Bull Trout

Bull trout were assessed using criteria similar to those designed for anadromous salmon species. However, due to differences in ecology and life history and data limitations methods to evaluate the interim criteria are altered to more appropriately assess Oregon's bull trout populations. These modifications reflect the intent of each criterion and identify populations and SMUs at risk. Changes and substitutions are described below.

Species Management Units and Populations

Bull trout Species Management Units were identified in concordance with USFWS recovery units since both delineations are derived from similar biological and geographical characteristics. Alignment of ODFW SMUs and USFWS recovery units will help facilitate interagency management and recovery plan implementation. The exception is the Umatilla/Walla Walla recovery unit, which was split into separate SMUs, one for each drainage, because movement between SMUs is considered rare, and ecological characteristics of the basins appear to be distinctly different.

Similarly, populations identified in this status review are those defined by the USFWS Bull Trout Draft Recovery Plan (USFWS 2004), Buchanan et al. (1997), and Ratliff and Howell (1992). These population delineations are based on geographical, physical, and thermal isolation of the spawning distribution, movement and life history information, and professional judgment of local and regional biologists. Any modification to the USFWS delineation of populations is noted within the assessment of the respective SMU.

Existing Populations

Assessment methods followed those outlined for anadromous salmon and steelhead, and is based on whether a population is considered extinct and not at risk of extinction in the near future.

Distribution

The distribution of bull trout within a drainage is influenced by the geography and connectivity of the channel network, water quality, and the physical character of the instream and riparian habitat (Dambacher and Jones 1997, Rieman and McIntyre 1993). Bull trout typically reside in mid to low order streams with cold water (Rieman and McIntyre 1995), high amounts of in-channel wood and shade, and low amounts of fine sediment and bank erosion (Dambacher and Jones 1997, Fraley and Shepard 1989, Kitano et al. 1994). Therefore, bull trout are sensitive to changes in stream condition caused by land use activities associated with mining, forestry, and agriculture.

Bull trout will exploit a wide diversity of habitat when given the opportunity. The more diverse the available habitat the greater the likelihood that bull trout will express multiple life history strategies, display higher phenotypic diversity, and access refuge from environmental alterations. Thus, the extent and quality of habitat are vital to the persistence and long term health and productivity of populations.

The distribution criterion for anadromous species is based on either the current distribution or the accessible range as they compare to historical range. Data describing complete historical and current extent of bull trout are not always available and difficult to acquire. Available data are inconsistent; accuracy and precision varies between basins and subbasins according to the frequency of documented historical observations and the effort invested to determine presence and distribution of bull trout. Thus, the current and historical distribution of bull trout in a population or SMU is difficult to consistently describe.

Similarly, the degree to which habitat remains assessable to bull trout is difficult to evaluate. Because bull trout are sensitive to poor water quality and habitat degradation, the degree to which habitat remains accessible depends on stream conditions, which fluctuate year around. Impacts of habitat quality on bull trout distribution are difficult to document and not fully described in every basin. It is easy to assume impassable barriers will truncate the amount of assessable habitat of salmon and steelhead populations, however the same is not always true for bull trout. In many instances bull trout are present both above and below an impassable barrier (natural or man-made) and, as a result, the total length of distribution does not change but the upstream population is isolated from others in the SMU. Hence, the evaluation of the distribution criterion as written for salmon and steelhead will result in inaccurate and inconsistent results for bull trout.

Since only a few SMUs have data pertaining to the historical distribution of bull trout, assessment of the distribution criterion also evaluates the current extent of the spawning distribution and whether a population is isolated from other populations. We chose to consider only spawning, juvenile rearing, and resident distribution because this distribution is relatively well identified, whereas the location of rearing and overwintering adults is only vaguely determined and the extent of fluvial migrations is poorly described. Only recently, through radio telemetry studies and passive integrated transponder (PIT) tag technology, has the distribution of the sub-adult and migratory adult lifestages become better understood.

A population is considered to pass the distribution criterion if spawning and resident distribution is: 1) more than ten km (six miles), 2) regularly (1-5 years) connected to other populations, and 3) known to occupy more than 50% of its historical distribution when those data are available. Given the non-anadromous life history and inconsistency of state wide datasets, the combination of these three metrics will identify populations with significantly limited distributions. Populations with a limited spawning and resident distribution are considered at greater risk to environmental perturbations and stochastic events. They may also have a lower potential to maintain adequate abundance to prevent impacts of inbreeding and genetic drift. Based on professional knowledge of average density and abundance necessary to support a small bull trout population (Reiman and Allendorf 2001), this review considers ten kilometers the absolute minimum distance below which managers should take note of population status. Also, if a population is isolated from other populations then it may be limited in genetic diversity and unable to mix with other populations, potentially putting a small population at risk.

The distribution criterion was assessed using a 1:100,000 scale GIS datalayer of bull trout distribution (Hanson 2001). The datalayer classified stream reaches into four categories according to bull trout use: 1) spawning, rearing, or resident bull trout, 2) historical distribution (pre-1990), 3) migration corridors or rearing areas for fluvial bull trout, and 4) probably extirpated. The ‘spawning, rearing, or resident bull trout’ category represents current distribution. When applicable, the ‘historical distribution’ and ‘probably extirpated’ categories were combined and used to calculate the percent of historical distribution currently occupied by bull trout. The ‘historical distribution’ classification is considered incomplete, and not representative of the absolute historical distribution. It is important to note that these data are primarily based on summer distribution sampling that often reflects the most restricted distribution. Also, current distribution is limited by where biologists have looked and doesn’t necessarily reflect absolute distribution. In many basins adequate resources are not available to implement appropriate survey methods to detect absence and current extent throughout all habitats.

Abundance

The abundance criterion for populations of anadromous species was evaluated based on reference levels, determined from either habitat capacity data or 30 year datasets of abundance. These types of data are not available for bull trout. The longest data set representing bull trout abundance is eighteen years in the Deschutes basin, most other datasets contain fewer than ten years. As a result reference levels of abundance for each bull trout populations can not be calculated and the criterion can not be assessed in the same manner as anadromous species.

Instead this review followed guidelines developed specifically for bull trout by Rieman and Allendorf (2001) to identify populations at risk of inbreeding effects and genetic drift. They estimate 50 - 100 spawning adults are necessary to minimize the risk of inbreeding and 500 - 1000 spawning adults are required to minimize the effects of genetic drift. Therefore populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift. Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Rigorous population estimates for bull trout are rare. Most measures of abundance used in this review are based on average census redd counts, expanded by a 2.3 fish per redd conversion factor (Ratliff et al. 1996, Dunham et al. 2001). Redd counts are highly variable and a high degree of statistical error is common (Dunham et al. 2001). Data presented on abundance should be viewed as a general estimate of adult abundance and not a quantitative assessment. More rigorous evaluation of abundance will be addressed in the conservation plan process. In cases where general estimate of abundance are not available this review relied on estimates based on professional judgment and the Bull Trout Draft Recovery Plan (USFWS 2004).

Productivity

The productivity criterion for salmon and steelhead is based on spawner-recruit relationships, where a population must express an intrinsic productivity of at least 1.2 naturally-produced adult offspring per parent in three of the last five years. Equivalent datasets describing bull trout productivity do not exist. Age at maturity, number of years between spawning events, and other life history characteristics for most bull trout populations are still unknown. Thus the assessment of the productivity criterion based on a spawner recruit relationship is not possible.

Instead the criterion is based on population trend of abundance. A population passes the criterion if the abundance trend appears stable or increasing in the past five years. A decreasing trend is cause for a population to fail the criterion. Trends in abundance for most SMUs were evaluated using data sets of annual census redd counts. This review recognizes the difficulties associated with characterizing population trend using redd counts given the inherent variability in redd detection and sources of statistical error (Dunham et al. 2001, Maxell 1999, Rieman and Myers 1997). In addition trends are more difficult to detect in small populations and over short temporal scales. Given that there are very few datasets available, the evaluation of the productivity criterion based on redd counts and population trend is made with caution and subject to uncertainty.

In cases where annual redd counts or other estimates of abundance do not exist or do not incorporate the past five years the productivity criterion was based on a qualitative evaluation of distribution and abundance, connectivity, life history, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. These qualities suggest populations are

minimally able to sustain current abundance. The presence of a migratory life history and connectivity between populations and a diversity of habitats also increases the potential of a population self-sustaining. Large migratory adults are also more fecund and are able to create deeper redds which are likely more secure from scour in winter flows and spring freshets and redd superimposition of other fall spawning species. The presence of non-native species or significant habitat degradation may negatively affect productivity.

We acknowledge that including measures of distribution and abundance may be redundant with other criteria, however given the lack of adequate data pertaining to this criterion these data present the best surrogate. In light of this, the assessment of the productivity criterion gives greater weight to life history, habitat quality, and presence of non-native species.

Reproductive Independence

All bull trout in Oregon are native fish sustained by natural production. No hatchery bull trout programs currently exist, therefore a metric to evaluate the reproductive independence criterion is not necessary.

Hybridization

Non-native brook trout are widespread throughout the range of bull trout and are present in many of the same watersheds as a result of hatchery outplantings and natural production (Rieman et al 1997, Thurow et al. 1997, Rieman and McInyre 1993). Where bull trout and brook trout co-occur hybridization is probable as both species are fall spawners and spawn in streams with similar water quality and habitat characteristics (Fraley and Shepard 1989; Kitano et al. 1994). A high degree of hybridization can result in reduced productivity and the loss of unique genetic characteristics.

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare (hybridized individuals comprise <5% of the population) or non-existent. We recognize the challenges associated with field identification of hybridized individuals and the potential for error. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Klamath Lake Bull Trout

Existing Populations

The Klamath Lake Bull Trout SMU is comprised of seven existing populations and four populations classified as extinct or functionally extinct (Table 189). Populations are concentrated in headwater streams of the Sycan (above Sycan Marsh) and Upper Sprague rivers, and tributaries of Klamath Lake. Although bull trout are considered to have existed throughout the Klamath Basin (Buchanan et al. 1997), the identification and delineation of historical populations is challenging given the lack of data and historical observations. Current and historical populations are based on those identified in the Klamath River Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004), known spawning distribution, and professional judgment of agency biologists.

Table 189. Populations, existence status, and life history of the Klamath Lake Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Sun	Sun Creek.	Resident
Yes	Threemile	Threemile Creek.	Resident
Yes	Long	Long and Calahan creeks.	Resident
Yes	NF Sprague	Upper North Fork Sprague River and tributaries including Sheepy, Boulder and Dixon creeks.	Resident
Yes	Deming	Deming Creek.	Resident
Yes	Leonard	Leonard Creek.	Resident
Yes	Brownsworth	Brownsworth Creek.	Resident
No	Sevenmile	Sevenmile Creek.	
No	Cherry	Cherry Creek.	
No	Coyote	Coyote Creek.	
No	Upper Sycan	Upper Sycan River above Sycan Marsh.	

In 1999 Crater Lake National Park began eradicating brook trout in Sun Creek using antimycin treatments. During the eradiation process Sun Creek bull trout were transplanted into Lost Creek to protect against loss of the Sun Creek genetic stock (USFWS 2002). Lost creek is not considered an existing population because it is an introduced experimental population, limited in extent and condition.

The Coyote Creek (Sycan) population is considered functionally extinct. Presence/absence surveys detected bull trout and brook trout x bull trout hybrids in the lower reaches of Coyote Creek in 2001 (USFWS 2004). It is unknown if these fish are remnant of a historic population or recolonizing unoccupied habitat. Coyote is treated as a historical population until spawning and reproduction can be documented.

Bull trout in the North Fork Sprague population reside primarily in Boulder and Dixon creeks. Bull trout were also detected in Sheepy Creek in 2001, and large migratory individuals were observed in the North Fork Sprague River during presence/absence surveys in 1997 (USFWS 2004). It is unknown if fish in Sheepy Creek and North Fork Sprague River are indicative of individual populations or migrants from Boulder and Dixon Creeks. Given the uncertainty of the population structure in the North Fork Sprague River Basin this review considers all bull trout in the basin as one population until data suggest a finer structure.

Large bull trout (>15") were detected in Long Creek in 1998. Since then radio telemetry studies have demonstrated seasonal use by large bull trout in the lower portions of Long Creek and parts of the Sycan Marsh (USFWS 2004), indicating the migratory life history may still persist.

Distribution

Bull trout are thought to have occupied most of the Oregon portion of the Klamath River basin (Buchanan et al. 1997); however, complete historical distribution data are unavailable. Current spawning and resident distribution in Klamath basin is highly fragmented and limited to a few isolated headwater streams of Klamath Lake, Upper Sprague River and Upper Sycan River above Sycan Marsh. High water temperatures, low flows, and irrigation diversions have isolated populations, minimizing the opportunity for bull trout to express a migratory life history, mix among populations, and colonize unoccupied habitats.

Analysis of the distribution criterion is based on values published in the USFWS Bull Trout Draft Recovery Plan (2004) and 1:100,000 scale GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997). These data are primarily based on summer distribution sampling that often represents the most restricted distribution. A population passed the criterion if spawning, juvenile rearing, and resident distribution is 1) greater than ten km, 2) connected to other populations, or 3) occupies greater than 50% of the historic distribution where historic distribution data are available. Only the Brownsworth population passed the distribution criterion (Table 190).

Table 190. Distribution data used to evaluate Klamath Lake bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Sun	14.5	59	No	Fail
Threemile	1.4	25	No	Fail
Long	23.2	77	No	Fail
NF Sprague	9.0	15	No	Fail
Deming	6.4	37	No	Fail
Leonard	2.7	44	Yes	Fail
Brownsworth	15	100	Yes	Pass
Sevenmile		*Extinct Population*		
Cherry		*Extinct Population*		
Coyote		*Extinct Population*		
Upper Sycan		*Extinct Population*		

Threemile, North Fork Sprague, Deming, and Leonard populations failed the distribution criterion due to a limited spawning and rearing distribution, less than ten km. Bull trout distribution in the North Fork Sprague population is limited to Boulder and Dixon creeks. Recent observations suggest the measured distribution in these creeks may be overestimated. Presence/absence surveys in 1998 did not detect bull trout in Boulder Creek (USFWS 2004), and more recent surveys only detected bull trout in North Fork Dixon Creek (W. Tinniswood, ODFW Klamath Fish District, personal communication).

The extent of spawning distribution in Leonard, Deming, and Threemile has decreased since 1990 (Hanson 2001). These populations currently occupy less than 50% of their historical distribution and fail the criterion.

Physical barriers in Deming, Sun, and Threemile prevent connection to migratory corridors and mixing among populations (USFWS 2004). Water withdrawals on Deming Creek effectively

dewater the natural channel and strand fish below the diversion. In addition, below the irrigation diversion, volcanic deposits cause the creek to flow subsurface, naturally isolating fish from the Sprague River. Barriers were constructed on Sun Creek to prevent the recolonization of brook trout after they were eradicated from the upper reaches. Although these barriers are effective at protecting bull trout from brook trout invasion, they prevent migratory bull trout from returning to Sun Creek and opportunities for mixing among populations in the future. Threemile Creek is isolated above an impassable culvert. Populations in each of the three watersheds, Klamath Lake, Sprague, and Upper Sycan, are unable to move between watersheds, further isolating populations and preventing mixing. Only bull trout in Leonard and Brownsworth creeks have the potential to mix.

Abundance

Few data exist to accurately assess abundance of bull trout in the Klamath Lake SMU. Population estimates were conducted for most existing populations between 1989 and 1991 (Buchanan et al. 1997, Ziller 1992, Dambacher et al. 1992) and have occurred more recently in Sun, Threemile and Brownsworth creeks (USFWS 2004; ODFW Klamath Fish District, unpublished data) (Table 191). Populations that were quantitatively assessed within the past five years were evaluated based on a rough estimate of the number of adults (Buchanan et al. 1997, USFWS 2004). At least three generations have passed since abundance estimates were collected in North Fork Sprague (Boulder/Dixon), Deming, and Leonard creeks and may not accurately represent current abundance. The assessment of these populations is based on recent observational data and professional judgment of agency biologists.

Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Table 191. Yearly estimated abundance of Klamath Lake bull trout populations (age 1+ fish). Quantitative assessment based on estimates from past five years (shaded).

Population	1989	1991	1992-1994	1994	1995	1996	1997	2000	2003	2004	Pass/Fail
Sun	133[a]		120-360[d]					635[d]	~1100[f]	>1500[f]	Pass
Threemile						50[e]		91[d]	129[d]		Fail
Long		841[c,e]		855[c,e]							Fail
above falls				394[c,e]	202[c,e]						
NF Sprague	219[b]										Fail
Deming	1,293[b]						1,470[g]				Pass
Leonard	834[b]										--
Brownsworth	964[b]				956[g]			1,290[h]			Pass
Sevenmile						*Extinct population*					
Cherry						*Extinct population*					
Coyote						*Extinct population*					
Upper Sycan						*Extinct population*					

[a] *(Dambacher* et al*. 1992)*
[b] *(Ziller 1992)*
[c] *(ODFW Klamath Fish District, unpublished data)*
[d] *(USFWS 2004)*
[e] *(Buchanan et al. 1997)*
[f] *(Buktenica, Crater Lake NP, pers. comm)*
[g] *(ODFW Aquatic Inventory Project, Corvallis)*

[h] *(ODFW Klamath Fish District, 2000)*

Three populations pass the abundance criterion. The assessment of the Sun and Brownsworth populations is based on estimates collected in the past five years. This review assumes greater than 100 of the bull trout in each population were reproductive adults. These populations are not considered at risk of inbreeding. Recent estimates of abundance in Deming Creek do not exist. The Deming population passes the criterion based on a high abundance prior to 1991 and in 1997, good current habitat quality, and recent habitat improvement projects (e.g. road closures and addition of large wood) (R. Smith, ODFW Klamath Fish District, personal communication).

The Threemile population likely contains fewer than 100 reproductive adults and therefore fails the abundance criterion. Biologists have also observed deformed bull trout in this population. The cause of the deformities is unknown, but genetic effects of a small population size are suspected.

Long and North Fork Sprague populations both failed the abundance criterion based on professional judgment. Routine snorkel surveys conducted since 1998 suggest bull trout densities in Long Creek are declining (ODFW, USFS unpublished data), however the number of bull trout captured at a downstream trap located above Sycan Marsh has increased in recent years. Bull trout abundance in North Fork Sprague River, specifically Boulder and Dixon creeks, is likely declining and precariously low. Bull trout were not detected in presence/absence surveys for many years and recently were only found in North Fork Dixon Creek. Bull trout were not detected at many sites where they were present in earlier surveys (W. Tinniswood, ODFW Klamath Fish District, personal communication).

Adequate information pertaining to the Leonard population is lacking and therefore was not assessed. The last population estimate was in 1991. Since then no monitoring or management activities have occurred to provide the basis for a general assessment.

A population size of 1,000 reproductive adults is necessary to minimize the effects of genetic drift (Rieman and Allendorf 2001). Barriers, poor water quality, and lack of a migratory life history prevent bull trout in each watershed (Sprague, Sycan, and Klamath Lake) from mixing. Thus each watershed should contain a minimum of 1,000 reproductive adults capable of moving between populations. Given these criteria, bull trout in each watershed and isolated population are considered at risk of genetic drift.

Productivity

Data are not available to quantitatively assess productivity and the intrinsic rate of population increase for bull trout in the Klamath Lake SMU. In the absence of these data the assessment of the productivity criterion is based on a qualitative evaluation of distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend. The expression of a migratory life history and connectivity between populations and high quality habitats are also indicators of potentially increased productivity. The presence of non-native species may negatively affect productivity and cause a population to fail the criterion if limited in other factors.

Sun, Brownsworth, and Deming populations pass the productivity criterion based on professional judgment of agency biologists (Table 192). Populations appear relatively abundant and data suggest a stable or increasing trend of abundance. Brook trout have been removed from the Sun population and brown trout removal efforts have begun on Brownsworth.

Threemile, Long, and North Fork Sprague populations fail the criterion (Table 4). Field surveys suggest abundance of these populations is decreasing over time. The presence of non-native brook trout, lack of many large migratory fish, and the isolation of each population suggest decreased degrees of productivity.

Data and field observations are not available to adequately assess the Leonard population. This population was not evaluated

Table 192. Factors considered in the assessment of the productivity criterion of Klamath Lake bull trout.

Population	Factors	Pass/Fail
Sun	Abundance appears to be increasing (Table 191); brook trout removal successful.	Pass
Threemile	Extremely low abundance and isolated; brook trout removal successful.	Fail
Long	Low density and apparently decreasing; brook trout present; recent observation of a migratory life history; able to express a migratory life history though not enough to impact population.	Fail
NF Sprague	Low density; distribution and abundance declining; brown trout present; possibly able to express a migratory life history.	Fail
Deming	Habitat quality is good and improving with recent projects; abundance apparently stable between 1991 and 1997 (Table 191).	Pass
Leonard	Adequate information lacking.	--
Brownsworth	Habitat quality is good and improving; abundance trends stable; efforts to remove brown trout ongoing.	Pass
Sevenmile	*Extinct population*	
Cherry	*Extinct population*	
Coyote	*Extinct population*	
Upper Sycan	*Extinct population*	

Reproductive Independence

All populations in the Klamath Lake Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

The first recorded planting of brook trout in Klamath Basin streams was in 1925. Brook trout were regularly stocked in streams throughout the basin until 1968 and the last stocking event was recorded in Sycan River in 1975. Brook trout currently are present in Threemile, Long, and Sun creeks.

Brook trout in Sun and Threemile creeks have been successfully removed from reaches where bull trout occur (M. Buktenica, Crater Lake National Park, personal communication; Smith and Tinniswood 2002). These populations pass the hybridization criterion. Crater Lake National Park biologists eradicated brook trout from the upper reaches of Sun Creek in 1999 using antimycin treatments. Since then regular surveys have not detected brook trout above the two barrier falls designed to prevent brook trout re-invasion (M. Buktenica, Crater Lake National

Park, personal communication). Currently, brook trout are not considered a current threat to bull trout in Sun Creek. In Threemile Creek brook trout removal efforts have been on-going since 1997. Brook trout have not been observed upstream of an impassable culvert in the past five years and the two species are not sympatric (Smith and Tinniswood 2002).

Ongoing efforts to remove brook trout above a barrier falls on Long Creek have been unsuccessful. Long Creek fails the hybridization criterion.

Table 193. Occurrence of brook trout and hybridization for Klamath Lake bull trout populations.

Population	Brook Trout	Pass/Fail
Sun	Yes	Pass
Threemile	Yes	Pass
Long	Yes	Fail
NF Sprague	No	Pass
Deming	No	Pass
Leonard	No	Pass
Brownsworth	No	Pass
Sevenmile	*Extinct population*	
Cherry	*Extinct population*	
Coyote	*Extinct population*	
Upper Sycan	*Extinct population*	

Assessment Conclusions

The Klamath Lake Bull Trout SMU is comprised of eleven populations, four of which are considered extinct. Distribution of bull trout within the SMU is highly fragmented and concentrated in a few isolated headwater streams of Sycan and Sprague rivers, and Klamath Lake. Movement between populations is hindered by barriers and poor habitat quality. Abundance is extremely depressed and in some cases considered precariously low. The introduction of non-native salmonids particularly brook trout and brown trout, and degraded habitat quality has impacted the productivity of many populations. The SMU meets only the reproductive independence and hybridization criteria and is classified as 'at risk' (Figure 50). Limited datasets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

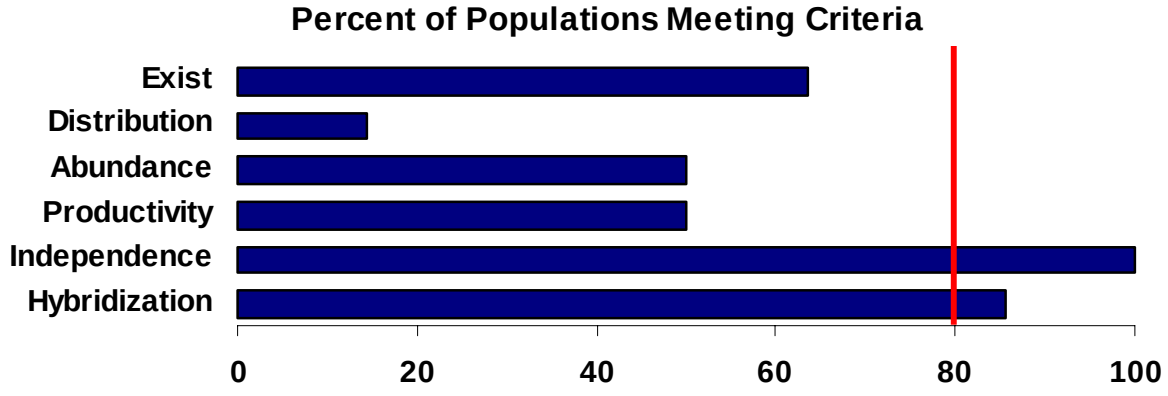

Figure 50. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Willamette Bull Trout

Existing Populations

The Willamette Bull Trout SMU includes four existing populations and three classified as extinct (Table 1). Populations were identified according to those defined in the USFWS Willamette River Chapter of the Bull Trout Draft Recovery Plan (2004), Ratliff and Howell (1992), and review by ODFW biologists.

Table 1. Populations, existence status, and life history for the Willamette Bull Trout SMU.

Exist	Population	Description	Life History
No	Clackamas	Clackamas River and tributaries.	
No	North Santiam	North Santiam River and tributaries.	
No	South Santiam	South Santiam River and tributaries.	
Yes	Trail Bridge	McKenzie River above Trail Bridge Dam.	Resident / Migratory
Yes	McKenzie	Mouth to Trail Bridge Dam.	Resident / Migratory
Yes	SF McKenzie	South Fork McKenzie River above Cougar Dam.	Migratory
Yes	MF Willamette	Middle Fork Willamette River above Hills Creek Dam.	Unknown

The population in the Middle Fork Willamette River was classified as 'probably extinct' by Buchanan et al. (1997). In an effort to rehabilitate bull trout in the Middle Fork Willamette Basin, ODFW and USFS released more than 10,000 bull trout fry from the McKenzie River population (Anderson Creek) into cold water springs and tributaries above Hills Creek Dam from 1997 to 2004 (ODFW and USFW 1998, Taylor and Reasoner 2000, Seals and Reis 2003, ODFW unpublished data). ODFW and USFS biologists observed sub-adults and adult bull trout in 2003 and 2004 and there have been several confirmed sightings of bull trout reported by anglers (USFWS 2004). This review treats bull trout in the Middle Fork Willamette as an existing population.

The Clackamas population is considered extinct. The last documented bull trout observation occurred in 1960 (Goetz 1989), and surveys between 1992 and 1999 failed to detect bull trout in the Clackamas River and its tributaries. Based on historical creel data, bull trout in the Clackamas River expressed a fluvial life history (USFWS 2004).

The historical record, although limited, documents bull trout in the North and South Santiam basins (Goetz 1994). The last verified observation of bull trout in North Santiam basin was in 1945, and 1953 in the South Santiam basin (Goetz 1989). Whether the few documented bull trout sightings in the Sanitam Basin are indicative of discreet populations or represent highly mobile migrants is undetermined. Surveys in the 1990s failed to detect bull trout in either watershed. The North Santiam and South Santiam populations are considered extinct.

Distribution

Analysis of the distribution criterion is based on information summarized in Willamette River Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004) and Ziller and Taylor (2000). A population failed the criterion if spawning and resident distribution is: 1) less than ten km, or 2) not connected to other populations. Knowledge of the historical bull trout distribution is insufficient; thus the percent of historical habitat currently occupied is not calculated for the Willamette SMU.

Prior to dam construction, bull trout in the McKenzie River watershed functioned as a single population (USFWS 2004, Taylor and Reasoner 2000). Spawning and juvenile rearing occurred in the upper watershed and large fluvial adults reared in the mainstem McKenzie and upper Willamette rivers. Dams built on the South Fork McKenzie (Cougar Dam) and upper McKenzie River (Trail Bridge Dam) divide the original population into three small discrete populations, prevent movement into portions of the upper watershed, and fragment spawning habitat.

All populations in the McKenzie River basin fail the distribution criterion based on limited spawning distribution and isolation above Trail Bridge and Cougar dams. Bull trout in the McKenzie population utilize up to 170 Km of the McKenzie River and its tributaries throughout their life cycle. Large fluvial adults have been observed downstream of Leaburg Dam and a few individuals pass over the dam each year (USFWS 2004). However, spawning distribution is limited to a total of five km in Anderson and Olallie creeks (Table 2). Because of the extremely limited and localized spawning distribution, the McKenzie population is at an increased risk of the impacts of stochastic events (USFWS 2004). The spawning distribution of the SF McKenzie and Trail Bridge populations are more restricted and therefore the populations are also at risk of extinction due to stochastic events.

Lack of upstream passage at Trail Bridge and Cougar dams prevent adult bull trout that move downstream past these dams from returning to their natal streams. These fish are lost to the populations above the dams, impacting the abundance and productivity of these already small populations. Lack of upstream passage also prevents gene flow between populations. Fish from Trail Bridge and SF McKenzie populations can pass downstream and spawn in the McKenzie population, but fish originating in the McKenzie population cannot pass upstream and spawn in populations above the dams (Table 2).

The Middle Fork Willamette bull trout population fails the distribution criterion based on the lack of a documented spawning and isolation above Hills Creek Dam. Distribution of introduced bull trout in the Middle Fork Willamette River is thought to extend 46 km between Chuckle Springs and Hills Creek Dam (ODFW 2005 unpublished data). Spawning by this population is undocumented.

Table 2. Distribution data used to evaluate Willamette Bull Trout populations.

Population	Spawning Distribution (km)	Connected to other Pops.	Pass/Fail
Clackamas		*Extinct population*	
North Santiam		*Extinct population*	
South Santiam		*Extinct population*	
Trail Bridge	1.8	No	Fail
McKenzie	5	Yes	Fail
SF McKenzie	1.9	No	Fail
MF Willamette	Unknown	No	Fail

Abundance

The USFWS Draft Recovery Plan (2004) provided estimates of average number of adult bull trout in each population based on total redd counts and professional judgment of local biologists. These estimates were used to assess the abundance criterion (Table 3). Populations of bull trout with less than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of

genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 adults spawning annually in order to pass this criterion.

Table 3. Estimated adult abundance of Willamette bull trout populations (USFWS 2004).

Population	Estimated Adult Abundance	Pass/Fail
Clackamas	*Extinct population*	
North Santiam	*Extinct population*	
South Santiam	*Extinct population*	
Trail Bridge	< 20	Fail
McKenzie	150-200	Pass
SF McKenzie	30-40	Fail
MF Willamette	Unknown	Fail

The number of adult bull trout in the Willamette SMU is estimated to be no more than 300 fish, two-thirds of which are thought to be in the McKenzie population (USFWS 2004). Since 1995, census redd counts of the McKenzie population have averaged 84 redds per year. Based on this average and a conservative 2.3 fish per redd conversion factor (Ratliff et al. 1996, Dunham et al. 2001) the number of adults in the McKenzie population is approximately 190 fish, similar to the estimated abundance reported by the Willamette Bull Trout Recovery Team (USFWS 2004). Only the McKenzie population passes the individual population abundance criterion (Table 3).

The estimated total number of adult bull trout in the SMU is 300 fish (<1,000)(USFWS 2004); thus the SMU is considered at risk of genetic drift. The three populations isolated above barriers to upstream migration have fewer than 1,000 adults, thus are also considered at risk of genetic drift.

Productivity

The assessment of the productivity criterion was based on trends of abundance over the past five years. A population passes the criterion if the abundance trend appears stable or increasing. A decreasing trend is cause for a population to fail the criterion. Trends in abundance for the Willamette SMU populations were evaluated using data sets of annual census redd counts. This review recognizes the difficulties associated with characterizing population trend using redd counts given the inherent variability in redd detection and sources of statistical error (Dunham et al. 2001, Maxell 1999, Rieman and Myers 1997). The evaluation of the productivity criterion based on apparent population trend is made with caution and subject to uncertainty.

The SF McKenzie and Trail Bridge populations show increasing trends in redd counts and pass the productivity criterion (Figure 1) (USFWS 2004, Seals and Reis 2003). However the increasing trend in the Trail Bridge population is slight and the magnitude of the counts is perilously low. In addition, identification of bull trout redds is hindered by redd building activity of Chinook salmon outplanted above Trail Bridge Dam (USFWS 2004). Even though this population passes the criterion, productivity of the population should be carefully monitored.

The trend in redd counts for the McKenzie population appears stable. Local and agency biologists believe this population is near spawning capacity due to the high density of the redds and frequent redd superimposition (Taylor and Reasoner 2000, Taylor and Ziller 2000). This population passes the productivity criterion.

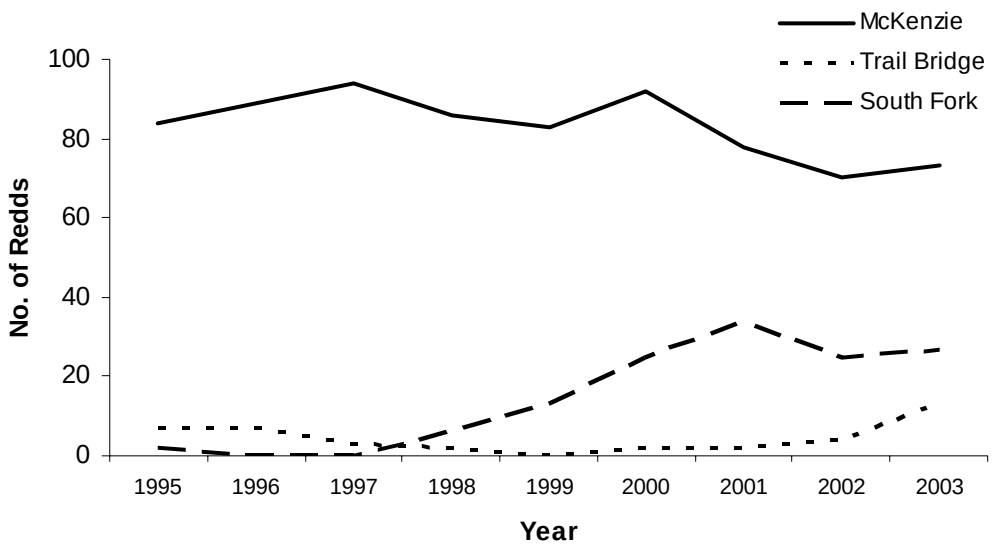

Figure 1. Trends in total redd counts for McKenzie, SF McKenzie, and Trail Bridge populations (USFWS 2004, Seals and Reis 2002).

The productivity of the Middle Fork Willamette population is dependant on the introduction of bull trout from the McKenzie River. Spawning is not yet documented and there is no indication of natural production. The MF Willamette population fails the productivity criterion.

Reproductive Independence

All populations in the McKenzie basin are native fish sustained by natural production and pass the reproductive independence criterion.

Bull trout fry from the McKenzie population are transfered into the Middle Fork Willamette in an effort to restore bull trout to the basin. Although the McKenzie bull trout are not native to the Middle Fork Willamette, they likely originated from the same initial population. Likewise, the introduction of bull trout from the McKenzie population may be the only method to maintain and conserve genetic traits unique to the Middle Fork Willamette population (ODFW and USFS 1998). The Middle Fork Willamette population passes the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For all populations in the Willamette SMU, the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available, and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Brook trout were stocked into many high lakes in the Cascade Mountains prior to the 1960s, and some of these releases resulted in self-sustaining populations (USFWS 2004). Brook trout currently occur in all basins of the Willamette SMU. Trail Bridge Reservoir contains a population of brook trout and hybridization is a significant concern. This population fails the hybridization criterion. Hybridization in the remaining three populations is rare or non-existent. Brook trout are sympatric with bull trout in portions of the McKenzie population, but not present in the primary spawning tributaries, Anderson and Ollalie creeks. Bull trout x brook trout hybrids have not been observed during routine monitoring activities (J. Ziller, ODFW Upper

Willamette Fish District, personal communication). Brook trout are present in the headwaters of the SF McKenzie population, but their range does not overlap the range of bull trout (USFWS 2004). Similarly, brook trout are present in the Middle Fork Willamette, but upstream of bull trout distribution. The McKenzie, SF McKenzie, and MF Willamette populations pass the hybridization criterion (Table 4).

Table 4. Presence of brook trout in populations of the Willamette Bull Trout SMU.

Population	Brook Trout	Pass/Fail
Clackamas	*Extinct population*	
North Santiam	*Extinct population*	
South Santiam	*Extinct population*	
Trail Bridge	Yes	Fail
McKenzie	Yes	Pass*
SF McKenzie	No	Pass
MF Willamette	No	Pass

** Brook trout are present but hybridization is uncommon.*

Assessment Conclusions

The Willamette bull trout SMU is comprised of seven populations, three of which are classified as extinct. Sightings of bull trout were last documented before 1960 in Clackamas, North Santiam, and South Santiam basins. All four existing populations have an extremely limited spawning distribution, and three populations are isolated above dams lacking upstream passage. Bull trout abundance in the Middle Fork Willamette population has dropped to precariously low numbers. ODFW and USFS biologists are attempting to restore this population with bull trout from the McKenzie population. The SMU meets only the reproductive independence criterion and is classified as 'at risk'(Figure 2). Limited datasets and inferences from other populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

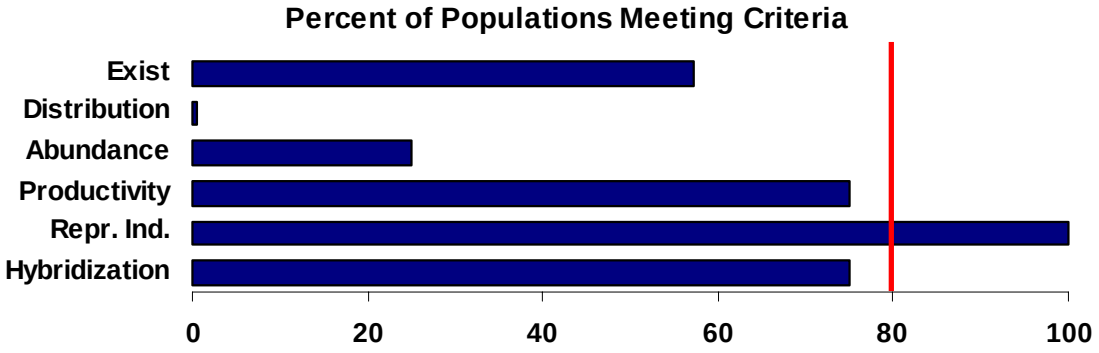

Figure 2. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Hood River Bull Trout

Existing Populations

The Hood River Bull Trout SMU is comprised of two populations, Hood River and Clear Branch (Table 1). Populations are identified according to those defined in the Mount Hood Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004), Ratliff and Howell (1992), and review by ODFW biologists. Genetic analysis shows Hood River bull trout are unique and likely descendants of both coastal and Snake River lineages (Spruell et al. 2003).

Table 1. Populations, existence status, and life history of the Hood River Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Hood River	Hood River, Middle Fork Hood River and tributaries	Resident / Migratory
Yes	Clear Branch	Clear Branch above Clear Brand dam incl. Pinnacle Creek	Resident / Migratory

Sandy River is included in this SMU. Although a self-sustaining bull trout population is not present in the Sandy River basin, anglers and ODFW biologists observed migratory bull trout in Sandy River in three instances since 1999. The USFWS considers Sandy River a potential location for recovery (USFWS 2004).

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information summarized in the Mount Hood Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004). These data are primarily based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when data are available (Table 2). In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical distribution. Though this is likely accurate for Hood River bull trout, these results should be interpreted with caution, given that historical data are not always available.

Current bull trout distribution in the Hood River SMU, albeit highly fragmented, likely reflects historical distribution (USFWS 2004). Spawning and juvenile rearing distribution is limited to a few tributary streams and portions of mainstem rivers in both populations.

Prior to dam construction, bull trout in Hood River likely functioned as a singe population. The construction of Clear Branch Dam in 1969 fragmented bull trout distribution, isolating bull trout above the dam, and partially inundating high quality spawning habitat. In the 1990s attempts to trap bull trout and pass them over the dam were found ineffective (USFWS 2004). The dam prevents opportunities for genetic exchange between populations. Because the Clear Branch population is isolated and has a limited spawning distribution, it is at risk of extinction due to stochastic events and fails the distribution criterion (Table 2).

Bull trout in the Hood River population utilize portions of the Middle Fork Hood River and its tributaries, mainstem Hood River, and Columbia River throughout their life history. Foraging and overwinter rearing occur primarily in Middle Fork Hood and mainstem Hood rivers and periodically the Columbia River. Three Hood River bull trout have been observed in the Columbia River. In each instance fish were tagged at the Powerdale Dam and recovered at Drano Lake in Washington state or downstream in the Columbia River (USFWS 2004).

Spawning activity in Hood River is restricted to just a few locations. Spawning habitat exists in Bear and Compass creeks, Coe Branch, Clear Branch below the dam, and potentially portions of Middle Fork Hood River (USFWS 2004), however, Coe Branch and Compass Creek are glacial streams with a high volume of sand and silt which may compromise spawning success. Recent temperature studies suggest water temperature below Clear Branch Dam may not be suitable for spawning (USFWS 2004). Because documented spawning distribution likely totals less than ten km (R. French, ODFW The Dalles Fish District, personal communication), the Hood River population fails the criterion (Table 2). In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical distribution. These results should be interpreted with caution, given that historical data may not be available.

Table 2. Distribution data used to evaluate Hood River bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Hood River	<10	100	Yes	Fail
Clear Branch	8.4	100	No	Fail

Abundance

Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Data are not available to provide a rigorous estimate of abundance for either population. However, night snorkel surveys, redd counts and dam counts all suggest both populations contain less than 100 adults and therefore fail the abundance criterion. A census count of redds for the Clear Branch population (eight km on Clear Branch and Pinnacle Creek) in 2002 and 2003 totaled 13 and 19 redds, respectively (USFWS 2004). USFS biologists have conducted night snorkel surveys in each population since 1996. Results show relative abundance of the Clear Branch population is an order of magnitude greater than the Hood River population (Figure 1) (USFWS 2004). These snorkel data have not been calibrated nor verified with more rigorous estimates of abundance and cannot be expanded to estimate population size. Counts of adult bull trout at the Powerdale Dam also suggest abundance of the Hood River population is precariously low. No more than 30 adults have been captured each year since 1992 (Figure 2) (Olsen 2003).

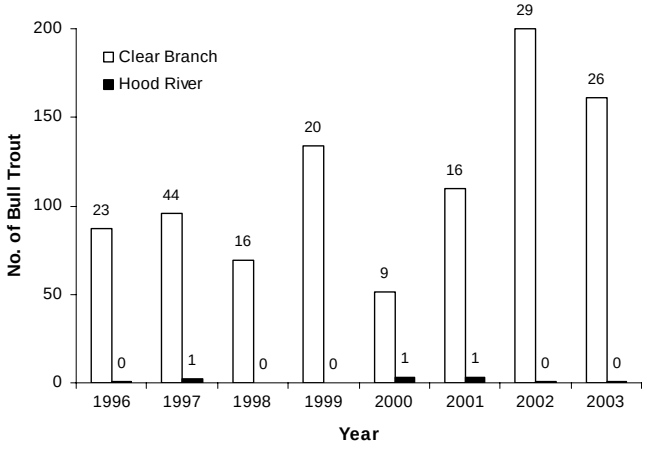

Figure 1. Annual peak night snorkel counts for Clear Branch and Hood River populations, 1996-2003. Numeric values represent number of adults (>8 inches) observed. 25% of Clear Branch habitat (0.75 mile) and 40% of Hood River habitat (0.25 mile) is snorkeled each year.

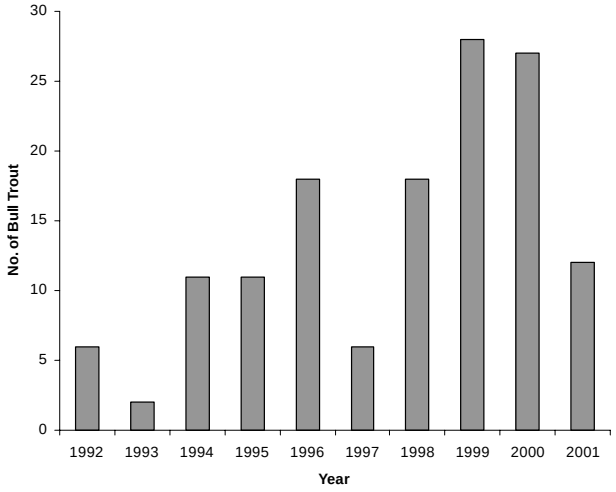

Figure 2. Number of adult bull trout captured at Powerdale Dam trap (Hood River population), 1992-2001.

Productivity

Data are not available to quantitatively assess productivity of populations in the Hood River SMU. In the absence of these data the assessment of the productivity criterion is based on a qualitative evaluation of distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. The expression of a migratory life history, connectivity between populations, and high quality habitat may also be indicative of productive populations. The presence of non-native species may negatively affect productivity and cause a population to fail the criterion if it is limited in other factors. Even though the Clear Branch population is isolated from other populations it passes the productivity criterion (Table 3). The assessment of both populations is subject to uncertainty.

Table 3. Factors considered in the assessment of the productivity criterion of Hood River bull trout.

Population	Factors	Pass/Fail
Clear Branch	Although the Clear Branch population is isolated above Clear Branch Dam USFS night snorkel data set indicates the population is stable (Figure 1); large adfluvial adults are fecund and productive; smallmouth bass in Laurence Lake may be impacting the population; introduced rainbow trout serve as a forage base for bull trout.	Pass
Hood River	Very limited distribution and extremely low abundance; migratory life history.	Fail

Reproductive Independence

All populations in the Hood River Bull Trout SMU are native fish sustained by natural production and passed the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Although brook trout are present in the Hood River Basin, they are not sympatric with bull trout and not considered a threat (USFWS 2004). Both populations pass the hybridization criterion.

Assessment Conclusions

Two populations, Clear Branch and Hood River, comprise the Hood River SMU. Historically, bull trout in the Hood River basin functioned as a single population. Construction of the Clear Branch Dam in 1969 fragmented the population and inundated spawning habitat. A lack of passage at the dam prevents mixing among populations. Distribution of both populations is extremely limited and abundance is precariously low. This SMU meets three of the six interim criteria and is classified as "at risk" (Figure 3). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

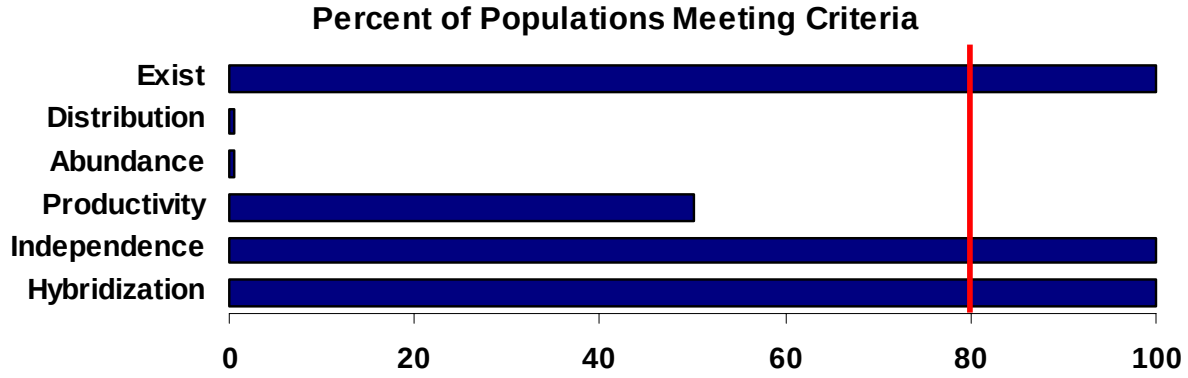

Figure 3. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Deschutes Bull Trout

Existing Populations

The Deschutes Bull Trout SMU is comprised of eight populations, three of which are classified as extinct (Table 1). Populations are identified according to those defined in the USFWS Deschutes River Chapter of the Bull Trout Draft Recovery Plan (2004). This review considers bull trout in the Metolius River basin as two distinct population complexes, Jefferson and Jack, however, individual PIT tagged bull trout have shown a high degree of fidelity to the same spawning stream and may be indicative of a finer population structure (S. Marx, ODFW Deschutes Watershed Fish District, personal communication). Extinct populations were inferred from historical distributions (USFWS 2004, Buchanan et al. 1997, Ratliff and Howell 1992).

Table 1. Populations, existence status, and life history of the Deschutes Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Warm Springs	Warm Springs River and tributaries.	Resident/ Migratory
Yes	Shitike	Shitike River and tributaries.	Resident/ Migratory
Yes	Whitewater	Whitewater River and tributaries.	Resident/ migratory
Yes	Jefferson Complex	Jefferson and Candle Creeks and tributaries.	Resident/ Migratory
Yes	Jack Complex	Canyon and Jack Creeks, Heising Springs and Metolius River and tributaries.	Resident/ Migratory
No	Suttle Lake	Suttle and Blue Lakes and Link Creek.	
No	Upper Deschutes	Deschutes River and tributaries above Big Falls.	
No	Crescent Lake	Crescent Lake.	

Historically, bull trout populations existed in Crescent Lake and the upper Deschutes River. The population structure of the Upper Deschutes is unknown and may have consisted of multiple distinct populations. This review identifies bull trout in Crescent Lake as a discreet historical population due to the expression of an adfluvial life history strategy (Buchanan et al. 1997, Ratliff and Howell 1992); other possible populations in the upper Deschutes River are treated as a single entity. The Upper Deschutes population was reproductively isolated from the lower Deschutes populations by Big Falls. The last bull trout observed in the upper Deschutes was in 1959 in Crescent Lake. Bull trout in the Upper Deschutes population were eliminated by a combination of factors including the construction of irrigation storage dams (Crane Prairie, Crescent Lake, and Wickiup) which blocked access to and inundated spawning grounds, increased water temperatures and altered flow regimes, overharvest, and competition with non-native trout.

A historic population also existed in Suttle and Blue lakes, which was possibly eliminated by the construction of an outlet dam, overharvest, and competition with introduced brook trout and brown trout (USFWS 2004, Buchanan et al. 1997).

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997). These data are primarily based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when historic

distribution data are available. In basins where the GIS hydrography does not depict historical distribution, the results will show populations occupy 100% of the historical range. Though this is likely accurate for Deschutes River bull trout, these results should be interpreted with care since historical data are not always available. All existing populations pass the distribution criterion (Table 2).

Table 2. Distribution data used to evaluate Deschutes bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Warm Springs	33.2	<100*	Yes	Pass
Shitike	38.1	100	Yes	Pass
Whitewater	20.1	100	Yes	Pass
Jefferson Complex	35.5	100	Yes	Pass
Jack Complex	37.7	100	Yes	Pass
Suttle Lake		*Extinct population*		
Upper Deschutes		*Extinct population*		
Crescent Lake		*Extinct population*		

** Bull Trout no longer present in Mill Creek, a tributary to Warm Springs River that is now occupied with only brook trout (USFWS 2004).*

Current spawning and juvenile rearing distribution is concentrated in three populations of the Metolius River basin. Spawning also occurs on the Warm Springs Indian Reservation in the upper reaches of the Warm Springs River and Shitike Creek. The spawning distribution within each population is relatively extensive. Adult and sub-adult bull trout in the Metolius populations utilize, the lower reaches of Crooked River (up to Opal Springs Dam), the Deschutes River between Lake Billy Chinook and Big Falls and lower Squaw Creek Bull trout from Warm Springs and Shitike creeks utilize the Deschutes River down to Sherars Falls (USFWS 2004). The construction of the Pelton\Round Butte Hydroelectric complex isolated populations on the Warm Springs Reservation from those in the Metolius - Lake Billy Chinook basin (Ratliff et al. 1996, Buchanan et al. 1997).

Knowledge of historical distribution is incomplete. To the best of our knowledge, bull trout utilized most of the Deschutes River basin throughout their life history (Ratliff et al.1996, Buchanan et al. 1997). Foraging bull trout used to occupy the Crooked River up to Prineville and were reported in Trout and Squaw creeks (USFWS 2004, Buchanan et al. 1997).

Abundance

Abundance of spawning bull trout has been monitored since 1986 in the Jack and Jefferson complexes and on the Warm Springs Reservation since 1998 (USFWS 2004). The USFWS Draft Recovery Plan (2004) provides estimates of adult bull trout abundance in each population based on redd count data collected between 1998 and 2002 and a 2.3 fish per redd expansion factor (Ratliff et al. 1996, Dunham et al. 2001, USFWS 2004). These estimates were used to assess the abundance criterion (Table 3). Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Table 3. Estimated adult abundance of Deschutes bull trout populations based on USFWS 2004.

Population	Estimated Adult Abundance	Pass/Fail
Warm Springs	214	Pass
Shitike	279	Pass
Whitewater	0-60	Fail
Jefferson Complex	410	Pass
Jack Complex	706	Pass
Suttle Lake	*Extinct population*	
Upper Deschutes	*Extinct population*	
Crescent Lake	*Extinct population*	

The Whitewater population is estimated to contain fewer than 100 adults, however, estimates of abundance in Whitewater may be conservative due to the difficult nature of redd surveys. Whitewater River is remote, difficult to access, and frequently turbid due to glacial run-off (USFWS 2004). This population is considered at risk of extinction due to inbreeding and fails the criterion until population abundance can be better assessed.

The estimated total number of adult bull trout in the SMU averaged 1,640 between 1998 and 2002, and ranged from 915 to 2,208 (USFWS 2004). Based on this estimate the SMU is not considered at risk of genetic drift (>1,000) (Reiman and Allendorf 2001). However, the Pelton Round Butte Hydroelectric Project prevents mixing between the Metolius populations and Warm Springs and Shitike populations. Because Warm Springs and Shitike have a total estimate of 500 adults combine these populations may be at risk of genetic drift until passage can be established at the hydroelectric facility and mixing among all population occurs.

Productivity

Productivity is evaluated using abundance estimates generated from annual redd counts. A population passes the productivity criterion if it displays a stable or increasing trend over the past five years. A decreasing trend is cause for a population to fail the productivity criterion. Trends in abundance for the Deschutes SMU populations are evaluated using data sets of annual census redd counts. This review recognizes the difficulties associated with characterizing population trend using redd counts given the inherent variability in redd detection and souces of statistical error (Dunham et al. 2001, Maxell 1999, Rieman and Myers 1997). The evaluation of productivity based on apparent population trend is made with caution and subject to uncertainty.

All populations pass the productivity criterion. Jefferson and Jack complexes and Shitike show an increasing trend in abundance, and Warm Springs appears stable (Figure 1). Data to assess productivity of the Whitewater population are not available due to difficult access and turbid water conditions. Even though the population has a low abundance this review assumes it is minimally self-sustaining given trends of the other Metolius Basin populations, an adfluvial life history, intact stream habitat, and an absence of non-native species. The population passes the productivity criterion.

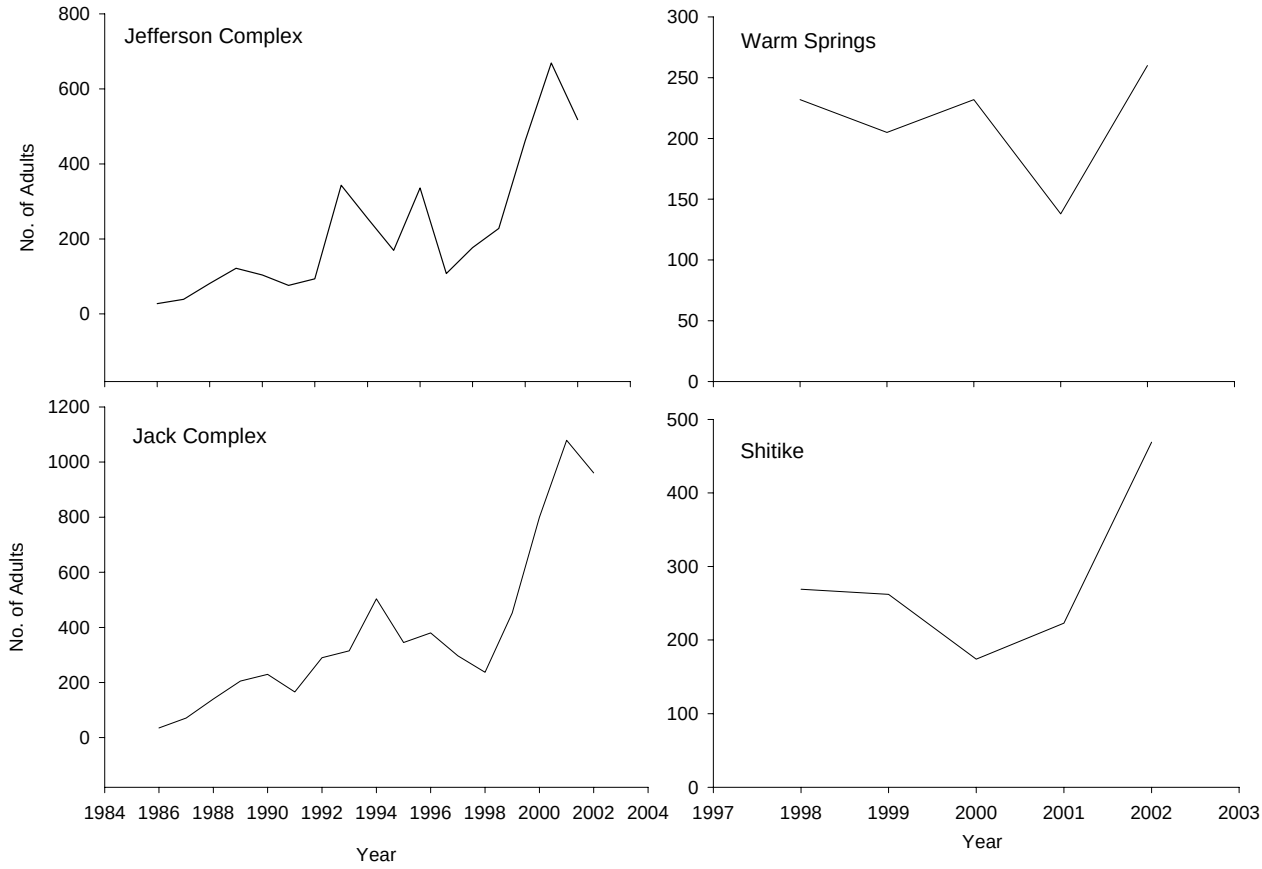

Figure 1. Trends in population abundance for Deschutes Bull Trout SMU populations.

Reproductive Independence

All populations in the Deschutes Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available, then it is assumed hybrids are common where bull trout and brook trout are sympatric.

Brook trout were stocked into streams, rivers, and high alpine lakes in the Deschutes River basin. Brook trout currently occur in the Warm Springs River, Shitike Creek, and Canyon Creek (Jack Complex). In Canyon Creek brook trout occur upstream of cold water reaches where bull trout are more abundant. This population passes the hybridization criterion because bull trout and brook trout are rarely sympatric and hybridization is rare. The degree of hybridization in Warm Springs and Shitike populations is undocumented. These populations fail the hybridization criterion until data are available to quantify hybridization (Table 4).

Table 4. Occurrence of brook trout and hybridization for Deschutes bull trout populations.

Population	Brook Trout	Pass/Fail
Warm Springs	Yes	Fail
Shitike	Yes	Fail
Whitewater	No	Pass
Jefferson Complex	No	Pass
Jack Complex	Yes	Pass*
Suttle Lake	*Extinct population*	
Upper Deschutes	*Extinct population*	
Crescent Lake	*Extinct population*	

** Brook trout are present but hybridization is uncommon.*

Assessment Conclusions

The Deschutes Bull Trout SMU contains eight populations, three of which are considered extinct. Bull trout no longer exist in the upper Deschutes River basin, Crescent Lake, and Suttle Lake. Movement between populations in the Warm Springs Indian Reservation and the Metolius River basin is impeded by the Pelton\Round Butte Hydroelectric Project. Jack and Jefferson complexes are two of the most abundant and productive in Oregon; both populations pass all interim criteria and are considered "not at risk". Hybridization with brook trout is assumed to be common in Warm Springs and Shitike creeks. The SMU is classified as "potentially at risk", failing the hybridization and extinction criteria (Figure 2). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

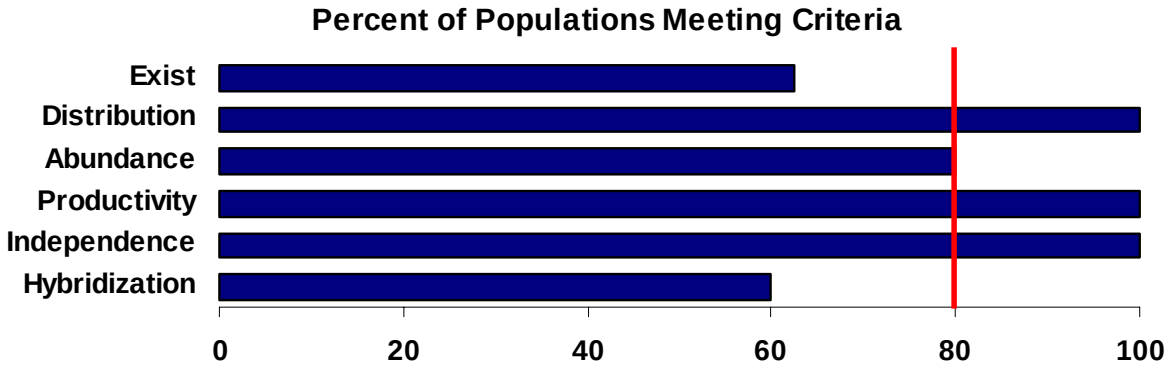

Figure 2. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Odell Lake Bull Trout

Existing Populations

The Odell Lake bull trout population is the one remaining, natural, adfluvial population in Oregon, and is the only population in the Odell Lake Bull Trout SMU (Table 1). Odell Lake was physically isolated from the Deschutes River Basin by a 5,500 year old lava flow which impounded Odell Creek and created Davis Lake (Buchanan et al. 1997).

Table 1. Populations, existence status, and life history of the Odell Lake Bull Trout SMU.

Exists	Population	Description	Life History
Yes	Odell Lake	Odell and Davis lakes and tributaries.	Adfluvial

Distribution

Bull trout currently occupy Odell Lake, Trapper and Odell creeks and two Odell Creek tributaries; Maklaks Creek and an unnamed tributary. Adfluvial bull trout are occasionally reported in Davis Lake and in 2002 one juvenile bull trout was observed in Fire Creek, an Odell Lake tributary (USFWS 2004). Bull trout spawning distribution exists in a 1.3 km reach of Trapper Creek between the mouth and a 2.3 meter barrier waterfall. Historically, Crystal Creek contained the majority of the bull trout spawning distribution; however only kokanee spawn there now (USFWS 2004).

Habitat degradation in Trapper and Crystal creeks is considered a significant threat to spawning bull trout (USFWS 2004). Habitat in Trapper Creek has been significantly altered in the past 70 years through the construction of railroad and road crossings. The removal of wood and riparian vegetation, and the construction of gabions and revetments have resulted in a channelized and over-simplified stream corridor. In 2003 the USFS completed a channel restoration project designed to improve spawning and rearing habitat (USFWS 2004). Crystal Creek spawning habitat is limited due to the contribution of fine sediment and potentially warm water temperatures (USFWS 2004).

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997). These data are primarily based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when historical distribution data are available (Table 2).

Table 2. Distribution data used to evaluate Odell Lake bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Odell Lake	1.3	33	No	Fail

Because Odell Lake is disconnected from the upper Deschutes basin, bull trout in Odell Lake are isolated from other populations. Given Odell Lake bull trout have a very limited spawning distribution, occupy less than 50% of their historical habitat, and are isolated from other bull trout populations, the population fails the distribution criterion (Table 2).

Abundance

Total abundance of Odell Lake bull trout is unknown. Creel surveys, night snorkel counts, trap captures, and redd surveys all suggest the abundance of bull trout is extremely low (USFWS 2004). An average of 15 (range 0 - 30) bull trout were incidentally captured in the kokanee fishery between 1996 and 1999. An average of two adult bull trout (range 0 - 8) and 95 juveniles (range 26 - 208) were counted during annual night snorkel counts in Trapper Creek since 1996. Redd counts in Trapper Creek have never exceeded 16 redds, although redds are difficult to detect due to large substrates, lack of algal growth, and kokanee redd superimposition (USFWS 2004). Challenges associated with each dataset hinder our ability to quantify abundance of the Odell Lake bull trout population.

Based on the previously mentioned datasets, field observations, and professional judgment, the USFWS Odell Lake Bull Trout Recovery Team estimated the abundance of bull trout to be between 20 and 50 adults (USFWS 2004). Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion. Given this estimate, Odell Lake bull trout are considered at risk of the deleterious effects of inbreeding and genetic drift. This population fails the abundance criterion (Table 3).

Table 3. Estimated adult abundance of Odell Lake bull trout populations based on USFWS 2004.

Population	Estimated Adult Abundance	Pass/Fail
Odell Lake	20-50	Fail

Productivity

Data are not available to quantitatively assess productivity of the Odell Lake population, however, the extremely small population size and high variability observed in redd counts and snorkel counts suggests productivity is depressed (USFWS 2004). The presence of non-native salmonids, particularly kokanee, brook trout, and lake trout, negatively impact productivity through redd superimposition, hybridization, competition, and predation. In addition, degraded and limited spawning and rearing habitat in Trapper and Crystal creeks likely limit the population's reproductive capacity. Given these factors, the population fails the productivity criterion.

Reproductive Independence

The Odell Lake bull trout population is native sustained by natural production and passes the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Brook trout were historically stocked in high elevation mountain lakes in Odell Lake basin including Yoran Lake, the headwaters of Trapper Creek, and Lower Rosary Lake, a tributary to

Odell Creek. Brook trout are currently present in Trapper Creek and are known to hybridize with bull trout (USFWS 2004). Two hybrids were captured in 2004, one in Odell Lake and one on a redd in Trapper Creek (S. Jacobs, ODFW Corvallis Research Lab, personal communication). Although the relative occurrence of bull trout x brook trout hybrids is undocumented, any degree of hybridization is considered a significant impact given the small size of the bull trout population. The Odell Lake population fails the hybridization criterion (Table 4).

Table 4. Occurrence of brook trout and hybridization for Odell Lake bull trout populations.

Population	Brook Trout	Pass/Fail
Odell Lake	Yes	Fail

Assessment Conclusions

The Odell Lake Bull Trout SMU is comprised of one population, the single remaining natural adfluvial population in Oregon. The abundance of the Odell Lake bull trout population is perilously low and spawning habitat is severely limited and of marginal quality. The presence of non-native salmonids, particularly lake trout, brook trout, and kokanee, drastically limit productivity. The Odell Lake SMU meets two of the six interim criteria and is classified as "at risk" (Figure 1). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of interim criteria.

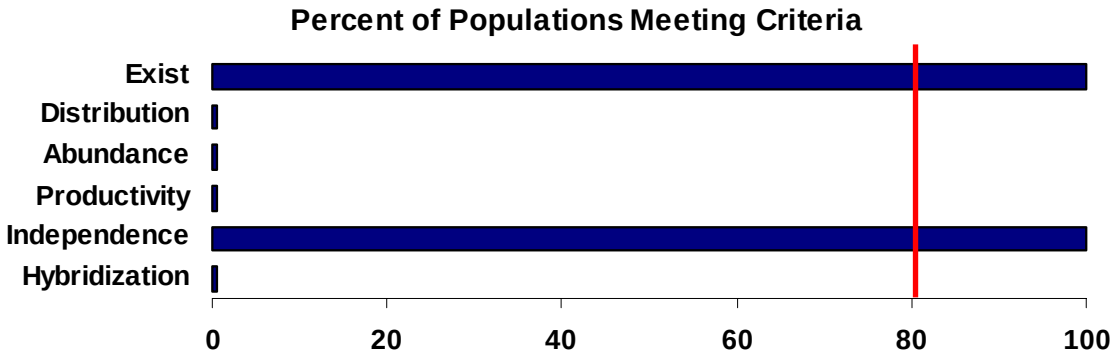

Figure 1. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

John Day Bull Trout

Existing Populations

The John Day Bull Trout SMU is comprised of 20 populations, seven of which are located in the North Fork John Day basin, nine in the Middle Fork John Day basin, and four in the Upper Mainstem John Day basin (Table 1). Six populations in the Middle Fork John Day basin and two populations in the Mainstem John Day basin are classified as extinct. Knowledge of historical distributions and populations is incomplete. Historically the populations structure may have been much different than represented in this review. Current and extinct populations are defined based on those identified in the John Day River Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004) and Ratliff and Howell (1992). This review identifies Big Creek as an additional population in the North Fork John Day Basin. USFS biologists have observed bull trout and bull trout x brook trout hybrids in streams of this watershed (T. Unterwegner, ODFW John Day Fish District, personal communication).

Table 1. Populations, existence status, and life history of the John Day Bull Trout SMU.

Exist	Population	Description	Life History
		North Fork	
Yes	Upper North Fork	Upper NF John Day River and tributaries upstream of Granite Creek, incl. Crawfish, Baldy, Cunningham, Trail, Onion and Crane creeks.	Resident /Migratory
Yes	Upper Granite	Upper Granite Creek and tributaries incl. Boulder, Boundary, Deep, and Bull Run creeks.	Resident /Migratory
Yes	Big	Big and Winom creeks.	Resident/Migratory?
Yes	Clear	Clear Creek below Pete Mann ditch.	Resident/Migratory?
Yes	Clear/Lightning	Clear, Lightning, and Salmon creeks above Pete Mann Ditch.	Resident
Yes	Desolation	Desolation, NF and SF up to falls.	Resident /Migratory
Yes	SF Desolation	SF Desolation above falls.	Resident
		Middle Fork	
Yes	Clear	Clear Creek.	Resident
Yes	Granite Boulder	Granite Boulder Creek.	Resident /Migratory
Yes	Big	Big and Deadwood creeks.	Resident /Migratory
No	Upper Middle Fork	Upper Middle Fork John Day River and tributaries.	
No	Big Boulder	Big Boulder Creek.	
No	Davis	Davis Creek.	
No	Vinegar	Vinegar Creek.	
No	Butte	Butte Creek.	
No	Indian	Indian Creek.	
		Mainstem	
Yes	Upper John Day	Upper Mainstem John Day River and tributaries, incl. Deardorff, Reynolds, Rail, Roberts and Call creeks.	Resident /Migratory
Yes	Indian	Indian Creek and tributaries.	Resident
No	Pine	Pine Creek and tributaries.	
No	Canyon	Canyon Creek and tributaries.	

Distribution

Spawning and rearing distribution of bull trout in the John Day basin is highly fragmented and limited to headwater streams of the North Fork, Middle Fork, and Upper Mainstem John Day rivers. Adult and sub-adult bull trout seasonally utilize the entire North Fork John Day River for rearing and foraging, and in the Upper Mainstem John Day River they are suspected to forage down to the vicinity of the town of John Day. Migratory bull trout have been captured in the Mainstem John Day River near the town of Spray; however use of the lower reaches is sporadic due to warm water temperatures and low flows during the summer months (USFWS 2004, Buchanan et al. 1997).

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997). These data are primarily based on summer distribution sampling that often represents the most restricted distribution. A population fails the criterion if spawning and resident distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historical distribution when historical distribution data are denoted in GIS. In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical range. These results should be interpreted with caution, given that historical data are not always available. Five of the 12 existing populations pass the distribution criterion (Table 2).

Table 2. Distribution data used to evaluate John Day bull trout populations.

Population	Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
		North Fork		
Upper North Fork	75.1	100	Yes	Pass
Upper Granite	1.08	11	Yes	Fail
Big	*undocumented*	*undocumented*	Yes	Fail
Clear	13.5	100	Yes	Pass
Clear/Lightning	*undocumented*	*undocumented*	No	Fail
Desolation	33.3	70.2	Yes	Pass
SF Desolation	5.8	100	No	Fail
		Middle Fork		
Clear	6.6		Yes	Fail
Granite Boulder	6.5		Yes	Fail
Big	17.5		Yes	Pass
Upper Middle Fork		*Extinct population*		
Big Boulder		*Extinct population*		
Davis		*Extinct population*		
Vinegar		*Extinct population*		
Butte		*Extinct population*		
Indian		*Extinct population*		
		Mainstem		
Upper John Day	68.4		Yes	Pass
Indian	3.6		No	Fail
Pine		*Extinct population*		
Canyon		*Extinct population*		

Spawning and rearing distribution of bull trout in the Upper Granite population is limited to an extremely short portion of Boulder Creek. Historically, spawning distribution included reaches of Granite Creek (Hanson 2001, Buchanan et al. 1997). The Upper Granite population fails the

distribution criterion because current spawning distribution is limited to one km, only 11% of the historical distribution.

W.F. Clear, Salmon, and Lightning creeks are bisected by the Pete Mann Ditch which diverts water from these creeks to the Burnt River basin for irrigation and mining purposes. Diversions associated with the ditch prevent upstream movement of bull trout into the upper reaches of streams in the Clear/Lightning population (USFWS 2004). Due to isolation from other populations in the North Fork John Day, the Clear/Lightning population fails the distribution criterion.

Irrigation withdrawal on Indian Creek (Upper Mainstem John Day) dewaters the stream channel each summer, seasonally isolating the small bull trout population in the headwaters (USFWS 2004). The Indian population fails the distribution criterion because of the short spawning distribution and seasonal isolation from migratory corridors and other populations.

Clear (MFJD), Granite Boulder, Big (NFJD), and SF Desolation all fail the distribution criterion because spawning and resident distribution is less than ten km. SF Desolation is also isolated above a natural barrier falls. Definitive spawning and rearing distribution of the Big (NFJD) population is undocumented; field observations indicate it is restricted to less than ten km (T. Unterwegner, ODFW John Day Fish District, personal communication).

Abundance

Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Few datasets describe the abundance of individual populations in the John Day SMU. In 1999 ODFW conducted population surveys of the three Middle Fork populations. Results estimated 1,950 individuals in Big Creek, 640 individuals in Clear Creek (MFJD), and 368 individuals in Granite Boulder Creek (Hemmingsen 1999b). These estimates of abundance primarily represent juvenile and sub-adult fish. Based on these data and the professional opinion of the John Day Bull Trout Recovery Team, none of the populations in the John Day SMU exceed 100 adults (USFWS 2004), therefore all populations in the SMU are at risk of inbreeding and fail the abundance criterion.

The John Day Bull Trout SMU likely contains fewer than 1,000 adults and is considered at risk of genetic drift. Basin-wide probabilistic sampling of bull trout using redd surveys between 2002 and 2004 produced an estimate of the total number of redds in the SMU (Table 3) (Sankovich et al. 2003, 2004, Starcevich et al. 2005). Measures of adult abundance based on these redd estimates and an expansion factor of 2.3 adults per redd (Ratliff 1996, Dunham et al. 1999) does not consistently exceed 1,000 adults.

Table 3. Estimates of total number of bull trout redds in the John Day SMU based on probabilistic sampling (Sankovich et al. 2003, 2004, Starcevich et al**. 2005).**

Year	n	Redds	95% CI
2002	42	540	± 38%
2003	48	193	± 31%
2004	49	235	± 36%

Productivity

Data are not available to quantitatively assess productivity and the intrinsic rate of population increase for bull trout in the John Day SMU. In the absence of these data the qualitative assessment of the productivity criterion is based on distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. These qualities suggest populations are minimally able to sustain current abundance. The expression of a migratory life history and connectivity between populations and high quality habitat also increases the probability of a population sustaining itself. The presence of non-native species or significant habitat degradation may negatively affect productivity and cause a population to fail the criterion if it is limited in other factors.

Only the North Fork John Day, Upper John Day, and Big (MFJD) populations pass the productivity criterion (Table 4). All other populations fail the criterion due to limited distribution, low abundance, and, in some instances, the presence of brook trout.

Table 4. Factors considered in the assessment of the productivity criterion of John Day bull trout.

Population	Factors	Pass/Fail
	North Fork	
Upper North Fork	Likely highest total abundance in SMU; wide distribution and adequate connectivity to support a migratory life history; abundant brook trout.	Pass
Upper Granite	Extremely limited distribution and low abundance; migratory life history.	Fail
Big	Limited distribution and abundance; brook trout abundant; resident life history.	Fail
Clear	Limited distribution and low abundance; resident life history, though recent sighting of two sub-adult bull trout in lower reaches may indicate otherwise.	Fail
Clear/Lightning	Limited distribution, isolated above Pete Mann Ditch; resident life history.	Fail
Desolation	Low abundance; migratory life history.	Fail
SF Desolation	Isolated above barrier falls; limited distribution; brook trout present.	Fail
Middle Fork		
Clear	Limited distribution; resident life history; potentially degraded habitat.	Fail
Granite Boulder	Limited distribution and abundance; migratory life history.	Fail
Big	Extensive spawning habitat; highest abundance in Middle Fork; migratory life history.	Pass
Upper Middle Fork	*Extinct population*	
Big Boulder	*Extinct population*	
Davis	*Extinct population*	
Vinegar	*Extinct population*	
Butte	*Extinct population*	
Indian	*Extinct population*	
	Mainstem	
Upper John Day	Highest concentration of spawning activity in the John Day Basin (ODFW, Native Fish Investigations Project, unpublished data); wide distribution; migratory life history; brook trout present but not abundant.	Pass
Indian	Very limited spawning distribution; seasonally isolated; resident life history.	Fail
Pine	*Extinct population*	
Canyon	*Extinct population*	

Reproductive Independence

All bull trout are naturally-produced and hatchery bull trout programs do not exist in Oregon. Because issues of reproductive independence do not apply to bull trout, all populations pass this criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Brook trout were stocked in tributary streams of the North Fork John Day (Camas, Winom, and Rock creeks) and Upper Mainstem John Day (Canyon Creek) between 1925 and 1940 (ODFW and Oregon Fish Commission Fish Stocking records). Brook trout were also stocked in alpine lakes of both basins, most importantly Baldy, Olive, Jump-Off-Joe, and Crawfish Lakes in the North Fork and Magone, Little Strawberry, Strawberry, and Slide lakes in the Mainstem John Day (USFWS 2004). Streams and lakes in the Middle Fork John Day basin were not stocked with brook trout.

In the North Fork John Day basin, hybridization appears to be common where bull trout and brook trout co-occur. Four populations in the North Fork John Day basin; Upper North Fork, Big, Desolation, and SF Desolation, fail the hybridization criterion (Table 5). Brook trout are present in Desolation Creek, however the degree of hybridization with bull trout is unknown. This population fails the hybridization criterion until the degree of hybridization can be better assessed. In the mainstem John Day River Basin brook trout are present in the Little Meadow section of the Upper John Day population, however hybrid trout have not been observed during routine sampling activities (T. Unterwegner, ODFW John Day Fish District, personal communication, ODFW Native Fish Investigations Project, unpublished data). This population passes the hybridization criterion.

Table 5. Occurrence of brook trout and hybridization for John Day bull trout populations.

Population	Brook Trout	Pass/Fail
North Fork		
Upper North Fork	Yes	Fail
Upper Granite	No	Pass
Big	Yes	Fail
Clear	No	Pass
Clear/Lightning	No	Pass
Desolation	Yes	Fail
SF Desolation	Yes	Fail
Middle Fork		
Clear	No	Pass
Granite Boulder	No	Pass
Big	No	Pass
Upper Middle Fork	*Extinct population*	
Big Boulder	*Extinct population*	
Davis	*Extinct population*	
Vinegar	*Extinct population*	
Butte	*Extinct population*	

Indian		*Extinct population*	
	Mainstem		
Upper John Day	Yes		Pass*
Indian	No		Pass
Pine		*Extinct population*	
Canyon		*Extinct population*	

** Brook trout are present in a section of the Upper John Day River, but hybrids are uncommon.*

Assessment Conclusions

The John Day Bull Trout SMU includes 20 populations distributed among headwater streams of the North Fork, Middle Fork, and upper Mainstem John Day rivers. Five populations in the Middle Fork John Day and two in the mainstem John Day rivers are considered extinct. Overall abundance within the SMU is extremely low and spawning distribution is highly fragmented and restricted to small tributary streams. Productivity of most populations is limited by habitat quality, non-native species, and a lack of a migratory life history. The SMU only meets the reproductive independence criterion and is classified as 'at risk' (Figure 1). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

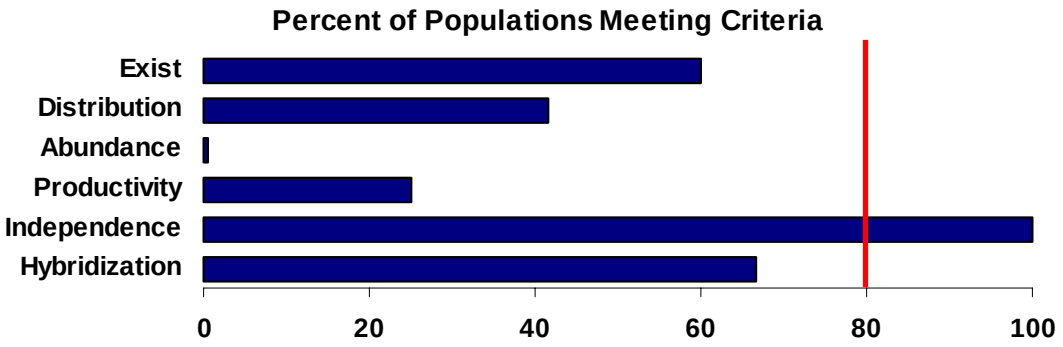

Figure 1. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Umatilla Bull Trout

Existing Populations

The Umatilla Bull Trout SMU is comprised of two populations, the upper Umatilla Complex and Meacham (Table 1). Populations were identified according to those defined in the Umatilla - Walla Walla Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004). Both populations exhibit resident and migratory life history strategies.

Table 1. Populations, existence status, and life history of the Umatilla Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Umatilla Complex	North and South Fork Umatilla River Basins	Resident/ migratory
Yes	Meacham	Meacham Cr and tributaries	Resident/ migratory

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information summarized in the Umatilla – Walla Walla Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004). These data are primarily based on summer distribution sampling that often represents the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when historic distribution data are denoted on GIS. In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical distribution. These results should be interpreted with caution, since historical data are not always available.

Bull trout in the Umatilla River are found primarily upstream of Pendleton. Adult bull trout rear and overwinter in the upper river, typically upstream of Thorn Hollow Creek. In the past ten years, adult bull trout have been observed in only five instances at dam facilities on the lower river. Adult bull trout are rarely observed rearing in the lower mainstem of Meacham Creek.

Spawning, juvenile rearing, and resident bull trout distribution in the Umatilla SMU is limited to the upper headwaters of the Umatilla River and NF Meacham Creek. In the Umatilla Complex population spawning activity is fragmented and patchy. A majority of the spawning activity occurs in the North Fork Umatilla River inside the North Fork Umatilla Wilderness Area; in the five km reach between Coyote Creek and Woodward Creek. A low percentage of the spawning activity occurs in the South Fork Umatilla River and Shimmiehorn Creek. A total of three redds were observed in the South Fork Umatilla River between 1996 and 2002 (USFWS 2004). Rearing occurs in Buck, Thomas, Spring and Shimmiehorn creeks (USFWS 2004). Based on the total distribution of spawning and juvenile bull trout, the Umatilla Complex population passes the distribution criterion (Table 2).

The spawning distribution within the Meacham population is limited to 6.6 km in the North Fork upstream of the Bear Creek confluence and in Pot Creek. North Fork Meacham Creek below Bear Creek is characterized as high quality spawning and rearing habitat and could potentially support bull trout even though fish have not been observed in this reach. East Meacham Creek and mainsteam Meacham Creek between North and East forks are also considered to contain suitable spawning habitat (USFWS 2004) but spawning activity has not been documented. The Meacham population fails the distribution criterion (Table 2).

Connectivity between the Umatilla Complex and Meacham populations is possible but hindered by seasonal low flows and thermal barriers (Table 2)(USFWS 2004). Movement of adults and sub-adults to and from the Columbia River is hampered by water quality issues and instream diversions used to divert flows into irrigation canals and off-channel storage reservoirs. Fish passage concerns at the six major diversions on the Umatilla River have been or are being addressed due to the impact on anadromous salmonids, however the needs of bull trout were not often considered in the design of the modifications (USFWS 2004).

Table 2. Distribution data used to evaluate Umatilla bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Umatilla Complex	65.1	100	Yes	Pass
Meacham	6.6	55.6	Yes	Fail

Abundance

The Bull Trout Draft Recovery Plan (USFWS 2004) provides estimates of the number of adult bull trout in each population based on average redd counts made between 1999 and 2003 and a 2.3 fish per redd expansion factor (USFWS 2004, Dunham et al. 2001, Ratliff et al. 1996). The assessment of the abundance criterion is based on these estimates (Table 3). Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion

Table 3. Estimated adult abundance of Umatilla bull trout populations (USFWS 2004).

Population	Estimated Adult Abundance	Pass/Fail
Umatilla Complex	249	Pass
Meacham	<10	Fail

Given the extremely low number of redds observed in the Meacham Creek annually (Table 4), the Meacham population appears to be precariously small and highly vulnerable. Biologists estimate the population consists of fewer than ten individuals (USFWS 2004). The Meacham population fails the abundance criterion and is considered at risk of inbreeding depression.

Table 4. Total redd counts in Meacham Creek 1994 - 2004 (USFWS 2004, ODFW unpublished data).

Year	1994	1995	1996	1997	1998-2001	2002	2003	2004
Redd Count	3	1	0	0	Not surveyed	2	0	0

The total number of adult bull trout in the SMU is estimated to be less than 1,000 fish, thus Umatilla Basin bull trout are at risk of the deleterious effects of genetic drift.

Productivity

The assessment of the productivity criterion is based on trends of abundance over the past five years. A population passes the criterion if the abundance trend appears stable or increasing. A decreasing trend is cause for a population to fail the criterion. Trends of abundance for the Umatilla SMU populations are evaluated using data sets of annual census redd counts. This review recognizes the difficulties associated with characterizing population trend using redd counts given the inherent variability in redd detection and sources of error (Dunham et al. 2001, Maxell 1999, Rieman and Myers 1997). The evaluation of productivity based on population

trend is made with caution and subject to uncertainty. Standardized redd counts in the Umatilla Complex began in 1994. Over the past five years the population shows a decreasing trend in abundance (Figure 1) and is considered to fail the productivity criterion until productivity can be better assessed.

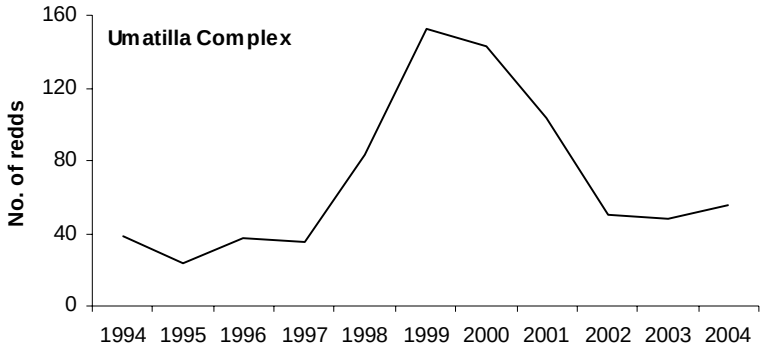

Figure 1. Trends in total redd counts for Umatilla Complex.

Productivity of the Meacham bull trout population is difficult to assess using the available data. Given the extremely low redd counts (Table 4), relatively few observations of bull trout and no evidence of a recent population increase, this population fails the productivity criterion.

Reproductive Independence

All populations in the Umatilla Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion.

Hybridization

Brook trout are not present in the Umatilla basin and not considered a threat to bull trout. Both populations pass the hybridization criterion.

Assessment Conclusions

The Umatilla Bull Trout SMU consists of two populations, one in each of Meacham Creek and Upper Umatilla River. The abundance of the Meacham population is dangerously low and distribution is severely limited. Habitat degradation significantly impacts both populations, particularly in the lower reaches of the Umatilla River, where adult bull trout rear and overwinter. Movement between populations is possible, but undocumented. The SMU passes three of the six interim criteria and is classified as "at risk" (Figure 2). Limited data sets and inferences from other information for populations in the SMU provide a qualified level of confidence in the assessment of the interim criteria.

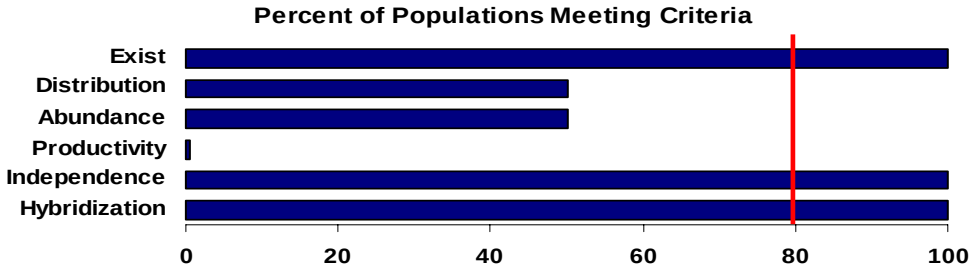

Figure 2. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Walla Walla Bull Trout

Existing Populations

The Walla Walla Bull Trout SMU is comprised of two populations, one in each of Mill Creek and the Upper Walla Walla River (Table 1). Populations were identified according to those defined in the Umatilla - Walla Walla Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004). Both populations express resident and migratory life history strategies.

Table 1. Populations, existence status, and life history of the Walla Walla Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Walla Walla Complex	North and South Fork Walla Walla Rivers	Resident/ migratory
Yes	Mill	Upper Mill Creek and tributaries	Resident/ migratory

The Touchet River basin, a subbasin of the Walla Walla River in Washington, contains three bull trout populations, South Fork, Wolf Fork, and North Fork. These populations are thought to be isolated from the Walla Walla Complex and Mill populations (USFWS 2004) as a function of poor water quality and inhospitable habitat in the lower Touchet River. Populations in Washington are considered to be "depressed" (USFWS 2004) but are not evaluated in this status review.

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information summarized in the Umatilla-Walla Walla Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004). These data are primarily based on summer distribution sampling that often represents the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when historic distribution data are denoted on GIS. In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical range. Though this is likely accurate for Walla Walla River bull trout, these results should be interpreted with caution since historical data are not always available.

Spawning, juvenile rearing, and resident bull trout distribution in the Walla Walla SMU occurs in the upper reaches of the North Fork and South Fork Walla Walla rivers and Mill Creek, and exceeds ten km in both populations (Table 2). The majority of the spawning distribution within the Walla Walla Complex occurs in the South Fork Walla Walla River and its tributaries upstream of Bear Creek. Spawning activity in the upper North Fork Walla Walla River is minimal and sporadic; only eight redds were observed in 2002 and none in surveys conducted since (USFWS 2004, ODFW John Day Watershed District office, unpublished data). Spawning activity in Mill Creek occurs primarily upstream of Paradise Creek.

Bull trout in both populations have access to large rivers and migratory corridors; however connectivity between populations is poor. Low flow conditions, high water temperatures, and diversion dams in the Walla Walla River and lower Mill Creek hinder the ability of bull trout to move between populations from late spring through fall. Adult bull trout rear and overwinter in the mainstem Walla Walla River upstream of the Oregon/Washington border (USFWS 2004). Occasional sightings of bull trout have occurred downstream of the Mill Creek confluence.

Recent observations of bull trout moving up the Bennington Lake Diversion Dam ladder, suggests movement from downstream of the town of Walla Walla, presumably from Yellowhawk Creek (T. Bailey, ODFW John Day Watershed District Office, personal communication). Although connectivity between populations in the SMU and to the Columbia River is poor, intermixing is possible. Both populations pass the distribution criterion (Table 2).

Table 2. Distribution data used to evaluate Walla Walla bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops	Pass/Fail
Walla Walla Complex	45.9	100	Yes	Pass
Mill	34.8	100	Yes	Pass

Abundance

The Bull Trout Draft Recovery Plan (USFWS 2004) provides estimates of the number of adult bull trout in each population based on average redd counts between 1994 and 2003 and a 2.3 fish per redd expansion factor (USFWS 2004, Dunham et al. 2001, Ratliff et al. 1996). These estimates are used to assess the abundance criterion (Table 3). Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion

Table 3. Estimated adult abundance of Walla Walla bull trout populations (USFWS 2004).

Population	Estimated Adult Abundance	Pass/Fail
Walla Walla Complex	989	Pass
Mill	480	Pass

Both populations exceed 100 spawning adults, are considered not at risk of inbreeding depression, and pass the abundance criterion. The total number of adults within the SMU exceeds 1000 adults minimizing the negative effects of genetic drift; however, connectivity between these populations must improve to fully avoid these genetic risks.

Productivity

The assessment of the productivity criterion was evaluated based on trends of abundance over the past five years. A population passes the criterion if trends appear stable or increasing. A decreasing trend is cause for a population to fail the criterion. Trends in abundance for the Walla Walla SMU populations were evaluated using data sets of annual census redd counts. This review recognizes the difficulties associated with characterizing population trend using redd counts, given the inherent variability in redd detection and sources of statistical error (Dunham et al. 2001, Maxell 1999, Rieman and Myers 1997). The evaluation of the productivity criterion based on apparent population trend is made with caution and subject to uncertainty.

Annual redd count data indicates an stable trend in abundance both in the Walla Walla Complex and Mill Creek over the past five years (USFWS 2004, ODFW John Day Watershed District office, unpublished data, USFWS 2004, Sankovich et al. 2003, 2004, Hemmingsen et al. 2002) (Figure 1). Based on these data, both populations pass the productivity criterion.

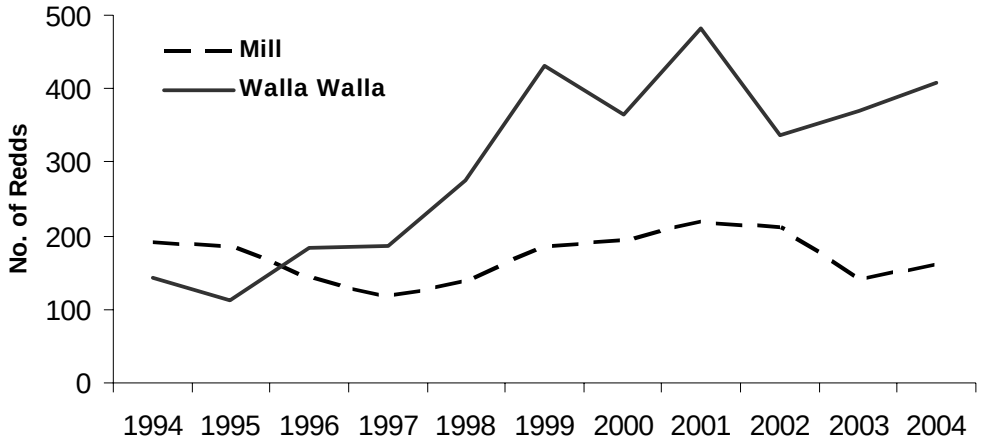

Figure 1. Trends in total redd counts for Walla Walla Complex and Mill populations.

Reproductive Independence

All populations in the Walla Walla Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion.

Hybridization

Brook trout are not present in the Walla Walla basin and not considered a threat to bull trout. Both populations pass the hybridization criterion.

Assessment Conclusions

The Walla Walla Bull Trout SMU consists of two populations, one in each of upper Walla Walla River and Mill Creek. Three additional populations not considered in this assessment are present in Touchet River, a tributary of the Walla Walla River in Washington. Bull trout in both Oregon populations express a fluvial life history strategy and are relatively abundant and productive. High quality spawning habitat is extensive in the upper reaches of Mill Creek and Walla Walla River, however connectivity between populations is poor from late spring to fall. Both populations pass all six interim criteria and the SMU is classified as "not at risk" (Figure 2). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

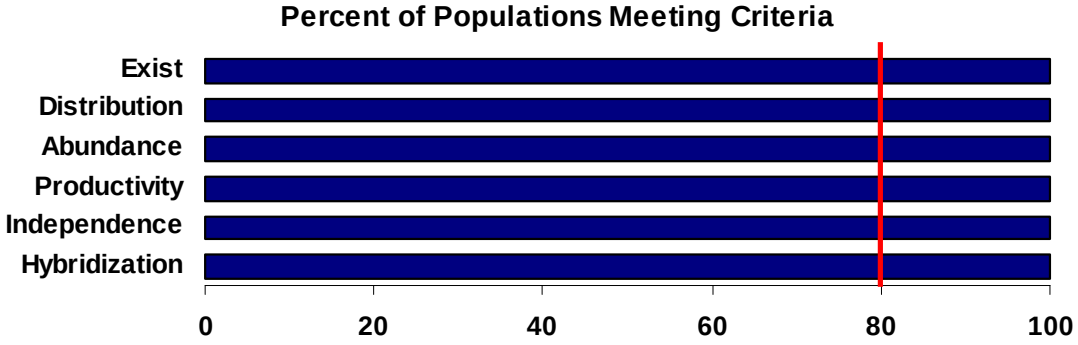

Figure 2 Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Grande Ronde Bull Trout

Existing Populations

The Grande Ronde Bull Trout SMU is comprised of 12 populations, one of which is classified as extinct (Table 1). Populations are identified according to those defined in the Grande Ronde Chapter of the Bull Trout Draft Recovery Plan (2004), with the exception of Lostine and Minam populations. The USFWS Draft Recovery Plan identifies bull trout in Bear Creek and Lostine River as one local population, and Deer Creek and Minam River as another. This review defines bull trout in these streams as separate populations. ODFW radio telemetry data collected from bull trout on the Lostine River show fish consistently returning to the Lostine River (Phil Howell, USFS La Grande, personal communication) and provide no evidence of movement into Bear Creek. Fish in Lostine and Minam rivers and Deer and Bear creeks are treated as separate populations until data suggest otherwise.

Table 1. Populations, existence status, and life history of the Grande Ronde Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Wenaha	Wenaha River and tributaries.	Resident /Migratory
Yes	Lookingglass	Lookingglass and Little Lookingglass creeks.	Resident /Migratory
Yes	Deer	Deer Creek and tributaries.	Resident /Migratory
Yes	Minam	Minam River and tributaries.	Resident /Migratory
Yes	Little Minam	Little Minam River above barrier falls.	Resident
Yes	Lostine	Lostine River.	Resident /Migratory
Yes	Bear	Bear and Goat Creek and tributaries.	Resident /Migratory
Yes	Hurricane	Hurricane Creek.	Resident
No	Wallowa Lake	Wallowa River above and including Wallowa Lake.	
Yes	Indian	Indian Creek.	Resident
Yes	Catherine	Catherine Creek and tributaries.	Resident
Yes	Upper Grande Ronde	Upper Grande Ronde River and tributaries, incl, Limber Jim, Indiana, Clear, Lookout, and Hoodoo creeks.	Resident

During the late 1930s and early 1940s bull trout were intentionally removed from Wallowa Lake and its tributaries to reduce predation on rainbow trout (Ratliff and Howell 1992). Migratory bull trout moving up into the lake were trapped and eliminated at a dam and a series of weirs and wild bull trout were eradicated by the 1950s (Buchanan et al.1997).

A population suspected to have been present in Wenatchee Creek, a tributary to the Grande Ronde River in Washington, is now considered extinct (USFWS 2004). This population is not included in this status review.

Distribution

Complete historical distribution is undocumented. It is thought that bull trout occupied all major tributaries in the upper Grande Ronde Basin and a seasonal connection existed with the Snake River (Buchanan et al.1997). Current known spawning and resident distribution of bull trout is spread throughout the headwaters streams of the Grande Ronde basin, though most populations are concentrated in the Wallowa River basin. Potential for inter-population connection exists through major migratory corridors and large rivers, however bull trout use of these rivers is limited by high temperatures and low flow during the summer months (USFWS 2004).

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information provided by ODFW biologists. These data are primarily based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and resident distribution is 1) less than ten km, and 2) not connected to other populations. Knowledge of the historical bull trout distribution is insufficient; thus the percent of historical habitat currently occupied was not calculated for the Grande Ronde SMU. Four of the 11 existing populations fail the distribution criterion (Table 2).

Table 2. Distribution data used to evaluate Grande Ronde bull trout populations.

Population	Spawning Distribution (km)	Connected to Other Pops.	Pass/Fail
Wenaha	92.5	Yes	Pass
Lookingglass	36.3	Yes	Pass
Deer	11.1	Yes	Pass
Minam	59.6	Yes	Pass
Little Minam	19.4	No	Fail
Lostine	23.3	Yes	Pass
Bear	27.5	Yes	Pass
Hurricane	7.6	No	Fail
Wallowa Lake	*Extinct population*		
Indian	<10	Yes	Fail
Catherine	57.6	Yes	Pass
Upper Grande Ronde	<10	Yes	Fail

Due to a limited spawning and rearing distribution and isolation from other populations the Hurricane population fails the distribution criterion. Distribution of bull trout in Hurricane Creek is limited to a short section of stream upstream of a series of barriers. The Consolidated/Moonshine Ditch diversion dam prohibits upstream movement as does seasonal dewatering of reaches below the ditch. In addition, a bedrock chute appears to be a barrier at low and moderate flows and potentially at high flows (USFWS 2004).

The Little Minam resident bull trout population also fails the criterion because it is isolated above a barrier falls which prevents the expression of a migratory life history and the opportunity for genetic exchange. As an isolated population, this group is at greater risk of extinction due to stochastic events.

Indian and Upper Grand Ronde populations fail the criterion due to a severely restricted spawning distribution. In both populations the definitive spawning distribution is undetermined. The lower portion of Indian Creek is located on private land where the potential downstream habitat and distribution has not been sampled. Biologists are certain that the population is not widely distributed and instead limited to a very small area. An unusual sighting of juvenile Chinook in the upper reaches confirms connectivity to the Grand Ronde River (J. Zakel, ODFW Grande Ronde Watershed District Office, personal communication).

Spawning distribution in the Upper Grand Ronde population is highly fragmented. Spawning activity is restricted to short segments in Limber Jim, Indiana, Fly, and Clear creeks. Even though definitive spawning distribution is undescribed, biologists believe it is severely limited (J. Zakel, ODFW Grande Ronde Watershed District Office, personal communication).

Abundance

In the absence of quantitative abundance data, the assessment of the abundance criterion is based on best guess estimates of adult bull trout generated by the Grande Ronde River Bull Trout

Recovery Team (USFWS 2004) and ODFW district biologists (Table 3). These estimates are supported by redd counts, trap data, field observations, and professional judgment. Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus, an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Table 3. Estimated adult abundance of Grande Ronde bull trout populations.

Population	Estimated Adult Abundance	Pass/Fail
Wenaha	2,000	Pass
Lookingglass	200	Pass
Deer	<100	Fail
Minam	200	Pass
Little Minam	750	Fail
Lostine	500-1,000	Pass
Bear	<100	Fail
Hurricane	<100	Fail
Wallowa Lake	*Extinct population*	
Indian	<100	Fail
Catherine	<100	Fail
Upper Grande Ronde	<100	Fail

Although bull trout in the Little Minam are relatively abundant (approx. 750 adults), the population is isolated above a barrier falls which prohibits upstream movement of migratory bull trout and exchange of genetic material. The abundance criterion provides a guideline of 1,000 adults in order to avoid effects of genetic drift. Since this population has no opportunity for mixing with other populations and is fewer than 1,000 adults, it is considered at risk of genetic drift and therefore fails the abundance criterion.

The Hurricane population fails the criterion based on a 2002 population survey. Results of the survey estimated 198 bull trout, 88 of which were likely mature adults (>170 mm) (ODFW, Enterprise Fish District, unpublished report). In addition bull trout in Hurricane Creek are repeatably observed at extremely low densities.

Few data are available to assess abundance of Bear, Deer, Indian, Catherine, and Upper Grande Ronde populations. Field observations in all of these populations suggest bull trout are sparse and densities are very low (J. Zakel, ODFW Grande Ronde Watershed District Office, personal communication; B. Smith, ODFW Enterprise Field Office, personal communication). Based on these observations and professional judgment these populations fail the abundance criterion until they can be better assessed.

Productivity

Data are not available to quantitatively assess productivity and the intrinsic rate of population increase for bull trout in the Grande Ronde SMU. In the absence of these data a qualitative assessment of the productivity criterion is based on distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. These qualities suggest populations are minimally able to sustain current abundance. The expression of a migratory life history and connectivity between populations and diverse habitats also increases the probability of a population sustaining itself. The presence of non-native species or significant habitat degradation may negatively affect productivity and cause a population to fail the criterion if it is limited in other factors. The Bear,

Deer, and Hurricane populations fail the productivity criterion due to restricted distribution and low abundance, limited habitat quality, and the presence of brook trout. All other populations in the SMU pass the criterion (Table 4).

Table 4. Factors considered in the assessment of the productivity criterion of Grande Ronde bull trout.

Population	Factors	Pass/Fail
Wenaha	Extensive distribution and high abundance; habitat pristine, exclusively in designated Wenaha Wilderness Area; connectivity to Grande Ronde River supports migratory life history.	Pass
Lookingglass	Distribution and abundance appear minimally adequate for the population to sustain itself; expression of a migratory life history; redd counts since 1994 generally indicate a stable to increasing trend in abundance (USFWS 2004).	Pass
Deer	Limited distribution and abundance, migratory life history; stable but restricted habitat; brook trout absent.	Fail
Minam	Distribution extensive; abundance likely high; habitat pristine – 90% within a Wilderness Area; brook trout present; migratory life history.	Pass
Little Minam	Although isolated from other populations and only able to express a resident life history; spawning distribution is adequate and abundance stable; habitat in excellent condition completely within Eagle Cap Wilderness Area.	Pass
Lostine	Widely distributed and adequate abundance; large migratory component to the population (citation); habitat in good condition with the exception of temperature and flow issues in the lower river due to irrigation activities in the summer months; brook trout present.	Pass
Bear	Migratory life history; low abundance; brook trout present; habitat degraded in lower reaches, upper reaches and Goat Creek in designated wilderness.	Fail
Hurricane	Limited distribution and low abundance; abundant brook trout population; limited ability to express a migratory life history; lacks connectivity to other populations.	Fail
Wallowa Lake	*Extinct population*	--
Indian	Distribution restricted and likely low abundance; resident life history; high quality habitat; evidence suggests productivity minimally adequate to persist.	Pass
Catherine	Migratory component exists; distribution is adequate; low abundance; Chinook and steelhead available as food source; evidence suggests productivity minimally adequate to persist.	Pass
Upper Grande Ronde	Small migratory component exists; abundance and distribution limited; Chinook and steelhead present as food source; productivity minimally adequate to sustain the population.	Pass

Reproductive Independence

The Grande Ronde Bull Trout SMU is the only SMU where hatchery bull trout were released historically. In order to re-establish the bull trout fishery in Wallowa Lake, fingerling and legal sized Dolly Varden and bull trout were released between 1968 and 1978. These plantings did not establish a self-sustaining population, and the population is now considered extinct (USFWS 2004, Buchanan et al. 1997). In 1997 bull trout collected in the Little Sheep Creek canal were released into Wallowa Lake, however natural production has not been documented.

All existing populations in the Grande Ronde Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion. Hatchery bull trout programs do not currently exist in Oregon.

Hybridization

Brook trout were historically stocked into streams, rivers, and high alpine lakes in the Grande Ronde basin. Brook trout stocking programs no longer exist in moving waters in the basin. A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are

rare or non-existent. For most populations the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Brook trout are present in the Wallowa, Minam, NF Minam, Lostine, and Grande Ronde rivers, and in Hurricane, Bear, Lookingglass, Lost, Limber Jim, Elk, Silver, Hoodoo, and Beaver creeks (USFWS 2004). In Hurricane Creek, 24% of the trout encountered during the 2002 population survey were bull trout x brook trout hybrids and therefore the population fails the criterion (ODFW, Enterprise Fish District, unpublished report). The degree of hybridization in other populations where brook trout are present is undocumented. These populations fail the hybridization criterion until data are available to demonstrate hybridization is rare (Table 5).

Table 5. Occurrence of brook trout and hybridization for Grande Ronde bull trout populations.

Population	Brook Trout	Pass/Fail
Wenaha	No	Pass
Lookingglass	Yes	Fail
Deer	No	Pass
Minam	Yes	Fail
Little Minam	No	Pass
Lostine	Yes	Fail
Bear	Yes	Fail
Hurricane	Yes	Fail
Wallowa Lake	*Extinct population*	
Indian	No	Pass
Catherine	No	Pass
Upper Grande Ronde	Yes	Fail

Assessment Conclusions

The Grand Ronde Bull Trout SMU includes 12 populations, of which over half are concentrated in the Wallowa River basin. The Wallowa Lake population was eliminated by the 1950s and is now considered extinct. The Wenaha River is one of Oregon's most pristine and undisturbed river systems and contains one of the states' healthiest bull trout populations. Abundance is considered precariously low in more than half of the populations in this SMU and hybridization with introduced brook trout has put many populations at risk, particularly in the Wallowa River. The SMU passes two of the six interim criteria and is classified as 'at risk' (Figure 1). Limited data sets and inferences from other information for populations in the SMU provide a qualified level of confidence in the assessment of the interim criteria.

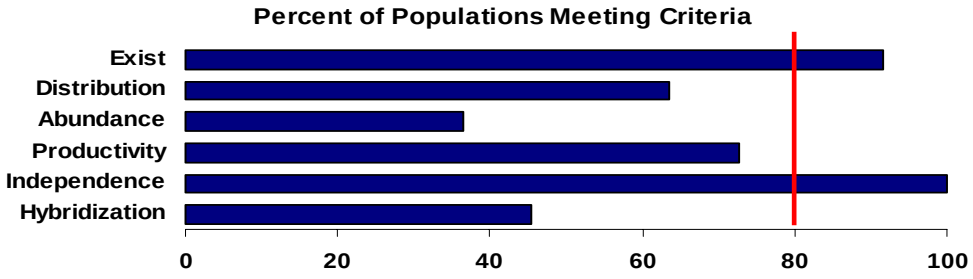

Figure 1. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Imnaha Bull Trout

Existing Populations

The Imnaha Bull Trout SMU is comprised of four populations, none of which are considered extinct (Table 1). Population delineation is defined based on geographical, physical, and thermal isolation of the spawning distribution of each population and populations are the same as those identified in the Imnaha-Snake Rivers Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004), Buchanan et al. (1997), and Ratliff and Howell (1992).

Table 1. Populations, existence status, and life history of the Imnaha Bull Trout SMU.

Exist	Population	Description	Life History
Yes	Imnaha	Imnaha River above Sheep Creek.	Resident /Migratory
Yes	Big Sheep	Big Sheep Creek and tributaries.	Resident /Migratory
Yes	Little Sheep	Little Sheep Creek and tributaries.	Resident /Migratory
Yes	McCully	McCully Creek above WVI canal.	Resident

It is unknown if bull trout naturally exist in Little Sheep Creek. The Wallowa Valley Improvement Canal (WVI), constructed in the 1880s, transports water from Big Sheep, Salt, Little Sheep, and McCully creeks to Prairie Creek in the Wallowa River basin for irrigation purposes. The Little Sheep bull trout population may have been established from the delivery of water and fish from Big Sheep Creek via the WVI canal (B. Knox, ODFW Enterprise Field Office, personal communication). For the purpose of this review, Little Sheep is treated as a current existing population.

Two additional populations, Sheep and Granite, exist on the Idaho side of the Snake River and are in close proximity to the Imnaha River populations. Intermixing among all populations potentially exists but has not been documented. Sheep and Granite populations are not assessed in this status review.

Distribution

Although historical distribution is undocumented, it is believed that current distribution of bull trout in the Imnaha basin reflects the historical distribution (USFWS 2004, Buchanan et al. 1997). However, the historical summer distribution likely extended further downstream than it does today. Currently, bull trout utilize the entire Imnaha River and the Big Sheep Creek system. Adult bull trout overwinter and rear in the lower reaches of the Imnaha River, downstream of Summit Creek, and in the Snake River. Spawning and resident distribution occurs in headwater reaches of each population.

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information summarized in the Bull Trout Draft Recovery Plan (USFWS 2004). These data are primarily based on summer distribution sampling that often represents the most restricted distribution. A population fails the criterion if the spawning and resident distribution is: 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historical distribution when historical distribution data are denoted on GIS. In basins where the GIS hydrography does not depict historical distribution, the results show populations occupy 100% of their historical range. Though this is likely accurate for Imnaha River bull trout, these results should be interpreted

with caution since historical data are not always available. Two of the four populations fail the distribution criterion (Table 2).

Table 2. Distribution data used to evaluate Imnaha bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
Imnaha	75.3	100	Yes	Pass
Big Sheep	31.5	100	Yes/No	Pass
Little Sheep	6.5	60	Yes/No	Fail
McCully	10.8	100	No	Fail

The Wallowa Valley Improvement canal dramatically affects the distribution of bull trout in Big Sheep, Little Sheep and McCully populations. Diversions for the WVI canal in each creek allow bull trout to move downstream but prevent any upstream movement. The canal is not screened and has the potential to capture bull trout from all streams it bisects (Buchanan et al. 1997).

Spawning and resident distribution of the Little Sheep population is limited to a total of 6.5 km which includes the lower reaches of Cabin and Redmont creeks. In addition to being restricted, the distribution is bisected by the WVI Canal. Fish can move downstream past the diversion but are unable to move upstream (USFWS 2004). Because of these factors Little Sheep fails the distribution criterion.

The McCully population fails the distribution criterion because it is isolated upstream of the WVI canal. The upstream barrier created by the WVI canal diversion prohibits the expression of a migratory life history and mixing with other populations. As an isolated population, this group is at greater risk of extinction due to stochastic events.

Abundance

Few data are available to adequately assess the abundance of bull trout in the Imnaha SMU. Data that are available were either collected more than ten years ago in 1992 or are better used to describe relative abundance and population trend. In the absence of quantified and current estimates of abundance, best guess estimates are based on the 1992 density estimates, recent field observations, and professional judgment (Table 3). Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Table 3. Estimated adult abundance of Imnaha bull trout populations (ODFW, Enterprise Fish District, unpublished data).

Population	Estimated Adult Abundance	Pass/Fail
Imnaha	2,000	Pass
Big Sheep	> 300	Pass
Little Sheep	--	Fail
McCully	> 300	Pass

-- *Data not available*

The Imnaha population is one of the most abundant and viable in Oregon. Based on redd counts, weir trap data, and creel information, the Imnaha-Snake Rivers Bull Trout Recovery Team estimates the entire SMU to contain approximately 4,000 adults, a majority of which reside in

the Imnaha River population (USFWS 2004). This population is estimated to contain at least 2,000 adult bull trout, and passes the abundance criterion.

The only measures of abundance in Big Sheep and McCully populations were density estimates collected more than ten years ago in 1992. Based on these data the number of adult bull trout in each population is estimated to be greater than 300 individuals. Field observations made since then indicate current densities have remained similar to those recorded in 1992 (B. Knox, ODFW Enterprise Fish District, personal communication). Evidence does not exist to suggest significant changes in abundance and productivity have occurred since. Both populations pass the abundance criterion.

Although estimates of abundance for the Little Sheep population are not available, it failed the abundance criterion because bull trout were found during presence/absence surveys in 1991, but not in 1992 (USFWS 2004). Buchanan et al. (1997) considers the Little Sheep population at a "high risk of extinction". There is no evidence to suggest this population should pass the abundance criterion.

Productivity

Data are not available to quantitatively assess productivity and the intrinsic rate of population increase for bull trout in the Imnaha SMU. In the absence of these data the assessment of the productivity criterion is based on distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. These qualities suggest populations are minimally able to sustain current abundance. The presence of a migratory life history and connectivity between populations and habitat also increases the probability of a population sustaining itself. The presence of non-native species or significant habitat degradation may negatively affect productivity and cause a population to fail the criterion if it is limited in other factors.

Only the Little Sheep population fails the productivity criterion due to an extremely limited distribution and low abundance (Table 4). The level of productivity of this population is not likely high enough to replace itself each year. Imnaha, McCully, and Big Sheep populations pass the criterion.

Table 4. Factors considered in the assessment of the productivity criterion of Imnaha bull trout.

Population	Factors	Pass/Fail
Imnaha	Extremely abundant and widely distributed; spawning distribution within designated wilderness; express a migratory life history.	Pass
Big Sheep	Abundance and distribution appears adequate though population bisected by the WVI canal; spawning areas partially within designated wilderness; express a migratory life history.	Pass
Little Sheep	Restricted distribution and extremely low abundance; limited expression of a migratory life history; habitat impacted by 1992 forest fire (Buchanan et al. 1997).	Fail
McCully	Isolated population though abundance and density appear high (USFWS 2004); resident life history; population likely self-sustaining.	Pass

Reproductive Independence

All populations in the Imnaha Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion. Hatchery bull trout programs do not currently exist in Oregon.

Hybridization

Brook trout are not known to occur in the Imnaha River basin, and thus hybridization is not a threat to populations in the SMU. All populations pass the hybridization criterion.

Assessment Conclusions

The Imnaha Bull Trout SMU includes four populations in the Imnaha River basin. Two additional populations occur in close proximity on the Idaho side of the Snake River. Potential of intermixing between all populations exists, but has not been documented. Distribution of McCully, Little Sheep, and Big Sheep populations is negatively impacted by irrigation diversions and barriers to movement. Even though the SMU is classified as 'at risk', passing only three of the six criteria (Figure 1), the Imnaha population is considered one of the most abundant and viable in Oregon. Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

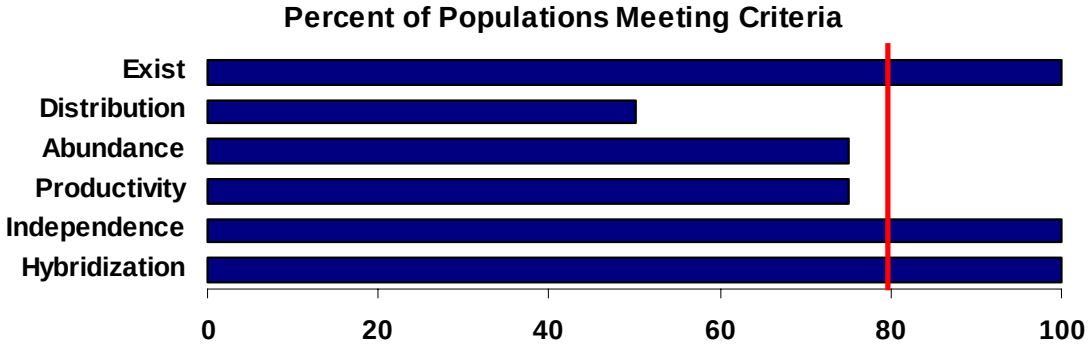

Figure 1. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Hells Canyon Bull Trout

Existing Populations

The Hells Canyon Bull Trout SMU includes 14 populations in basins draining into the Snake River between Wieser River and Hells Canyon Dam (Table 1). Four existing populations are contained in the Pine Creek watershed, which enters the Snake River at Hells Canyon Reservoir. Ten populations are within the Powder River basin, which enters the Snake River at Brownlee Reservoir. Populations are defined based on those identified in the Hells Canyon Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004) and Ratliff and Howell (1992). This review defines the Anthony population as two distinct populations, Anthony (including North Anthony Creek) and Indian. Bull trout in Indian Creek are above a natural barrier falls and isolated from fish in Anthony Creek (USFWS 2004). In addition, Eagle Creek is identified as an existing population. Eagle Creek historically supported a significant bull trout population; however surveys in 1991 and 1994 failed to locate bull trout (USFWS 2004, Buchanan et al. 1997). If bull trout are present in the basin the distribution and abundance is severely limited. The population will not be considered extinct until a thorough and appropriate survey is conducted.

Three additional populations exist in Idaho, across the Snake River from the Pine Creek system, Bear, Indian, and Crooked. Potential exists for movement between the Pine Creek populations and the Indian population (ID) (USFWS 2004). Populations in Idaho are not assessed in this review.

Table 1. Populations, existence status, and life history of the Hells Canyon SMU.

Exist	Population	Description	Life History
		Pine Creek	
Yes	Elk	Elk Creek and tributaries, incl. Aspen, Big Elk and Cabin Creeks	Resident
Yes	East Pine	East Pine Creek	Resident
Yes	Clear	Clear Creek and tributaries incl Meadow and Trail Creeks	Resident
Yes	Upper Pine	Upper Pine Creek incl. West Fork, East Fork and Middle Fork Pine Creek	Resident
		Powder	
Yes	Eagle	Eagle Creek and tributaries	Resident
Yes	Wolf	Wolf Creek	Resident
Yes	Anthony	Anthony Creek and tributaries	Resident
Yes	Indian	Indian Creek	Resident
Yes	North Powder	Upper North Powder River and tributaries	Resident
Yes	Muddy	Big Muddy Creek and tributaries	Resident
Yes	Pine	Pine Creek and tributaries	Resident
Yes	Salmon	Salmon Creek and tributaries	Resident
Yes	Lake	Lake Creek and tributaries	Resident
Yes	Upper Powder	Upper Powder River and tributaries incl. Silver and Little Cracker Creeks	Resident

Passage barriers and overall degradation of aquatic habitat and riparian conditions have contributed to the loss of migratory life history in these basins. All populations exhibit a resident life history (Buchanan et al. 1997, Chandler et al. 2001a), however the movement of a radio-tagged bull trout from Hells Canyon Reservoir into Pine Creek indicates a migratory life history may still persist in the basin (USFWS 2004, Chandler et al. 2001b).

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997) and information summarized in the Hells Canyon Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004) and Pratt (2001). These data are based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and resident distribution is 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historic distribution when historic distribution data are denoted on GIS. Two of the 14 populations pass the distribution criterion (Table 2)

Table 2. Distribution data used to evaluate Hells Canyon bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
		Pine Creek		
Elk	17.0	46	Yes	Fail
East Pine	7.9	25	Yes	Fail
Clear	20.7	58	Yes	Pass
Upper Pine	6.5	22	Yes	Fail
		Powder River		
Eagle	--	<10	Yes	Fail
Wolf	1.9	--	No	Fail
Anthony	13.3	62	Yes	Pass
Indian	3.2	--	No	Fail
North Powder	2.0	9	Yes	Fail
Muddy	0.5	--	Yes	Fail
Pine	1.3	--	Yes	Fail
Salmon	1.5	--	No	Fail
Lake	3.4	--	Yes	Fail
Upper Powder	11.7	45	Yes	Fail

-- Historical distribution unknown.

Known bull trout distribution in the Hells Canyon SMU is highly fragmented and limited to short isolated segments of headwater streams. Eleven of the 14 populations in the SMU have a distribution less than ten km, and seven are less than four km. Only two populations in Powder River basin, Anthony and Upper Powder, and two in the Pine Creek basin, Elk and Clear, exceed a distribution of ten km.

Elk, East Pine, Pine, North Powder, Upper Powder, and Eagle populations all fail the distribution criterion because they occupy less than 50% of the known historical distribution. In the Upper Powder population current distribution is discontinuous; remnants of the historic distribution remain in Little Cracker and Silver creeks and movement between each creek is possible but not common. In Eagle Creek, bull trout historically were distributed throughout the basin, but current distribution appears to be drastically restricted. The population is considered to occupy just fragments of its historical distribution.

Large dams and irrigation diversions restrict distribution and minimize connection between populations within the SMU. Brownlee Dam on the Snake River has isolated bull trout in the Powder River from populations in Pine Creek and Idaho drainages. Thief Valley Dam, located on the Powder River downstream of Baker City, prevents access to the Snake River for bull trout in the Powder River populations, and Mason Dam (Phillips Reservoir) in the upper Powder River basin prohibits potential mixing between Upper Powder and Lake populations with other

populations in the Powder River. The Salmon population is constricted by passage barriers at both the upstream and downstream extent of the distribution. A municipal diversion prevents bull trout from moving upstream, and downstream movement is prohibited at a point where the stream flows subsurface (USFWS 2004). The Wolf Creek population is isolated above Wolf Creek Reservoir (USFWS 2004).

Abundance

For this review populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criterion. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Data are not available to adequately assess the current abundance of adult bull trout in each population. The only quantitative population estimate in the Pine Creek basin was conducted 11 years ago in 1994 (Buchanan et al. 1997) and may not capture current conditions. Also, redd surveys occur at index reaches that do not census the entire population. In the Powder River basin evaluation and monitoring activities do not regularly occur. Knowledge of distribution and abundance is derived primarily from field observations.

Given the lack of quantified information, this review utilizes the index redd surveys in Pine Creek basin as the basis for evaluation of the abundance criterion (Table 3). These surveys are not a complete census of the spawning grounds, and contain inherent sources of error due to difficulties of redd detection and surveyor variability (Dunham et al. 2001), and therefore are not to be interpreted as absolute measures of abundance. Instead this review considers these redd counts, expanded by a factor of 2.3 adults per redd (Ratliff et al. 1996, Dunham et al. 2001), to represent the minimum number of adults present in each population. If redd counts estimate close to 100 adults for the most recent years then a population passes the criterion. Upper Pine is the only population to pass the abundance criterion in the Pine Creek basin (Table 3).

Table 3. Total redds observed at index spawning survey sites in Pine Creek basin (ODFW, LaGrande Fish District, unpublished data).

Population	Miles Surveyed	1999	2000	2001	2002	2003	2004
Elk	1.70	5	9	13	7	11	25
East Pine	1.15	5[a]	6	13	8	3	4
Clear	2.05	5	26	33	16	16	38
Upper Pine	2.71	38[b]	20[c]	42	43	51	41[d]

[a] *6.5 miles surveyed.*
[b] *4.2 miles surveyed.*
[c] *2.9 miles surveyed.*
[d] *3.2 miles surveyed.*

All populations in the Powder River basin, except the Upper Powder population, fail the abundance criterion. A 1999 population survey in Silver Creek (Upper Powder) incorporated electrofishing and snorkel techniques and an endoscope to determine maturity to estimate the reproductive population. Results approximated the population to contain 885 individuals (Hemmingsen et al. 2001). Based on this estimate the Upper Powder population passes the criterion. The remaining populations failed the criterion given field observation of low densities. None of the observations in these populations suggest abundance might exceed 100 adults (Bellerud et al. 1997, USFWS 2004).

The Hells Canyon Bull Trout Recovery Team estimated abundance of adult bull trout to be fewer than 1,000 reproductive adults (USFWS 2004), putting bull trout in the SMU at risk of the deleterious effects of genetic drift. Even though we are unable to quantitatively assess each population individually, the SMU is considered to fail the abundance criterion.

Productivity

Data are not available to quantitatively assess productivity and the intrinsic rate of population increase for bull trout in the Hells Canyon SMU. In the absence of these data a qualitative assessment of the productivity criterion is based on distribution and abundance, connectivity, life history, habitat quality, and presence of non-native species. A population passes the criterion if it is widely distributed and relatively abundant or if there are indications of an increasing or stable trend in abundance. These qualities suggest populations are minimally able to sustain current abundance. The presence of a migratory life history and connectivity between populations also increases the probability of a population sustaining itself. The presence of non-native species or significant habitat degradation may negatively affect productivity and cause a population to fail the criterion if it is limited in other factors.

All populations in the Hells Canyon SMU fail the productivity criterion due to limited distribution and abundance and the expression of only a resident life history. Brook trout present in some populations also potentially impacts productivity. A viability modeling exercise implemented by Idaho Power assessed the persistence and population growth of populations in the Pine Creek basin (Pratt 2001). The study concluded that all populations in Pine Creek are at risk of extinction because of low abundance, isolation, and limited suitable habitat. Because the Powder River populations have many of the same population characteristics as the Pine Creek populations the results are assumed to also apply to the Powder populations. High productivity in each population is likely episodic, not consistently high enough to replace a population annually.

Reproductive Independence

All bull trout are naturally-produced and hatchery bull trout programs do not exist in Oregon. Because issues of reproductive independence do not apply to bull trout, all populations pass this criterion.

Hybridization

Brook trout were stocked into many of the high alpine lakes in the Elkhorn and Wallowa mountains as early as the 1930s (USFWS 2004). In many cases introduced brook trout established self-sustaining populations and invaded connecting streams. Brook trout have established populations in all but East Pine in the Pine Creek basin and are widespread in the Powder River basin (USFWS 2004).

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For most populations in the SMU the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available and bull trout and brook trout are sympatric, this review assumes hybrids are common. Seven of the existing populations pass the hybridization criterion (Table 4).

Table 4. Occurrence of brook trout and hybridization for Hells Canyon bull trout populations.

Population	Brook Trout	Pass/Fail
	Pine Creek	
Elk	Yes	Pass*
East Pine	No	Pass
Clear	Yes	Fail
Upper Pine	Yes	Pass*
	Powder River	
Eagle	Yes	Fail
Wolf	No	Pass
Anthony	Yes	Fail
Indian	Yes	Fail
North Powder	Yes	Fail
Muddy	Yes	Pass*
Pine	Yes	Fail
Salmon	No	Pass
Lake	Yes	Pass*
Upper Powder	Yes	Fail

* Brook trout are present but distribution does not overlap bull trout.

Four populations pass the hybridization criterion even though brook trout are present in each stream. In these instances brook trout and bull trout are not sympatric. The distribution of bull trout and brook trout in Lake Creek are separated by a natural barrier and the two species remain allopatric (USFWS 2004). Brook trout were observed both upstream and downstream of the bull trout distribution in Big Muddy Creek, but distributions do not overlap (USFWS 2004). The Elk population passes the hybridization criterion, even though brook trout are present in the headwaters in Twin Lakes (USFWS 2004). In Upper Pine brook trout are not present in bull trout occupied reaches. Brook trout distribution in these populations should be carefully monitored in the future.

Assessment Conclusions

The Hells Canyon Bull Trout SMU includes 14 populations in Pine Creek and Powder River, both of which flow into the Snake River between Weiser River and Hells Canyon Dam. Three additional populations exist in close proximity on the Idaho side of the Snake River. Movement between the Idaho and Pine Creek populations is possible. Most populations in this SMU are characterized by extremely low abundances and restricted distributions. Productivity is hampered by habitat quality and quantity and the inability to express a migratory life history. The SMU passes two of the six criteria and is classified as 'at risk' (Figure 1). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

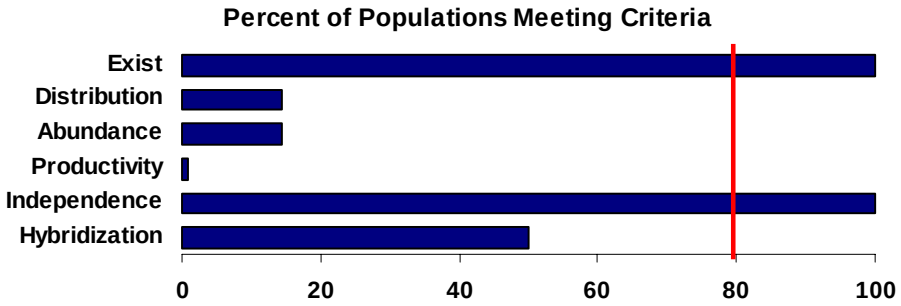

Figure 1. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.

Malheur River Bull Trout

Existing Populations

The Malheur River Bull Trout SMU is comprised of two populations, North Fork Malheur and Upper Malheur (Table 1). Populations are identified according to those defined in the Malheur River Chapter of the Bull Trout Draft Recovery Plan (USFWS 2004), Buchanan et al. (1997), and Ratliff and Howell (1992). Bull trout in both populations express resident and migratory life history strategies (Buchanan et al. 1997).

Table 1. Populations, existence status, and life history of the Malheur River Bull Trout SMU.

Exist	Population	Description	Life History
Yes	North Fork Malheur	NF Malheur River and tributaries, incl. Crane, Sheep and Swamp creeks.	Resident / Migratory
Yes	Upper Malheur	Upper Malheur River and tributaries, incl. Big and Lake creeks.	Resident / Migratory

Distribution

Analysis of the distribution criterion is based on 1:100,000 GIS hydrography of bull trout distribution (Hanson 2001, Buchanan et al. 1997). These data are primarily based on summer distribution sampling that often represent the most restricted distribution. A population fails the criterion if spawning and juvenile rearing distribution is 1) less than ten km, 2) not connected to other populations, or 3) occupies less than 50% of the historical distribution when historical distribution data are denoted on GIS (Table 2).

Historically, bull trout were thought to utilize the entire Malheur River downstream to the Snake River. Summer and spawning habitat is assumed to have included most of the upper basin tributaries in the upper mainstem and North Fork basins (Buchanan et al. 1997, USFWS 2004). In 1919 Warm Springs Dam was built on the mainstem Malheur River creating Warm Springs Reservoir. Agency Dam was constructed in 1934 on the North Fork Malheur River creating Beulah Reservoir. Both dams were constructed for irrigation and flood control purposes and neither provided fish passage (USFWS 2004).

Distribution in the North Fork Malheur River has remained unchanged since bull trout were first documented in the basin in 1955 (Buchanan et al. 1997). Currently in the North Fork Malheur bull trout are present in and upstream of Beulah Reservoir including most upper basin tributaries. Spawning, juvenile rearing, and adult resident bull trout exist in Horseshoe, Swamp, Sheep, Elk, Little Crane, and Flat creeks. Migratory bull trout overwinter in Beulah Reservoir and river reaches upstream of the reservoir, and move to the upper basin to spawn.

Bull trout in the Upper Malheur population are distributed upstream of the confluence with Wolf Creek, including many of the upper basin tributaries. Spawning, juvenile rearing, and resident adult distribution includes Snowshoe, Meadow Fork, Big, and Lake creeks. Bull trout are not documented in Warm Springs Reservoir, however it may provide suitable overwinter habitat.

Given that Agency and Warm Springs dams do not provide passage, bull trout populations in the Malheur River SMU are reproductively isolated. Gene flow between populations is not possible. Even though spawning distribution is relatively extensive compared to other populations in Oregon, both populations fail the distribution criterion due to the lack of connectivity (Table 2).

Table 2. Distribution data used to evaluate Malheur River bull trout populations.

Population	Spawning Distribution (km)	% of Historical	Connected to Other Pops.	Pass/Fail
North Fork Malheur	101.6	100	No	Fail
Upper Malheur	54	54	No	Fail

Abundance

Populations of bull trout with fewer than 100 spawning adults are considered at risk of inbreeding and fail the interim risk criteria. The sum of interconnected populations also must exceed 1,000 adults to avoid risk of genetic drift (Rieman and Allendorf 2001). Thus an SMU or an isolated population must total greater than 1,000 reproductive adults in order to pass this criterion.

Few data are available to provide a rigorous estimate of abundance. Instead abundance is inferred from census redd counts. Standardized annual spawning surveys have been conducted in the North Fork Malheur since 1996 (USFWS 2004). Abundance of bull trout in this population is estimated at 202 adults using the average of 1996-2004 redd counts (USFWS 2004, ODFW, Vale District Office, unpublished data) and an expansion factor of 2.3 fish per redd (Ratliff et al. 1996, Dunham et al. 2001) (Table 3). This population is not likely at risk of inbreeding.

Annual redd surveys have occurred in the Upper Malheur population since 1998, however, the presence of brook trout complicates redd counts. Identification of the species associated with an unoccupied redd is not possible. A redd cannot be positively identified as that of a bull trout unless bull trout are observed building the nest. Thus, use of these data to estimate bull trout abundance is unfeasible. Other data necessary to estimate abundance of bull trout in the Upper Malheur population are not available or do not represent current status (i.e. > 10 year old population estimates). Field observations reflect that bull trout densities are relatively low, except in Meadow Fork of Big Creek, which is an apparent stronghold in the population (T. Walters, ODFW Malheur Watershed District Office, personal communication).

Table 3. Estimated adult abundance of Malheur River bull trout populations.

Population	Estimated Adult Abundance	Pass/Fail
North Fork Malheur	202	Fail
Upper Malheur	--	Fail

-- *Data unavailable.*

Given the Malheur River SMU populations are reproductively isolated, each population must exceed 1,000 adults to avoid the deleterious effects of genetic drift. The USFWS Malheur River Bull Trout Recovery Team estimated fewer than 1,000 adult bull trout occupied the SMU (USFWS 2004). Thus neither population exceeds 1,000 adults and both are considered at risk of the deleterious effects of genetic drift. Both populations fail the abundance criterion.

Productivity

The assessment of the productivity criterion is based on trends of abundance over the past five years. A population passes the productivity criterion if the trend in abundance appears stable or increasing. A decreasing trend in abundance is cause for a population to fail the productivity criterion. Trends in abundance for the Malheur River SMU populations are evaluated using standardized census redd counts. This review recognizes the difficulties associated with

characterizing population trend using redd counts given the inherent variability in redd detection and sources of statistical error (Dunham et al. 2001, Maxell 1999, Rieman and Meyers 1997). The evaluation of the productivity criterion based on apparent population trend is subject to uncertainty and made with caution.

Standardized redd counts in the North Fork Malheur population began in 1996. Redd counts have declined since 2000, though recent redd counts are greater than those in 1996 (Figure 1). Given the recent trends in redd counts the populations fails the productivity criterion until productivity can be thoroughly evaluated.

Data appropriate to assess the Upper Malheur population are not available since redd counts are confounded by fall spawning brook trout. In the absence of these data the population is considered to fail the criterion due to low abundance, an isolated and fragmented spawning distribution, and the presence of a large population of brook trout. Migratory bull trout are present in the population but are not likely numerous enough to compensate for the negative impacts of the other factors.

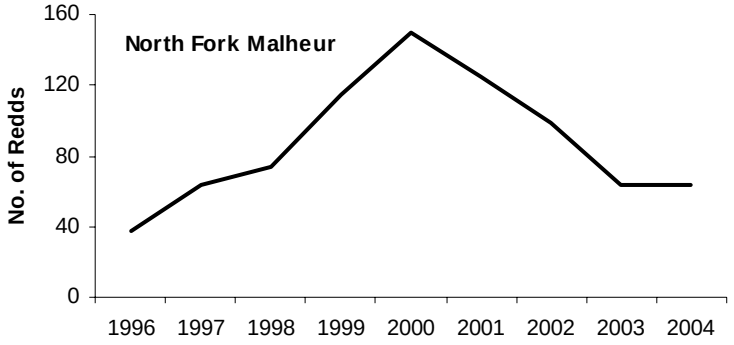

Figure 1. Trends in redd counts for North Fork Malheur population

Reproductive Independence

All populations in the Malheur River Bull Trout SMU are native fish sustained by natural production and pass the reproductive independence criterion.

Hybridization

A population is considered to pass the hybridization criterion if brook trout x bull trout hybrids are rare or non-existent. For populations in the Malheur River SMU, the degree of hybridization is not quantified, but professional judgment and the frequency of hybrids encountered during sampling provides a general indication. In cases where little or no information is available, and bull trout and brook trout are sympatric, this review assumes hybrids are common.

Stocking of brook trout in the Malheur River basin was first recorded in the late 1920s and 1930s (ODFW stocking records). Some brook trout releases resulted in self-sustaining populations. Currently brook trout are present and abundant in streams in the Upper Malheur population where bull trout x brook trout hybrids are common (ODFW, unpublished data). This population fails the hybridization criterion (Table 4). Brook trout are not present in the North Fork Malheur River.

Table 4. Occurrence of brook trout and hybridization for Malheur River bull trout populations.

Population	Brook Trout	Pass/Fail
North Fork Malheur	No	Pass
Upper Malheur	Yes	Fail

Assessment Conclusions

The Malheur River Bull Trout SMU consists of two populations, North Fork Malheur and Upper Malheur. Current spawning distribution is widespread, though fragmented, in headwater streams, and both populations are isolated from each other and other Snake River populations by impassable dams on the Malheur and North Fork Malheur Rivers. Brook trout are present and abundant in the Upper Malheur population and likely diminish the productivity of bull trout. The SMU met two of the six interim criteria and is classified as "at risk" (Figure 2). Limited data sets and inferences from other information for populations in this SMU provide a qualified level of confidence in the assessment of the interim criteria.

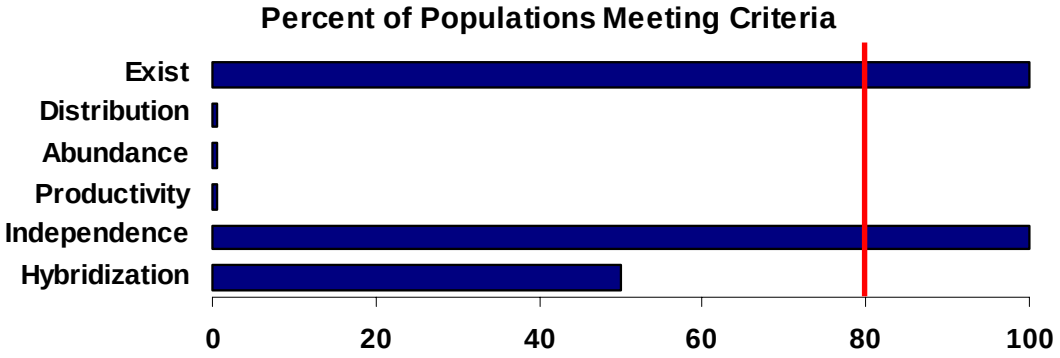

Figure 2. Assessment outcome for each of the six interim criteria with respect to the 80% threshold identified by the NFCP.