

threatened by overutilization for commercial, recreational, scientific, or educational purposes.

(C) Disease or Predation

Threats from Disease—As part of both the initial and new status reviews, we considered the threat that diseases may pose to WCT. Perhaps the most important of the contemporary diseases is whirling disease, which is caused by an exotic myxozoan parasite. That microscopic parasite was introduced to the eastern United States from Europe in the 1950s and has since been found in many western States. Two separate host organisms are necessary for completion of the parasite's life cycle, a salmonid (*i.e.*, salmon, trout, and their close relatives) fish and a specific aquatic oligochaete worm. Within the range of WCT, whirling disease was first found in Idaho in 1987 and in Montana in 1994 (Bartholomew and Reno 2002).

The WCT status update report (Shepard *et al.* 2003) concluded that the threats to extant WCT populations from diseases in general were greater for the extensive WCT metapopulations than for the smaller WCT populations that occur as isolets. The key assumption made in reaching that conclusion was that, because the ranges of individual metapopulations were naturally much larger and encompassed habitats more diverse than those of isolets, the probability that diseases may be introduced and become established in WCT populations was greater for metapopulations than isolets. As noted previously, we examined the database of Shepard *et al.* (2003) to assess the disease risk to two groups of extant WCT: (1) Nonintrogressed or suspected nonintrogressed populations and (2) introgressed or suspected introgressed fish classified as "conservation" populations. Results indicated that only about 10 percent of the 1,944 stream miles occupied by nonintrogressed and suspected nonintrogressed WCT populations occurring in isolets were at moderately high or high risk of disease, whereas 69 percent of the 9,999 stream miles occupied by nonintrogressed WCT in the considerably more-extensive metapopulations were considered to be at similar risk. Similarly, introgressed or suspected introgressed WCT "conservation" populations occurring as isolets were at moderately high or high risk of disease in about 20 percent of their 751 occupied stream miles, whereas introgressed WCT in metapopulations were considered at similar risk in 88 percent of their 11,775 occupied stream miles.

However, we believe that the procedures used by Shepard *et al.*

(2003) to assemble their database inevitably led to inflated estimates of the proportions of stream miles in which the WCT are at moderately high or high risk of disease. Moreover, as we will describe, the available scientific information indicates whirling disease is not a substantial threat to the majority of populations constituting the WCT subspecies. Although the whirling disease parasite continues to spread in many waters of the western United States (Bartholomew and Reno 2002), few outbreaks of whirling disease in resident fishes (mainly rainbow trout) have occurred. Studies summarized by Downing *et al.* (2002) indicated that presence of the whirling disease parasite does not portend outbreaks of the disease in resident fishes. For example, although 46 of 230 sites tested in Montana were positive for the parasite, disease outbreaks were known to have occurred at only 6 of those sites. Downing *et al.* (2002) provided evidence that the frequent absence of manifest whirling disease in resident trout, despite presence of the parasite, is due to complex interactions among the timing and spatial locations of important host-fish life-history events (*e.g.*, spawning, fry emergence from stream gravels, and early-life growth) and spatial and temporal variation in the occurrence of the parasite itself. Only under specific conditions, which evidently occur only in a small proportion of the locations where the parasite has been found, are those interactions such that disease outbreaks occur in resident fishes. The available scientific information specific to whirling disease thus indicates considerable variation in the probable disease threat among individual WCT populations and provides evidence that the disease is not a significant threat to the majority of populations constituting the WCT subspecies. The database procedures used by Shepard *et al.* (2003) necessarily resulted in entire WCT metapopulations being treated at the same level of risk from disease, even though that risk applied only to specific populations within those metapopulations. Thus, we conclude that the percent of stream miles in which Shepard *et al.* (2003) reported that WCT are at moderately high or high risk of disease is inflated to an extent that cannot be quantified with the available data.

A broad suite of variables has been shown to influence the incidence and intensity of infections of salmonid fishes by the whirling disease parasite, including host-fish species and age, parasite dose, and water temperature

(Kerans and Zale 2002; MacConnell and Vincent 2002). Among the salmonid fishes that have been examined under controlled conditions, rainbow trout has been found to be the most susceptible to whirling disease (Bartholomew and Wilson 2002). Studies conducted on various salmonids by Vincent (2002) revealed that WCT were moderately susceptible to whirling disease and had the lowest susceptibility of the three cutthroat trout subspecies examined. We are unaware of any studies of the susceptibility of the hybrids of rainbow trout and WCT to whirling disease.

In addition, although the parasite's essential oligochaete host, *Tubifex tubifex*, can be found in a wide variety of habitats and is considered ubiquitous across the diversity of freshwater habitats used by trout, *T. tubifex* has a much higher probability of occurring at locations with abundant fine sediments in eutrophic (*i.e.*, nutrient-rich) lakes and streams (Granath and Gilbert 2002). The mountain streams that WCT often inhabit are cold and have low biological productivity, factors that make those streams much less suited to both the whirling disease parasite and *T. tubifex* (Bartholomew and Wilson 2002).

Extensive research is being conducted to determine the distribution of whirling disease, the susceptibility of WCT and other fishes to whirling disease, infection rates, and possible control measures (Bartholomew and Wilson 2002). Although no means have been found to eliminate the whirling disease parasite from streams and lakes, the States have established statutes, policies, and protocols that prevent the human-caused spread of extant pathogens and the introduction of new pathogens (*e.g.*, Hagener 2002). Except for whirling disease, the fish pathogens that occur in the natural habitats of WCT are mainly benign in wild populations and cause death only when the fish are stressed by severe environmental conditions.

On the basis of the best scientific and commercial information available to us, we conclude that the WCT subspecies is not threatened by whirling disease, although some specific populations may be at higher risk.

Threats From Predation—The instances when predation by other fishes may negatively affect extant WCT populations are few and limited to a few large rivers, lakes and reservoirs (U.S. Fish and Wildlife Service 1999; Hagener 2002). However, as reported in the initial status review, predacious, nonnative fishes in Idaho's Coeur d'Alene Lake, Montana's Flathead Lake, and other lakes have negatively affected resident WCT. In those instances,