Appendix C - Overview of Reintroduction Strategies: Artificial Propagation, Captive Rearing, and Transplantation

Conservation efforts for imperiled fishes in the western United States have included numerous reintroductions (and introductions) utilizing a number of different strategies. The goal has generally been to increase population size and dispersion while maintaining genetic diversity, thus increasing probability of survival (Minckley 1995). Many of these efforts were called for in federal recovery plans as shown in a review by Williams et al. (1988) that indicated a majority (32 of 39) of recovery plans for threatened and endangered fishes in the United States called for one or more forms of introductions.

A decision to move forward with a reintroduction will require the development of an implementation plan, consistent with, and building from, this feasibility assessment. An implementation plan would provide a greater level of detail on the strategy and logistics of implementing the reintroduction than the level of analysis and investigation in this feasibility assessment. However, the CRBTWG believes it is appropriate to provide a brief summary of potential reintroduction strategies herein, as well as a brief review of known information on the propagation of bull trout and bull trout reintroductions that have occurred in Oregon.

The three strategies that would be considered as a precursor to developing a reintroduction proposal include:

1. **Artificial Propagation**, in which wild donor stock are moved into a hatchery environment for development of a captive broodstock program with resulting progeny released into the wild.

2. **Captive Rearing**, in which fertilized eggs, fry or juveniles are taken into a hatchery environment for short-term holding before translocation into the wild.

3. **Transplantation**, in which wild fish (fertilized eggs, fry, juveniles, sub-adults or adults) are taken from the wild and transported directly into the receiving habitat.

A reintroduction program may conceivably utilize more than one strategy, and any strategy that involves the transfer of fish from one basin to another would need to meet applicable State, Federal, and Tribal fish handling and disease policies. Also, inherent with any of the strategies outlined above is the need to address: 1) risk to the donor population; 2) life stage to introduce; 3) number to introduce to fully reflect the genetic composition and survival capabilities of donor stock; and 4) how long to conduct the transfer (i.e., over how many years or generations).

Artificial Propagation

Section 3(3) of the ESA lists artificial propagation as a method that may be used for the conservation of listed species. Hatcheries have been used in recovery efforts of other listed fish species (Rinne et al. 1986). The draft bull trout recovery plan (USFWS 2002) recognized that certain recovery units may require the use of artificial propagation techniques in order to meet recovery criteria. Artificial propagation could involve the use of Federal, State, or Tribal hatcheries to assist in recovery efforts (Buchanan et al. 1997; USFWS 1998a).

Any artificial propagation program instituted for bull trout would need to follow the joint policy of the USFWS and NMFS regarding controlled propagation of listed species (65 FR 56916). Defined in the context of the policy, controlled propagation refers to the production of individuals, generally within a managed environment, for the purpose of supplementing or augmenting a wild population(s), or reintroduction into the wild to establish new populations.

The overall guidance of this policy is that every effort should be made to recover a species in the wild before implementing an artificial propagation program. Because recovery for bull trout entails the identification and correction of threats affecting bull trout, artificial propagation programs should not be implemented until the reasons for decline have been addressed. The reasons for decline of bull trout in the Clackamas River Subbasin and the cessation of those threats are addressed in Chapter 1 of this assessment. The intent of the policy is to provide guidance and establish consistency for use of controlled propagation as a component of a listed species recovery strategy. The policy will help to ensure smooth transitions between various phases of conservation efforts such as propagation, reintroduction and monitoring, and foster efficient use of available funds. The policy's list of appropriate uses of artificial propagation includes supporting recovery related research, maintaining refugia populations, providing plants or animals for reintroduction or augmentation of existing populations, and conserving species or populations at risk of imminent extinction or extirpation.

The Montana Bull Trout Scientific Group (MBTSG 1996g) evaluated seven strategies for the potential use of artificial propagation in the recovery of bull trout. The report evaluated the use of hatcheries in establishing genetic reserves, restoration stocking, research activities, supplementation programs, introductions to expand distribution, and the establishment of "put, grow, and take" fisheries. The report concluded that the potential use of hatcheries in bull trout recovery should be limited to the establishment of genetic reserves for declining populations, restoration stocking (reestablishment of a self-sustaining bull trout populations in habitat where they have been extirpated), and some research activities including the evaluation of hybridization. The report concluded the use of hatcheries for bull trout supplementation programs, "put, grow, and take" stocking, and introductions outside historic range are not appropriate.

History of Bull Trout Propagation

Bull trout are probably the most geographically widespread char native to North America that has not been extensively cultured in hatcheries (MBTSG 1996). As a result, little information exists on bull trout propagation, especially in regards to stocking individuals in the wild. The most extensive information available originates from propagation efforts beginning in 1993 by Creston National Fish Hatchery in Montana. In addition to successfully propagating bull trout, experiments were undertaken to evaluate the effects of water temperature, diet, structure, cover, and rearing density on growth and behavior and to evaluate time of imprinting by juvenile bull trout via thyroid hormone analysis (Fredenberg et al. 1995). Due to various concerns, no progeny from these experiments have been stocked into the wild.

Other experiments in bull trout cultivation occurred by Montana Fish, Wildlife and Parks in the 1940s and 1950s within the Clark Fork and Kootenai River drainages. One effort in 1949 and 1950 involved the collection of 876,000 eggs from bull trout in the Clark Fork River drainage. Subsequently, during 1950 to 1952, about 10,000 of these fish were planted into Lake Pend Oreille and about 65,000 into Flathead Lake (Pratt and Huston 1993).

More recently, several experiments in bull trout cultivation occurred in Idaho and Canada. From 1989 to1991, Idaho Fish and Game conducted a small experimental hatchery program at Cabinet Gorge Hatchery to investigate techniques for egg taking, egg incubation and hatchery rearing (Pratt and Huston 1993). Canada's Kootenay Trout Hatchery in British Columbia conducted experimental work with bull trout in the early 1980s and that work continued at Hill Creek Hatchery in the headwaters of the Columbia River drainage as part of a mitigation program for loss of bull trout spawning habitat due to dam construction. Wild bull trout adults are captured annually, spawned, and then returned to the wild. Resulting juveniles are planted in tributaries as four-inch fingerlings in the fall. Post stocking evaluation of the program has been inadequate to assess its outcome, however, the program is continuing (MBTSG 1996).

History of Bull Trout Reintroductions in Oregon

In Oregon, several attempts have been made to propagate or translocate bull trout. In 1989, over 60 resident adult bull trout from the Sprague River in the Upper Klamath Basin were captured and spawned in the Klamath Hatchery for a reintroduction effort in the McCloud River, California. Pre-spawning mortality, combined with egg and juvenile mortality, ultimately resulted in only 270 juvenile bull trout available for stocking into the wild during the spring of 1990. After five years of monitoring in the McCloud River, the reintroduction was determined a failure and terminated (Buchanan et al. 1997). A contributing factor to this unsuccessful effort may have been the resurgence of brook trout overlapping in distribution with the introduced bull trout even though a previous rotenone treatment program was attempted to eradicate brook trout.

In Northeast Oregon, bull trout were thought to be extirpated from the watershed above Wallowa Lake by the 1950s (Buchanan et al. 1997). A reintroduction program using translocated bull trout and/or Dolly Varden from Alaska began in 1968 and ran through 1978 before being terminated. The program was determined to be unsuccessful after no bull trout or Dolly Varden were detected in creel surveys at Wallowa Lake from 1980 to 1996 (Buchanan et al. 1997). In 1997, 600 bull trout (age-1 to 15 inches) were taken from Big Sheep Creek (tributary of the Imnaha River) during a canal salvage, and translocated to Wallowa Lake. No funds were available to monitor this effort and the status of the translocated fish is generally unknown (Brad Smith, Oregon Department of Fish and Wildlife, personal communication, August 2006). Though no official creel surveys have been conducted in recent years, sporadic catches of bull trout are reported, and individual bull trout have been occasionally observed in the Wallowa River above Wallowa Lake. Limiting factors in this reintroduction may include limited spawning habitat, redd superimposition by kokanee, and the presence of lake trout, a known predator and competitor with bull trout (Brad Smith, Oregon Department of Fish and Wildlife, personal communication, August 2006).

In the Middle Fork Willamette River, a transplantation program has been implemented since 1997, as discussed earlier in this assessment. Bull trout were thought to be extirpated or in extremely low abundance at the time the program was initiated. Since 1998, over 10,000 fry have been captured from Anderson Creek in the McKenzie River (also a Willamette River tributary) and transported directly to multiple release sites in the Middle Fork Willamette River above Hills Creek Reservoir. Over time, annual monitoring has provided evidence of survival, and in 2005 spawning was documented for the first time from 11 adults. Successful recruitment was subsequently documented during the summer of 2006. Ultimately the success of this project will hinge on the ability of this population to rebound to a self-sustaining level.

Despite information and knowledge gained from the projects described above, there is still an obvious need to determine the effectiveness and feasibility of using artificial propagation for bull trout recovery. To that end, the draft bull trout recovery plan recommended a study be initiated to determine the effectiveness and feasibility of using artificial propagation in bull trout recovery (USFWS 2002). Specific goals and objectives for the use of hatcheries in the recovery and conservation of bull trout should be identified. Information gained from such a study would help guide proposed artificial propagation programs identified in individual recovery units.

The following briefly summarizes general advantages and disadvantages of the three reintroduction strategies when weighed against each other:

Artificial Propagation:

Advantages: 1) ability to potentially stock a large number of individuals thereby increasing the probability of a successful reintroduction; and 2) reduced risk to the donor population due to a reduced number of individuals needing to be removed.

Disadvantages: 1) high cost relative to other reintroduction strategies; 2) potential loss of genetic variability and ecological diversity; and 3) possible increase in the frequency of deleterious recessive alleles.

Captive Rearing:

Advantages: 1) better survival of wild eggs, fry and juveniles in a hatchery environment as compared to in the wild may result in greater numbers available for a reintroduction, and may reduce the number of individuals removed from the donor stock; 2) older age and larger size of captive reared individuals would result in better survival rates when stocked into the wild, relative to individuals translocated directly to the receiving habitat from the wild; 3) captive rearing may allow individuals to attain a size prior to release that would allow for implantation of PIT tags, greatly facilitating future monitoring of survival, growth, movement, distribution and other parameters; 4) captive rearing prior to release into the wild may facilitate disease testing.

Disadvantages: 1) moderate cost relative to other reintroduction strategies (i.e., lower cost relative to artificial propagation, but higher cost than direct transplantation); 2) higher potential for disease transmission relative to direct transplantation; 3) potential catastrophic loss of valuable wild individuals from hatchery malfunction (e.g., temperature, dissolved oxygen, disease); and 4) possible increase in the frequency of deleterious recessive alleles.

Transplantation:

Advantages: 1) lowest relative cost when compared to other reintroduction strategies; 2) assuming appropriate numbers of individuals transferred, least potential for loss of genetic variability and ecological diversity

Disadvantages: 1) highest risk to the donor population relative to the other reintroduction strategies due to the number of individuals needed to start a new population. Assuming a transplantation of eggs and/or fry, naturally high mortality suggests numbers of individuals transplanted may need to be high.