was twelve. The wheelwright's business closed down, and Fletcher joined a Wanganui surveying team. During this period Fletcher served a harder apprenticeship living and surviving in the dense bush country then being opened up and surveyed for the first time.

But he wanted to be a church missionary and despite the lack of secondary education and opportunity he became an extra-mural theological student. After years of study he was ordained a

O.H.M.S.

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R J Behnke
Dept of Forestry & Wildlife Biology
Colorado State University
Fort Collins Colorado
USA 80523

2-20-89

Dear Dr. Behnke

I appreciate your letter and value your insight with respect to salmonid origins, classification and distribution.

Attached is the paper by Seeb & Wishard 88. This work hasn't been published anywhere & so far exists only as "on file" in Fisheries files. Dr. Leon Carl, who was the salmonid coordinator for the Province at the time this work was completed, has moved to Ontario and was at one time considering publication. It was to him that we had shipped an additional sample of fish for analysis - still no word! I'm sure there isn't a problem using the data - you undoubtedly could obtain a copy of the paper from Pacific Fisheries Research!

In any case, I hope that it is useful information. And any further comments you might have would be most useful.

Will look forward to seeing your monograph.

Sincerely

George Sterling.

George L. Sterling

A BIOCHEMICAL GENETIC ANALYSIS OF ATHABASCA RAINBOW FROM WAMPUS CREEK

Prepared for

Fish and Wildlife Division
Alberta Energy and Natural Resources

February, 1984

By

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and

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INTRODUCTION

Rainbow trout from the Athabasca River drainage in Alberta, Canada, are unique in that they represent one of the rare natural occurrences of Salmo gairdneri east of the Continental Divide (MacCrimmon, 1971). Behnke (1979) inferred that they most probably were derived from headwater transfers from the upper Fraser River basin. He categorized them at that time with other inland rainbow trout-like salmonids and labelled this group as redband trout, Salmo newberryi (see Wishard et al., 1984). The objective of this study was to perform a broad electrophoretic screening of Athabasca rainbow trout and identify their genetic relationship to other strains of rainbow trout.

MATERIALS AND METHODS

Specimens of rainbow trout (whole fish or organs and tissue) were collected by the Fish and Wildlife Division of Alberta Energy and Natural Resources. Samples were frozen upon collection and were stored at -20° C until analyzed. Prior to the electrophoretic analysis, each sample was thawed, and an entire eyeball, the heart, the liver, and a piece of muscle tissue were extracted. Extractions were placed in separate culture tubes to which an equal volume of water was added, homogenized to free soluable proteins from the cells, and then centrifuged.

Electrophoresis followed procedures outlined in Utter et al. (1974) and May et al. (1979). Three buffer systems were used: (1) MF--a tris-boric acid-EDTA gel and tray buffer (pH 8.5) (Markert and Faulhaber, 1965); (2) RW--a tris-citric acid gel buffer (pH 8.5), lithium hydroxide-boric acid tray buffer (pH 8.5) (Ridgway et al., 1970); and (3) AC--an amine citrate gel and tray buffer (pH 6.5) (Clayton and Tretiak, 1972). Staining for enzyme activity followed methods outlined in Harris and Hopkinson (1976) and Allendorf et al., (1977). A list of the protein stains used, their abbreviations and resolution, and the numbers of loci expressed are given in Table 1. A system of nomenclature outlined in Allendorf and Utter (1979) was used so that the collected data would be comparable to the previously published

data. For each electrophoretically detectable locus the mobility of the most common allele in rainbow trout was used as a standard and designated (100). The mobility of all other alleles was calculated relative to this common form. For example, an allele that migrated half as far as the common allele was designated (50). In the case of multiple forms of the same functional enzyme, a hyphenated number was attached to the protein abbreviation to designate the locus (e. g., LDH-2 was the second LDH locus).

After electrophoresis each fish was scored for its obersved genotype, and allelic frequencies at each locus were calculated. Fish of known genotypes from the Dworshak National Fish Hatchery, Idaho, were run on each gel as controls. Nei's (Nei, 1978) genetic distance (D) measure was calculated and used to quantify the degree of differentiation between populations. A matrix of (D) values between all pairs of populations was generated and used to construct a phenogram using the unweighted average linkage method (UALM) (Sneath and Sokal, 1973).

RESULTS AND DISCUSSION

The rainbow trout samples were screened for 59 presumptive genetic loci of which 51 were consistently resolved. (Table 1). A total of 127 individuals from Wampus Creek were analyzed. Some of the fish were very small (less than 40 mm) and as a result data from heart and liver loci were not always obtained. However, with the exception of ALD-2, data were always available from more than 100 fish (Table 2).

Table 2 also contains data from six representative Washington and Idaho coastal and inland Salmo gairdneri populations. The gene frequencies of the Idaho hatchery population are typical of most domesticated rainbow trout populations which originated from the McCloud River, California (MacCrimmon, 1971; Allendorf and Utter, 1979). The Wampus Creek fish are clearly unique overall resembling neither the inland strains nor the coastal and hatchery strains. They share a high frequency of the LDH-4(100) allele with the coastal and hatchery populations, however they lack the LDH-4(76) allele and show a 9% frequency of the LDH-4(120) allele instead. This 120 allele has only been rarely seen previously. At the AGP-1 and the SOD locus they share characteristics with inland populations. At two other loci--GL-1 and PMI--they have frequencies totally unlike any of the other populations. The overall uniqueness of the Wampus

Creek strain can be visualized by the phenogram (Figure 1).

Several other sets of pertinent rainbow trout data are available for comparison. Parkinson (1980) examined coastal and interior British Columbia steelhead populations and found parallel expression for LDH-4, SOD, MDH-3,4, and IDH-3,4 genotypes with coastal and interior U. S. populations. Milner (G. W. Milner, NMFS, Seattle, WA, personal communication) has recently examined 8 populations from the upper Columbia and Dworshak Hatchery for PGK and EST. He found a frequency of 53-66% for PGK and a frequency of 44-73% for EST. The Wampus Creek population is again unique from these populations at both loci. A comparison to redband trout originating from either California or Idaho also shows that the Wampus Creek population has significantly different frequencies (Wishard et al., 1984).

The origins of the Wampus Creek stock is certainly of interest considering its relationship to other native rainbow and steelhead trout populations. If they did indeed originate from the headwaters of the Fraser River, then a substantial amount of genetic drift probably has occurred. However, the population does not lack variation showing a heterozygosity value of approximately .05. This is well within the range observed for other native trout populations (Allendorf and Utter, 1979) and is somewhat contradictory to the idea of small population sizes, bottlenecks, and large amounts of genetic drift in the recent past. Whatever their origins, this population should be

recognized and managed as a unique strain of rainbow trout.

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Table 1. Designation of loci coding for the different enzymes and proteins stained for in Wampus Creek trout. Abbreviations and Enzyme Commission numbers are also given. A (+) indicates that the loci were adequately resolved, while a (-) indicates that the loci were not adequately resolved to use in the analysis.

Enzyme	Abbreviation	Locus designation (if multiple)	Resolution	Enzyme Commission Number
Aconitase	ACO		-	4.2.1.3
Adenosine deaminase	ADA		+	3.5.4.4
Alcohol dehydrogenase	ADH		+	1.1.1.1
Aldolase*	ALD	1-3	+	4.1.2.13
Asparatate amino-transferase	AAT	1,2 3	+ -	2.6.1.2
Creatine kinase	CK	1,2	+	2.7.3.2
Esterase	EST	1-3	+	3.1.1.1
Fumarase	FUM		+	4.2.1.2
B-Galactosaminidase	BGAM		-	
B-Glucoseaminidase	BLUM		-	
Glucose phosphate isomerase	GPI	1-3	+	5.3.1.9
Glutathione reductase	GR		+	1.6.4.2
Glyceradehyde phosphate dehydrogenase	GAP		+	1.2.1.12
Glycerol-3-phosphate	AGPD	1-3 4	+ -	1.1.1.8

* Aldolase 1 and 3 were well resolved and clearly monomorphic. Aldolase 2 was polymorphic, but only 44 individuals were scored.

Table 1. continue.

Enzyme	Abbreviation	Locus designation (if multiple)	Resolution	Enzyme Commission Number
Guanine deaminase	GDA		+	3.5.4.3
Hexokinase	HK		+	2.7.1.1
Isocitrate dehydrogenase	IDH	1-4	+	1.1.1.42
Lactate dehydrogenase	LDH	1-5	+	1.1.1.27
Malate dehydrogenase	MDH	1-4	+	1.1.1.37
Malic enzyme	ME	1-3	+	1.1.1.40
Mannose phosphate isomerase	PMI		+	5.3.1.8
Peptidase 1/	GL	1-2	+	3.4.11
Peptidase 2/	LGG		+	3.4.11
Peptidase 3/	PHAP		+	3.4.11
Peptidase 4/	LT		+	3.4.11
Phosphoglucomutase	PGM		+	2.7.5.1
Phosphogluconate dehydrogenase	6PG		+	1.1.1.43
Phosphoglycerate kinase	PGK		+	2.7.2.3
Pyruvate kinase	PK		+	2.7.1.40
Sorbitol dehydrogenase	SDH	1,2	_	1.1.1.14

1/ Resolved using glycyl leucine
2/ Resolved using leucylglycylglycine
3/ Resolved using phenylalanyl proline
4/ Resolved using leucyl tyrosine

Table 1. continue.

Enzyme	Abbreviation	Locus designation (if multiple)	Resolution	Enzyme Commission Number
Superoxide dismutase	SOD		+	1.15.1.1
Triosephosphate dehydrogenase	TPI	1-2	+	

Table 2. Sample size and allele frequencies for each polymorphic locus in rainbow trout. Sources of the data are from (a) this study, (b) Milner et al. (1980), (c) Allendorf (1975), (d) Wishard et al. (1984) and (e) Wishard and Seeb (1983). Dashes (---) indicate that the resolution was too poor to accurate score or that the data was not taken on a particular locus. The Idaho Hatchery population is representative of a coastal strain derived from the McCloud River, CA.

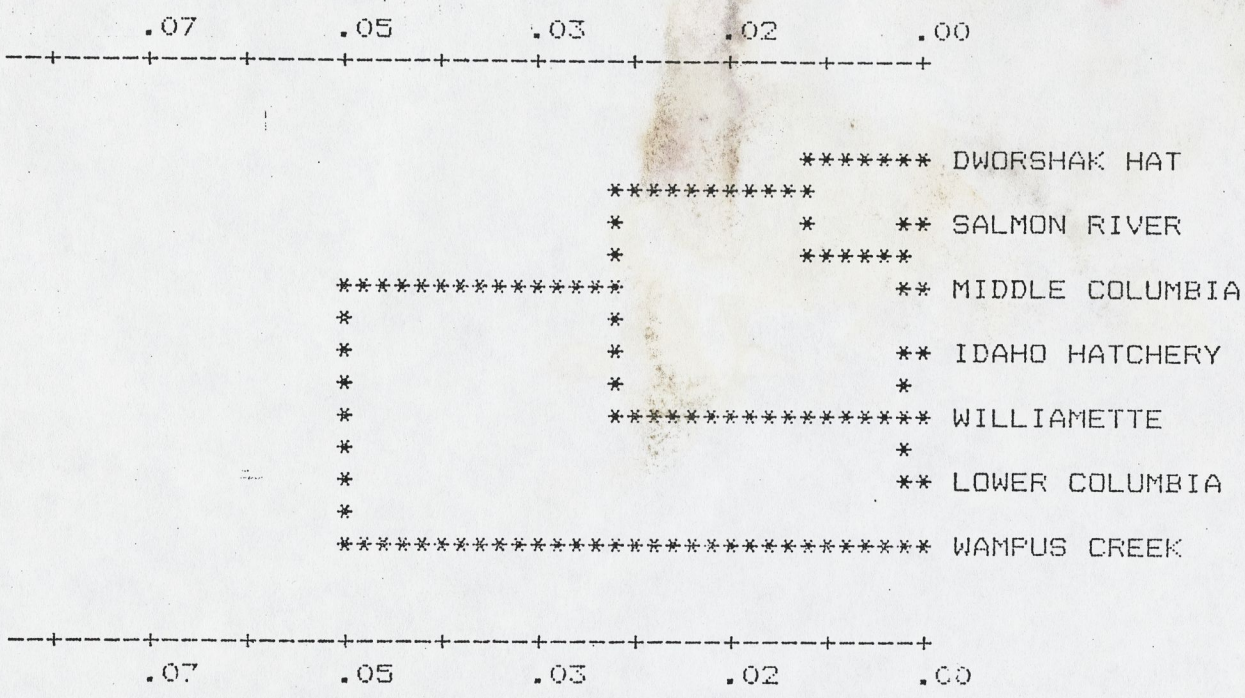
Location (Source)	N	LDH4			AGP1	AGP2	MDH3			
		100	76	120	100	100	100	81	120	76
(a) Wampus Creek	127	.91	.00	.09	1.00	1.00	1.00	.00	.00	.00
(b) Dworshak Hat.	482	.31	.69	.00	1.00	.97	.99	.01	.00	.00
(e) Salmon River	97	.24	.73	.03	1.00	1.00	.98	.00	.01	.01
(c) Mid. Columbia	388	.38	.62	.00	.97	1.00	.97	.01	.02	.00
(b) Low. Columbia	200	.80	.20	.00	.82	1.00	.87	.12	.01	.01
(b) Willamette	200	.90	.10	.00	.90	1.00	.78	.22	.00	.00
(d) Idaho Hat.	50	.99	.01	.00	.89	1.00	.90	.10	.00	.00

Table 2. Continue.

Location	N	GL-1				IDH-3,4				PGM	PMI
		100	111	94	116	100	38	67	171	100	100
Wampus Creek	127	.00	.76	.00	.24	.66	.15	.19	.00	1.00	.71
Dworshak Hat.	482	.47	.53	.00	.00	1.00	.00	.00	.00	.99	1.00
Salmon River	97	.95	.04	.01	.00	.67	.15	.18	.01	1.00	.98
Mid. Columbia	388	.91	.09	.00	.00	.62	.24	.14	.00	1.00	1.00
Low. Columbia	200	.95	.02	.04	.00	.67	.16	.16	.00	1.00	1.00
Willamette	200	.99	.01	.00	.00	.66	.18	.12	.02	1.00	1.00
Idaho Hat	50	---	---	---	---	---	---	---	---	.72	1.00

Location	N	SOD			GPI1	GPI3	PGK	EST	ME
		100	152	48	147	100	100	100	100
Wampus Creek	127	1.00	.00	.00	.00	1.00	.89	.98	.71
Dworshak Hat.	482	1.00	.00	.00	---	1.00	---	---	---
Salmon River	97	.96	.01	.03	.01	.99	---	---	---
Mid. Columbia	388	.96	.06	.02	---	.97	---	---	---
Low. Columbia	200	.78	.22	.00	---	.96	---	---	---
Willamette	200	.71	.29	.00	---	.98	---	---	---
Idaho Hat.	50	.67	.33	.00	.00	1.00	---	---	---

Figure 1. Phenogram depicting the relationships of selected rainbow trout populations.



GENETIC DISTANCE
(Nei, 1978)

– Berg

Seeb & Wishard 1984 unpub.

Wampus C.R., ATHabasca drainage

LDH 100 – 76 – 120 - only rarely observed previously
91% 0 9

AGP-1 = SOD characteristics of inland RB
100
1.00

GL-1 & PMI – frequencies totally unlike other P.p.

100	76	111	94	116
0	.76	0	.24	

.1–.53 other sp.

unique

100 ~78 .22?

other 98–100

PGK
100
.89

Sterling
Box 3008
Edson, Alta
CAN.
T0E 0P0

— Wampus Crk — Bill Berry
—cutt symp. report
— limits electroph. — definite sbs —
— inland gairdneri — most
prim. — LDH 100
— 76 — 'new' — in older
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Survival estimates of catchable hatchery[39] rainbow trout stocked in O'Dell Crk.[36] (Madison R. study)[8]

	Stocked May - July	Sampling Periods: Fall 1970	Spring 1971	Fall 1971	Spring 1972	Fall 1972
1970	4,000 (1255 lbs.)	430 (10.8%)	28 (0.72%)	0	0	0
1971	4500 (2498 lbs.)			284 (6.3%)	39 (0.63%)	0
1972	4500 (3789 lbs.)					104 (2.3%)

Angling exploitation aprx. 15%

Impact of catchable trout stocking[34] on total trout population (8 in. and larger)[44] in Varney section of Madison R.[31]

Comparisons of fall populations in stocked and unstocked years

	STOCKED 1967	STOCKED 1968	STOCKED 1969	UNSTOCKED 1970	UNSTOCKED 1971
wild brown trout	3022	5536	4374	5694	6765
wild rainbow trout[18]	138	405	191	926	1116
hatchery rainbow	329	209	604	0	19 ①
Total catchable size Trout available	3,489	6,150	5169	6620	7900 ②

① Catchable trout stocked .5 mi. below Varney section in 1971

② 60% more than 3 yr. average when section stocked with 8,000 - 10,000 catchable trout annually.

Stocking 10,000 trout adds 1500 trout to creek, but not loss of more than 2000 wild trout at cost of 5000

Table 6