Selected Fishes of Yellowstone to Yukon: Distribution and Status

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Introduction

At least 118 species of fish have been reported from the Yukon to Yellowstone (Y2Y) region. We have mapped the distribution and status of five of these to illustrate some of the issues involved in conserving fish and aquatic ecosystems in Y2Y. The five species exemplify an anadromous fish (chinook salmon), a widespread interior salmonid (bull trout), a Y2Y endemic subspecies (westslope cutthroat trout), a widespread northern salmonid with disjunct southern stocks (Arctic grayling), and an invasive introduced fish (brook trout).

Methods

To make mapping practical for such a large study area, we divided the Y2Y region into over 340 watershed units. With only minor modifications, we used the U.S. Environmental Protection Agency’s HUC4 units in the U.S., and the watershed groups defined by the B.C. Ministry of Environment, Lands and Parks (BCME LP) in British Columbia (FISS B.C. database). For the Yukon we combined the Canadian Department of Fisheries and Oceans’ watershed groups (FISS Yukon database), some of which are very small, into larger watershed units. Watershed units have not been predefined for Alberta, so we defined our own to be ecologically meaningful and roughly comparable in area to the smaller units in the other jurisdictions.

Fish distribution and status were assessed from an extensive analysis of the primary scientific literature, published and unpublished technical and historical documents, government agency file data, and online computer databases. Major sources were Prince et al. (1912), Carl et al. (1959), McPhail and Lindsey (1970, 1986), Brown (1971), Scott and Crossman (1973), Lee et al. (1980), Crossman and McAllister (1986), Lindsey and McPhail (1986), Behnke (1992), Nelson and Paetz (1992), McPhail and Carveth (1993), and online or disk-based databases of the Interior Columbia River Basin Ecosystem Management Project (ICBEMP), the Montana Rivers Information System (MRIS), Idaho Rivers Information System, the Canadian Department of Fisheries and Oceans’ Fisheries Information Summary System (FISSS) databases for the Yukon and British Columbia, and the Fish Stocking Query Page of BCME LP. We adopted the categories of the ICBEMP (and used the ICBEMP data, where available) for mapping status or state of knowledge of the U.S. stocks (e.g., Rieman et al. 1997:1115). Suitable data were seldom available to apply the ICBEMP criteria for the categories Strong and Depressed in Canada. When used in the Canadian range, these classifications represent our subjective assessment based on other available information.

This is a preliminary study. There remain many relevant data on Y2Y fishes that we have not included, and some datasets on which we relied are still under development.

The Fishes

Chinook salmon (Oncorhynchus tshawytscha)

Chinook salmon use every major Pacific river system in Y2Y from the Columbia to the Yukon, penetrating to the very headwaters in the Fraser, Skeena, Nass, Taku, and Yukon systems, and formerly in the Columbia system as well (Figure 1). They are blocked by the Grand Canyon of the Stikine and by Iskut Canyon from attaining the upper reaches in those rivers, and now the Grand Coulee Dam on the Columbia blocks them from reaching former spawning areas in Washington, Idaho, and at the source of that river in Canada. Numerous other Columbia and Snake River dams impede movements of adult chinook into, and juveniles out of, these rivers.

In addition to the many Columbia River stock extinctions, at least five Y2Y chinook stocks in Oregon, Washington and Idaho are presently at risk (Nehlsen et al. 1991), and many more are depressed (Figure 1). Apart from the Columbia River stocks, Y2Y chinook spawning runs in Canada appear to be stable or perhaps increasing, with numerous important exceptions (Healey 1982; Slaney et al. 1996; Baker et al. 1996). The exceptions are important because there are few data for many stocks: their status is simply unknown at this time. The actual number of stocks at risk thus is undoubtedly higher than reported. Based on these evaluations, one unidentified chinook stock on the North Coast (possibly not from a Y2Y river) was judged to

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1This article is based upon a larger study of 121 fishes. The technical report on that study now in preparation will be available from the Y2Y office or the authors, and should be consulted for further details on the fishes treated here.
be declining and at moderate risk of extinction (Baker et al. 1996). At least four B.C. Y2Y chinook stocks (one each in the Nass, South Thompson, North Thompson and Nechako watershed groups) have been identified as at risk (Slaney et al. 1996). Dams are cited as a major factor in most of these extinctions or threats of extinction, but many other factors, including overfishing and habitat damage from forestry, were also often noted.

**Bull trout (Salvelinus confluentus)**

The bull trout is native to most inland waters in Y2Y on both sides of the Continental Divide (Cavender 1978; Haas and McPhail 1991; Figure 2). This fish closely resembles the Dolly Varden trout, a mainly coastal species with which it has been lumped until quite recently, especially in B.C. In that province the range of the two species broadly overlaps, so that many records of Dolly Varden there may in fact refer to bull trout. We have mapped Dolly Varden records in areas of known overlap with bull trout for that reason.

Damage from overexploitation, habitat damage and blockage of migration routes by dams in whole or in part has driven many stocks into decline, and has extirpated some throughout the accessible portions of Y2Y (Nelson 1965; Allan 1980; Roberts 1987; Mayhood 1995; Fitch 1997; Rhude and Stelfox 1997). In some cases, hybridization with introduced brook trout can quickly drive bull trout stocks to extinction (Leary et al. 1993), or competition or predation from introduced char species may destroy lake-dwelling stocks (Donald and Alger 1993; Donald and Stelfox 1997).

Presently bull trout are listed variously as of Special Concern (vulnerable) throughout the native range in the U.S. and Canada (Williams et al. 1989), of special concern in Alberta (Berry 1994), under review (vulnerable) in Canada (Campbell 1997), and as warranted for listing (Category 1) under the U.S. Endangered Species Act in the coterminous United States (USDI Fish and Wildlife Service 1997). Because many bull trout stocks carry genes at a high frequency that are rare in, or absent from, other stocks, retaining the full genetic diversity of bull trout means conserving as many local populations throughout the range as possible (Leary et al. 1993). Bull trout will have to be restored and conserved by maintaining, restoring and reconnecting many high-quality habitats throughout the range of the species (Rieman and McIntyre 1993), much of which lies in Y2Y, and exploitation rates will have to be kept low (Berry 1994).

**Westslope cutthroat trout (Oncorhynchus clarki lewisi)**

The contiguous native range of westslope cutthroat trout lies entirely within the Y2Y region in the upper Missouri, upper Kootenai\(^2\); Flathead, Clark Fork, Bitterroot, Madison and Gallatin headwaters, Pend Oreille, Clearwater, Salmon, Bow and Oldman rivers (Behnke 1992; Van Eimeren 1996; Figure 3). The subspecies may also have been native in the Kicking Horse drainage above Wapta Falls (Columbia drainage), and in a few other Columbia headwater tributaries near Windermere and Columbia lakes (Prince et al. 1912; Mayhood 1995). In Y2Y, several small, disjunct populations are native to drainages in the South Thompson, Columbia mainstem (Revelstoke reservoir) and Kootenay Lake basins in south-central B.C., mostly above barrier falls (Dymond 1932; Behnke 1992). Outside Y2Y there are several more native disjunct populations in Oregon and Washington (Behnke 1992).

Most native populations of this subspecies are either extinct or are presently in grave danger of extirpation throughout the range (American Wildlands et al. 1997), primarily from habitat damage, hybridization with introduced blackspotted trouts, and competition with or predation by introduced exotic fishes.

In Montana, the fish now occupies only 19% of its native range (Van Eimeren 1996), and could be considered viable in just 10% of the native range. East of the Continental Divide, in the upper Missouri River Basin, westslope cutthroat still occur in less than 5% of the native range. Over 70% of 144 populations studied have a very high probability of extinction over 100 years (Shepard et al. 1997). Genetically pure populations in the upper Missouri Basin have been reduced to just 1% of the native range and some populations have recently gone extinct (USDA Forest Service/USDI Bureau of Land Management 1996). Similarly, west of the Continental Divide in Montana's Kootenai River Basin, pure populations have been reduced to 3% of their historical range (MRIS). Viable populations remain in 36% of the historical range in Idaho, but most of these are hybridized (American Wildlands et al. 1997; Rieman and Apperson 1989; Johnson 1992; Van Eimeren 1996). In Idaho, pure populations that survive in strongly protected habitat occupy approximately 4% of their historic range (Rieman and Apperson 1989; Van Eimeren 1996). In Wyoming six remnant introgressed populations of westslope cutthroat remain in the 12 to 15 streams that once held native stocks (Van Eimeren 1996).

In Alberta, westslope cutthroat occupy considerably less than 5% of the native range in the Bow drainage, being restricted to the extreme headwaters of a few of the major tributaries and the upper mainstem (Mayhood 1995). In the Oldman River drainage, westslope cutthroats still occur

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\(^2\)Kootenai in Montana and Idaho. Most of the mainstem lies in B.C., so the B.C. spelling is used when we refer to the entire river; otherwise the spelling appropriate to the region of reference is used.
cupy most of the native range in the upper Oldman basin, but have been lost from native waters in the lower mainstem and most of its fish-accessible tributaries (Radford 1977; Fitch 1978; Mayhood et al. 1997). All stream populations in the Bow and Oldman systems that have been examined for it, except one, (out of several dozen) show evidence of introgressive hybridization (D. Mayhood, unpublished data).

In British Columbia, most of the presumptive native range in the Kicking Horse drainage above Wapta Falls now lacks cutthroats (Pole 1990; Mayhood 1995). Cutthroats (mainly hybrids) still occupy all native range within the Kootenay drainage of Kootenay National Park (Alger and Donald 1984; Mayhood 1995), and within the White River watershed. Nevertheless, several genetically pure westslope cutthroat trout populations continue to exist in native range in the upper Kootenay drainage in B.C. (Leary et al. 1987). The status of most other B.C. stocks remains undocumented, including that of most disjunct populations.

Westslope cutthroats have been widely transplanted outside the native range within Y2Y, including the Murray and Narraway watersheds (Peace drainage) (Nelson and Paetz 1992; FISS database), some Athabasca drainage lakes and headwater streams3 (Ward 1974; Nelson and Paetz 1992; Barton et al. 1993), and the North Saskatchewan and Red Deer drainages (Nelson and Paetz 1992). Both pure stocks and those of uncertain origin have been introduced, sometimes with other species, into formerly fishless habitat above barrier falls in several streams in the Oldman, Bow, Kootenay and Columbia systems in Alberta and B.C. The state of Washington has stocked westslope cutthroats extensively in lakes of the Cascades (Behnke 1992). Although transplanted stocks are widespread, most individual populations appear to be small and localized.

The westslope cutthroat trout is designated as a species of special concern in Montana and Idaho (Johnson 1987), but there is no formal recognition of its precarious status in B.C. or Alberta. The Canadian Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has given the subspecies no consideration as yet, and has no plans to do so (Campbell 1997). There are no provisions under Canadian federal law to protect most endangered species in any case. The U.S. Fish and Wildlife Service listed the subspecies prior to 1973 in its “Red Book” as threatened or endangered species, but dropped the listing after the Endangered Species Act came into force. American Wildlands et al. (1997) have petitioned the USFWS under the Act to list westslope cutthroat trout as threatened throughout its range, and to designate critical habitat for the subspecies, citing habitat loss and degradation (from logging, grazing, agriculture and damming), overfishing, competition with introduced fish, and genetic introgression (hybridization) with introduced species as causes of decline and as reasons for expecting decline to continue.

Arctic grayling (Thymallus arcticus)

This species is indigenous to all of mainland Alaska and Canada south from the Arctic coast to northern British Columbia, Alberta, Saskatchewan and Manitoba eastward to the western shore of Hudson Bay (Scott and Crossman 1973). Disjunct populations were native to parts of Michigan and the upper Missouri drainage of Montana. In Y2Y the species is widespread in the Yukon, Liard, Peace, Athabasca, Taku, and Stikine systems (Scott and Crossman 1973; Lee et al. 1980; Nelson and Paetz 1992; McPhail and Carveth 1993; Figure 4), and still exists in remnant populations in Montana (Liknes and Gould 1987).

Grayling are easily caught, making them highly susceptible to overexploitation wherever they are readily accessible (Falk and Gilman 1974, and references therein; Tripp and Tsui 1980; Michiel 1989:149-151). They are widely believed to be especially sensitive to pollution, although the evidence for this view is rather unsatisfying. There is some evidence that native grayling populations have suffered from competition with, or predation from, introduced salmonids (Erikson 1975; Feldmuth and Erikson 1978).

Whatever the cause, Arctic grayling populations are depleted in parts of Y2Y that are most accessible and developed, including Montana and much of the southern part of their range in Alberta. For example, the Big Hole River drainage holds the single remaining native fluvial stock in Montana (Kaya 1991, where it is now classified as Category 1 (warranted but precluded for listing) under the Endangered Species Act (C. Kaya4, pers. comm. 1997). Arctic grayling were indigenous to virtually all of Alberta’s Fisheries Management Area 4 (east and north of Jasper National Park), yet 28 of 42 streams recently surveyed in FMA 4 held no grayling at all, and the species was rated as common or abundant in just six others (Hunt et al. 1997). The Embarras River, which flows among the Coal Branch mining towns of Alberta’s road-laced foothills, produced the provincial record Arctic grayling in 1966 (1.3 kg). But “now it is difficult to catch even one grayling in this river” (Alberta Fisheries Management Division 1997). Grayling populations are said to be depleted in all the streams along the Alaska Highway (B.C. and Yukon), and one must hike several miles away to find any (Michiel 1989:150).

Overall, Arctic grayling appear to have been extirpated from at least eight watershed units in Y2Y, of the 95 to which it is believed indigenous. Of those watershed units remain-

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3 Some of these may have been Yellowstone cutthroat stocks, rather than westslope.

4 Montana State University, Bozeman, Montana.
ing, nine have depressed stocks, the populations of two are believed to be strong, and the status of grayling in the great majority is unknown.

**Brook trout (Salvelinus fontinalis)**

Brook trout are native to northeastern North America from northern Labrador, Quebec and the southwestern drainages of Hudson Bay, southward to Minnesota, through the upper Mississippi and Great Lakes drainages to the Appalachians as far south as Georgia (Scott and Crossman 1973). They have been introduced widely throughout the west, including Y2Y (Figure 5). Introductions in our study area began in the 1880s in Montana (Brown 1971), Idaho (Simpson and Wallace 1982), Alberta and B.C. (Mayhood 1992), and have persisted to the present day. Brook trout are now found in every major Y2Y basin south of and including the Stikine (one population) and Peace. They are widespread and often abundant in the headwater lakes and streams of the Columbia, Kootenay, Athabasca, Saskatchewan, and Missouri systems.

Brook trout replace native fishes such as cutthroat trout and bull trout in their native streams. Cutthroats often can be found only in steep gradient reaches, typically headwaters, in streams where both species exist (Griffith 1988). Bull trout in a stream can be driven to extinction by hybridizing with introduced brook trout (Leary et al. 1993). There is some evidence suggesting that brook trout may competitively replace Arctic grayling in lower-elevation streams (Feldmeth and Eriksen 1978), or eliminate them through predation on their fry (Eriksen 1975). Brook trout thus are potentially a serious threat to the continued survival of native fish stocks in Y2Y.

**Discussion**

The most widespread native fishes—chinook salmon, bull trout and Arctic grayling—have all sustained significant stock losses and population declines in the accessible southern parts of their ranges in Y2Y, but appear to be reasonably secure in the less developed, less accessible northern parts of the study area. Native westslope cutthroat trout are in a much more precarious state. Confined as a native fish to the southern part of Y2Y, this endemic subspecies has suffered serious declines and extirpations throughout its original range, and has few secure indigenous populations anywhere. In contrast, non-native brook trout introduced throughout the southern half of Y2Y have flourished, now being much more widespread and often more abundant than the native westslope cutthroat, replacing that species in many instances. Many reasons for the decline of native fish stocks in Y2Y have been advanced, including overfishing; habitat damage; habitat alienation and fragmentation; and competition or hybridization with, or predation from, introduced species. These factors are not independent, and several usually are present simultaneously, implying that in many cases several conservation problems must be addressed at once. Or on a more positive note, several problems may be solved at once by judicious selection of conservation technique. For example, decommissioning roads into the watershed of a depressed fish stock could simultaneously (1) reduce exploitation rates; (2) reduce erosion and siltation, major causes of habitat damage; (3) remove roadbeds and culverts that often block access to critical habitat and isolate stocks; and (4) render introduction of exotics less likely.

The motivating idea of Y2Y is the concept of connectedness; the major problem to be solved that of re-connecting the fragments isolated by human activity. At least in the case of the fishes discussed here, reconnection implies radical action. To give just one example, the greatest chinook salmon losses in Y2Y are attributable to habitat fragmentation and alienation caused by the Columbia basin dams. Restoring chinook salmon in Y2Y means reconnecting the fish to their fragmented and alienated habitats. Inevitably this will require decommissioning dams, since many years of attempting less fundamental solutions have not worked, as evidenced by the continuing declines in many stocks. The challenge to Y2Y is not to abandon a sound concept because it requires radical action to achieve, but to find realistic ways of making such fundamental changes in the way humans use the land and water.

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1 Far-reaching; thorough; going to the root (radical change) (Concise Oxford Dictionary, 8th edition).

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A SENSE OF PLACE

80
Yellowstone to Yukon Chinook Salmon

LEGEND

Status of Chinook Salmon:
- Depressed
- Extirpated
- Within native range, but data not available
- Present, but status unknown
- Migration corridor
- Outside of native range
- Outside of study area

Legend:
- Red
- Orange
- Purple
- Blue

Scale:
- 50 100 150 200 Miles
- 75 150 225 300 Kilometers

Ecology Center

Y2Y
Yellowstone to Yukon Conservation Initiative
Yellowstone to Yukon Brook Trout

Yellowstone to Yukon Conservation Initiative

Status of Brook Trout
- Introduced
- Not present
- Outside of study area

Data compiled by David Mayhood and Richard Walker
Base map by the Ecology Center
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