

streams. The study design involved mechanical removal of brook trout in certain stream reaches; the marking of brook trout in neighboring reaches; and the subsequent assessment of movement of marked brook trout into the stream reaches that had been mechanically depopulated. Because they were already inhabited by brook trout, the four streams examined by Adams *et al.* (2000) may have been among streams especially conducive to colonization by brook trout. Thus, it is not possible to extrapolate the results of Adams *et al.* (2000) to the broad array of headwater streams in which WCT presently occur but brook trout do not, even though brook trout occur in the downstream portions of those drainages.

More recently, Adams *et al.* (2002) assessed historic changes in the upstream limits of distribution of brook trout in 17 streams accessible by the fish in the upper South Fork Salmon River drainage in central Idaho. Brook trout already inhabited portions of 10 of the streams in 1971–1985. In 1996, their upstream-distribution limit remained unchanged in 8 streams that historically contained brook trout and 5 of 6 streams that did not (*i.e.*, one stream was invaded by brook trout). In the remaining 4 streams, the distribution of brook trout had moved upstream 1.9 to 3.1 km (1.2 to 1.9 mi). There was no detectable increase in the upstream distribution of brook trout in 10 streams that had no obvious physical barriers to such movement. The authors concluded that upstream colonization by brook trout is not continuously progressing throughout much of the drainage, and that the absence of brook trout in streams with no apparent barriers to the upstream movement of fish indicated that other factors were limiting the upstream expansion of brook trout. Consequently, the best scientific and commercial information available to us indicates that the WCT subspecies is not threatened by competition from introduced brook trout, although some populations may be at higher risk.

Risks Associated With Catastrophic, Natural Events—Our initial status review found that the geographic isolation of some extant WCT populations had not resulted in stochastic extirpations of such populations (due, for example, to floods, landslides, or wildfires) to a degree that threatened the WCT subspecies (U.S. Fish and Wildlife Service 1999).

Information provided in the WCT status update report (Shepard *et al.* 2003) ranked each of four measures of population viability that could make WCT vulnerable to catastrophic, natural events or adverse human effects on the

aquatic environment: (1) Population productivity, (2) temporal variability, (3) isolation, and (4) population size. That analysis suggested that about 76 percent of the stream miles occupied by WCT conservation populations considered isolets were at high risk from catastrophic events because WCT would not be available to naturally recolonize those habitats. In contrast, only a small (~2 percent) proportion of the stream miles occupied by WCT conservation populations considered metapopulations were at moderately high or high risk from catastrophic or human events with respect to the four measures of population viability. However, on the basis of empirical information, Rieman and Dunham (2000) reported that none of the small WCT populations they studied in the Coeur d'Alene River drainage were extirpated by a large winter flood that was considered a once-in-100-years event and affected more than 50 watersheds. Similarly, despite large wildfires in 1996 and 2002 in Oregon's Indian Creek and Roberts Creek drainages, respectively, WCT populations in those streams have exhibited no immediate negative effects of the fires (Unterwagner 2002). The widespread geographic distribution of WCT across the subspecies' range further mitigates potential negative effects resulting from local population extinctions following future catastrophic natural events, as no single event is likely to impact a significant percent of the overall number of isolated populations. Moreover, given the widespread efforts for the conservation of these fish (*see* "Evaluation of Ongoing Conservation Efforts," below), any such local extirpation is likely to be followed by reintroduction efforts if WCT were not available naturally to recolonize those habitats.

Kruse *et al.* (2001) assessed the possible demographic and genetic consequences of purposely isolating the populations of another cutthroat trout, the YCT, in headwater streams in the Absaroka Mountains, Wyoming. Such isolation may actually result, for example, from intentional placement of a movement barrier to prevent nonnative fishes downstream from invading upstream reaches. Kruse *et al.* (2001) made estimates of population size for YCT in each of 23 streams, then compared those estimates to minimum criteria that the authors considered necessary to prevent population extirpation. Kruse *et al.* (2001) acknowledged that their minimum-viability criteria had not been confirmed for YCT and that there was debate

among researchers regarding the applicability of those criteria. Despite those limitations, 21 of 23 YCT populations met 2 of the 3 criteria, and the third criterion (*i.e.*, a population size of at least 500 fish) was met by 7 of the 23 populations. Nevertheless, the authors speculated that isolated YCT populations are vulnerable to chance extinctions, although they also pointed out that "there has been little opportunity to observe the real effects of small population size and isolation on native, extant Yellowstone cutthroat trout populations." We believe those limitations of knowledge also apply to WCT in isolated headwater streams across the subspecies' range. Consequently, the best scientific and commercial information available to us indicates that the WCT subspecies is not threatened at the present time by risks associated with catastrophic, natural events.

Threats to Any of the Three Westslope Cutthroat Trout Life-History Forms—The three WCT life-history forms occur in numerous areas across the subspecies' range. In our initial status review, we found that WCT naturally occur in 6 lakes in Idaho and Washington that total about 72,843 ha (180,000 ac) and in at least 20 lakes that total 2,164 ha (5,347 ac) in Glacier National Park, Montana (U.S. Fish and Wildlife Service 1999). All of those WCT in lakes are adfluvial (*i.e.*, migratory) populations and many of them receive the high level of protection afforded by Glacier National Park. However, outside the park, protections accorded WCT in most lakes are less rigorous (U.S. Fish and Wildlife Service 1999). Today, WCT with the adfluvial life history probably constitute the smallest proportion of the WCT subspecies, and probably did so historically.

We also found (U.S. Fish and Wildlife Service 1999) that resident (*i.e.*, showing little movement) and fluvial (*i.e.*, migratory) WCT populations, which live entirely in streams, constitute the most common WCT life-history forms and occur in about 4,275 tributaries or stream reaches that collectively encompass more than 37,015 km (23,000 linear mi) of stream habitat. Those WCT populations are distributed among 12 major drainages and 62 component watersheds in the Columbia, Missouri, and Saskatchewan River basins, within the international boundaries of the United States. As described in the preceding section Occurrence of Westslope Cutthroat Trout Life-history Forms, the information recently provided to us (Shepard *et al.* 2003) indicates even