McCLOUD RIVER REDBAND TROUT
***Oncorhynchus mykiss stonei* (Jordan)**

Status: Critical Concern. Because of ongoing and recently increased interest and management, McCloud River redband trout are in no immediate risk of extinction but their populations are small, fragmented, and exist in limited habitats so status could change rapidly, particularly related to predicted climate change impacts.

Description: The following description is based on the Sheepheaven Creek population (Hoopaugh 1974, Gold 1977), which appears to have a somewhat narrower range of meristic characters than the other known populations found in Swamp, Edson, and upper Moosehead creeks. Behnke (1992), however, considered this population to best represent the subspecies because it is unlikely to have had any history of hybridization with introduced rainbow trout. Overall body shape of this redband trout is similar to the "typical" trout as exemplified by rainbow trout. It has a yellowish to orange body color with a brick-red lateral stripe. The dorsal, anal, and pelvic fins are white tipped. Adults retain parr marks. Gill rakers number from 14-18 (average 16), which is the lowest number known from any rainbow trout population (Behnke 1992). Pyloric caeca number is 29-42, which is also low. However, the numbers of scales along the lateral line (153-174) and above the lateral line (33-40) are greater than in most rainbow trout. Pelvic fin rays are 9-10 and branchiostegal rays range from 8-11. Many, but not all, McCloud River redband trout have basibranchial teeth, a characteristic more typically associated with cutthroat trout.

Taxonomic Relationships: Distinct “redband trout” from the lower McCloud River were first recognized in 1885 by Deputy U.S. Fish Commissioner, Livingston Stone, who was responsible for a fish hatchery located on the river. However, the lower portion of the McCloud River (below Middle Falls) was historically inhabited by coastal rainbow trout, including steelhead, the anadromous form and other fishes. It is uncertain whether redbands were distributed in these lower reaches and, if so, whether Stone identified them as distinct. The redband trout we recognize today are varieties of inland resident rainbow trout that resulted from invasions of headwater systems thousands of years ago, followed by isolation. The taxonomic status of California populations of redband trout has been under much debate, reflecting the diversity of forms that are called ‘redband’ trout and the long isolation of many populations (Legendre et al. 1972, Miller 1972, Behnke 1992). A complicating factor is that many populations have hybridized with the closely related coastal rainbow trout, which have been widely planted in historic redband trout streams. Behnke (1992, 2002) considers redband trout in the western U.S. to consist of a number of distinct lineages, each independently derived from early invasions of ancestral forms of trout into headwater systems, with populations then becoming isolated through geologic events. Behnke (2002) indicated that McCloud River redband trout are part of a Northern Sacramento River basin trout complex in which all populations are, or were, tied to the headwaters of the Sacramento, McCloud, Pit, and Feather rivers. In theory, the subspecies name *O .m. stonei* could be applied to any population in these headwaters but only the upper McCloud River watershed populations apparently retain unhybridized

redbands; these fish are now the exclusive possessors of the subspecies epithet (Behnke 2002).

The population in Sheepheaven Creek, described above, is so distinctive, even from other McCloud River redband trout, that Behnke suggested it should be classified as a separate subspecies. Genetic studies by Berg (1987), using electrophoretic techniques, by Nielsen et al. (1999) using microsatellites, and more recently by Stephens (2007) using nuclear DNA methods, support the conclusion that the Sheepheaven Creek form is distinct but the most recent study (Simmons et al. 2009), using both nuclear and mitochondrial single nucleotide polymorphisms indicates that Sheepheaven Creek and fish from three other streams should be considered together as the McCloud River redband trout group. Of the tributaries to the Upper McCloud River, upper Moosehead, Sheepheaven, Edson and Swamp creeks were found to contain relatively "pure" populations, with few introgressed alleles from coastal rainbow trout. Trout Creek (northern tributary) and most of the southern tributaries to the McCloud River contain redband populations with higher levels of introgression with rainbow trout. Trout in the Upper McCloud River itself apparently retain some genetic and physical characteristics of redband trout but are hybridized with coastal rainbows (Simmons et al. 2009).

Life History: Available information suggests that the life history of McCloud River redband trout is similar to that of other *O. mykiss* populations, including golden trout, in small streams. Redband trout caught from Sheepheaven Creek were in reproductive condition in June, indicating that they spawn in late spring (May-June), as do other rainbow trout at high elevations. The largest fish recorded during a 1973 survey (Hoopaugh 1974) was 208 mm FL, and the population was then estimated at 250 fish over 80 mm FL. Four size classes were found in the stream. Observations in August, 2008, suggest the same age classes were still present (J. Katz, R. Quinones, and P. Moyle, unpublished observations). However, recent (2011) CDFW surveys of Sheepheaven Creek indicated a lack of younger age classes, extremely low abundance, and limited distribution within suitable habitat (J. Weaver, CDFW, pers. comm. 2012).

Habitat Requirements: Habitat requirements for the McCloud River redband are derived from conditions in Sheepheaven Creek (Hoopaugh 1974, Moyle 2002) and the McCloud River, based on descriptions in the 1998 Redband Trout Conservation Agreement (RTCA), which summarizes information from unpublished habitat surveys. Sheepheaven Creek is a small, spring-fed stream at an elevation of 1,433 m. Water temperature in summer typically reaches 15°C and the flow drops to 0.03 m^3 sec^{-1} (1 cfs). The stream flows for about 2 km from the source and then disappears into the stream bed. During periods of drought, flows are greatly reduced and streams in the upper McCloud basin become intermittent; as a consequence, summer water temperatures can exceed 22°C. The portion of the upper McCloud River historically inhabited by redband trout usually flows at 1.2 m^3 sec^{-1} (40 cfs) through a steep canyon. It is extremely clear and cold (<15°C) but becomes very low or intermittent in times of drought.

The present day streams inhabited by presumptive redband trout are generally small and dominated by riffles and runs with under-cut banks. Pools appear to be preferred habitat for larger fish, especially if they contain dense cover from fallen trees. Spawning substrates are gravel riffles, as described for other small trout (Moyle 2002).

Spawning temperatures are usually 6-10°C. Fry rear in shallow water on stream edges for the first weeks after emergence.

Distribution: McCloud River redband trout are confined to small creeks that are tributary to the upper McCloud River (Table 1). All watersheds are wholly or partially located on the Shasta-Trinity National Forest. Historically, they were apparently present in the mainstem McCloud River above Middle Falls and perhaps in the lower river and its tributaries as well, especially in reaches not accessible to anadromous steelhead. Redband trout from Sheepheaven Springs (McKay Creek) were transplanted into Swamp Creek in 1972 and 1974 and into Trout Creek in 1977 (RTCA 1998). They are now established in both streams. According to a 2011 CDFW survey, putative redband trout exist in streams with a total length of about 8.9 km, with a total estimated population of 3,560 fish (Weaver and Mehalick 2011). Potential habitat, including the upper McCloud River, is about 98 km, or about 50 km in dry years (RTCA 1998). Most of these tributary streams remain isolated from the upper McCloud River due to subsurface flows and may only experience limited connectivity with the McCloud River during high flow events. One exception is Moosehead Creek, which can have subsurface flows during drier periods, but also has an artificial barrier 2.2 km from the confluence with the McCloud River to prevent upstream migration of non-native or hybridized trout.

Stream	Summer Flow class	Redband status	Isolation	Comments
Sheepheaven (McKay)	1	1	3	Key "pure" population
Trout	2	3	3	Introduced from Sheepheaven
Swamp	1	1	3	Introduced from Sheepheaven
Edson	1	1	3	
Tate	2	3	1	
Moosehead (upper)	1	1	2	
Raccoon	1	3	2	
Blue Heron	1	3	2	Possibly extirpated
Bull	1	3	2	
Dry	1	3	2	
Upper McCloud	3	0	1	Dominated by hybridized and non-native trout

Table 1. Redband trout streams in the upper McCloud River. Summer flow class (1 = <1 cfs, 2 =1-5 cfs, and 3 = >5 cfs in late summer in most years). Redband status (1 = 'pure' population, 2 = relatively 'pure', little introgression 3 = good redband population but slightly higher levels of hybridization, 0 = all trout hybridized). Isolation (3 = no passable connections with other streams, 2 = connections present in wet years in lower reaches, and 1 = no barriers to non-native trout).

Trends in Abundance: McCloud River redband presumably once had large, interconnected populations in the Upper McCloud River and tributaries, so the present

isolated populations represent greatly reduced remnants of historic populations. Recent genetic analyses indicate that all populations sampled from across the upper McCloud watershed shared alleles in common with the distinctive Sheepheaven Creek population, indicating that redband trout with common ancestry were once widely distributed throughout the basin (Simmons et al. 2009). Existing redband trout creeks were surveyed a number of times from 1975-1992 and in 2011 (Table 2 in RTCA 1998; Weaver and Mehalick 2011). Numbers of fish estimated were highly variable and depended on the stream and habitat sampled; numbers ranged from 53 to 1100 per km. Repeated drought cycles (e.g., 1976-1977, 1987-1992), combined with the predominance of loamy volcanic soils in the watershed, have intermittently reduced surface flows in most McCloud basin streams and limited populations of McCloud redband trout. The same is expected under future drought conditions and may be exacerbated by the effects of climate change. If population estimates are confined to the unintrogressed populations in Sheepheaven, Edson, upper Moosehead and Swamp creeks, then abundance is estimated at 3,560 putative McCloud redband trout (Weaver and Mehalick 2011).

It is likely that habitat conditions and consequent abundance of McCloud River redband trout have improved in the past 10 years, except in extremely dry years. An increase would be the expected response to many ongoing habitat restoration and protection efforts that have taken place. Presumably, habitat protection and restoration, including protection of springs, has moderated population fluctuations and reduced vulnerability to drought.

Nevertheless, it will take considerable effort to maintain McCloud redband trout populations, especially through extended droughts. A particular threat is climate change and potential reduction in stream flows in 25-50 years (once the full effects of global warming hit the Mt. Shasta region). Until then, it is likely that redband populations will continue to maintain themselves, as long as active management continues.

Nature and Degree of Threats: Long-term survival of populations of McCloud River redband trout confined to small, isolated, streams such as Sheepheaven Creek is tenuous because stream habitats are largely diminshed during drought years, a process which can be accelerated by poor watershed management practices impacting upland and riparian areas (Table 2). Fortunately, interest in conservation of McCloud River redbands has resulted in a recent reversal of downward trends in abundance and habitat quality. Factors which threaten McCloud River redband trout populations are: (1) grazing, (2) roads, (3) logging, (4) fire, (5) harvest, and (6) alien species, especially coastal rainbow trout. Upper McCloud streams can be regarded as exceptionally vulnerable to these factors due to their geologic and hydrologic nature.

Grazing. Grazing by cattle and sheep has taken place in the McCloud River watershed for over 125 years and was especially intense in the first half of the 20th century. Heavy grazing, especially by cattle, reduced trout habitat by eliminating streamside vegetation, collapsing banks, making streams wider and shallower, increasing temperatures, reducing bank undercutting, polluting the water with feces and urine, silting up spawning beds, and generally making the habitat less complex and suitable for trout. The reduction of grazing pressure in the late 20th century and the increasing willingness of land managers to implement improved grazing practices has led to better condition of small streams in the McCloud River watershed and improved habitat for

redband trout. Today, much of Sheepheaven and lower Trout creeks have been fenced to exclude cattle. The grazing allotment associated with Sheepheaven Creek has not been active for several years, but this could change in the future.

Roads (transportation). Roads, mainly from logging, are numerous and widespread throughout the upper McCloud River basin, providing a source of sediment and pollutant input into streams (potentially covering spawning gravels) and providing easy access to most redband streams in the watershed.

	Rating	Explanation
Major dams	Low	Major dams are downstream of remaining McCloud redband habitat but their construction may have contributed to fragmentation of habitat in the past
Agriculture	n/a	
Grazing	Medium	Historically pervasive in the area but currently limited on private and U.S. Forest Service lands through attrition and better grazing management
Rural residential	n/a	
Urbanization	n/a	
Instream mining	n/a	
Mining	n/a	
Transportation	Medium	Roads are widespread in the upper McCloud basin and are sources of sediment and pollutant input into streams
Logging	Medium	The major land use in the region; associated water drafting may reduce stream flows and cause direct or indirect mortality
Fire	Medium	Headwater areas could be altered by more severe fires than occurred historically
Estuary alteration	n/a	
Recreation	Low	Off-road vehicles a potential threat
Harvest	Low	Light angling pressure in most streams; special fishing regulations to protect key redband populations
Hatcheries	n/a	
Alien species	High	Major potential threat & cause of limited distribution

Table 2. Major anthropogenic factors limiting, or potentially limiting, viability of populations of McCloud River redband trout. Factors were rated on a five-level ordinal scale where a factor rated "critical" could push a species to extinction in 3 generations or 10 years, whichever is less; a factor rated "high" could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated "medium" is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated "low" may reduce populations but extinction is unlikely as a result. A factor rated "n/a" has no known negative impact. Certainty of these judgments is high. See methods section for descriptions of the factors and explanation of the rating protocol.

Logging. The region in which McCloud River redband trout live contains a checkerboard of private and public ownership, with most public lands as part of the Shasta-Trinity National Forest. According to the RTCA (1998):

> "Small sawmills were operating in the upper McCloud River watershed starting in the late 1800s. At the turn of the century, railroads facilitated expansion of the sawmill capacity by allowing access to timber on steeper slopes, untapped by the previous horse/oxen era. Railroad-style logging predominated through World War II when truck and tractor operations replaced Shay locomotives and steam donkeys in the woods….
>
> Potential impacts to McCloud redband and their habitat from past logging practices include loss of shade canopy, increased water temperatures, increased sedimentation, reduced recruitment of large woody debris, loss of fish habitat diversity, and increased peak storm flows".

These impacts continue into the present day, both as a legacy of the past and through continued logging, including culverts potentially blocking or limiting instream movement, removal of water for dust control on dirt roads, erosion of sediment from roads, and similar factors. Fortunately, greatly improved logging practices have reduced the effects of logging and logging roads on streams, in good part because both private and public land managers recognize the uniqueness of the McCloud River redband trout and their habitats (RTCA 1998).

Fire. The 1998 RTCA considered fire a potential threat to this subspecies because fire suppression has greatly increased the amount of fuels in surrounding forests and increased the potential for high intensity fires. Such fires can cause direct mortality to fishes (high water temperatures), as well as indirect impacts from increased sedimentation and reduction in riparian vegetation and associated instream shading.

Harvest. It is likely that harvest was never a major problem in the small streams of the McCloud basin but redband trout populations are small enough that even occasional harvest by anglers or scientific collectors could reduce populations (RTCA 1998). Special angling regulations are in place for the following streams: Sheepheaven, Edson and Moosehead creeks (closed to all fishing all year); Swamp Creek (last Saturday in April through November 15 – zero limit, artificial lures with barbless hooks only).

Alien species. Coastal rainbow trout (*O. mykiss*), brown trout (*Salmo trutta*), and brook trout (*Salvelinius fontinalis*) have been repeatedly introduced into the upper McCloud watershed and have established self-sustaining populations. In particular, the McCloud River has received substantial numbers of stocked hatchery rainbow trout in the past to support a "put-and-take" fishery, although stocking of coastal rainbow trout in the upper McCloud River was discontinued in 1994 (RTCA 1998). Generally, where alien trout are present, redband trout are absent or have become hybridized. The exact causes of redband trout disappearance from the McCloud River itself have not been documented, but presumably it was a combination of predation on young (brown trout), competition for space (all species), disease introductions (all species), and hybridization (rainbow trout, next section). Fortuitously, a number of redband trout streams were too small or isolated to be subject to introductions, although some (e.g. Trout Creek) were nevertheless invaded at one time or another by unknown means.

Hybridization between coastal rainbow trout and redband trout is a natural event: both are native to California and hybridization would have occurred where their populations overlapped (e.g. lower McCloud River and tributaries). However, due to

planting of rainbows above natural barriers, hybridization has become the primary threat to headwater redband populations which were formerly isolated from coastal rainbow trout. Once hybridization occurs, the rainbow trout phenotype tends to dominate, resulting in a loss of the distinctive, brightly-colored redband trout phenotypes. This is likely coupled with a loss of adaptivity to the unique streams redband trout have evolved in. Rainbow trout and rainbow-redband hybrids have presumably replaced McCloud River redbands in the majority of their historic range, perhaps presenting the greatest threat to redband trout persistence in this basin.

Effects of Climate Change: The fact that existing redband trout streams are so small and flow through highly permeable volcanic soils means that they are exceptionally vulnerable to stressors such as floods, drought and fire, which, in turn, are likely to be more extreme under climate change scenarios. However, the persistence of distinctive trout in Sheepheaven Creek is due to the springs that maintain some level of surface flow (albeit for a short distance), even during severe drought. Presumably, most of the other streams occupied by McCloud River redbands have similar 'safe' water sources. If, however, this is not the case, drying of key stream reaches due to climate change may be a critical limiting factor to their persistence. It is also worth noting that spring flows can be eliminated by even minor volcanic or seismic activity and these streams are located in a relatively active region. Additionally, most streams currently inhabited by redbands are already subject to seasonal reductions in flow (during non-drought periods), so increases in air temperature or reductions in snow pack may dramatically reduce available habitat. Moyle et al. (2013) consider McCloud redband trout to be "critically vulnerable" to climate change because of the small size of their streams, warmer temperatures, and the potential effects of lengthy drought.

Status Determination Score = 1.7 – Critical Concern (see Methods section Table 2). Long-term drought, fire, or other factors that affect stream flows or habitat suitability, coupled with genetic risks associated with isolation of small populations, threaten McCloud redband with possible extinction. McCloud redband populations are especially vulnerable to rapid changes in status due to their small, isolated populations. While high levels of interest and management scrutiny seem to preclude *immediate* risk of extinction, recent events such as rescue efforts and movement of vulnerable populations into artificial refuge sites is of concern. In longer time frames, extinction probability will increase as the climate becomes warmer and droughts more frequent. Genetic risks increase with habitat reductions, potentially leading to bottlenecks in small, isolated populations.

The McCloud River redband trout is considered to be Vulnerable by American Fisheries Society (Jelks et al. 2008) because of its limited distribution and exposure to multiple threats. It was considered to be a Candidate Species for listing by the USFWS in 1994 but, following the signing of the RTCA by the USFS and other cooperators in 1998, it was removed from consideration. However, the conservation agreement does not actually preclude listing if needed (M. Dege, CDFW, pers. comm. 2013). The USDA Forest Service lists it as a Sensitive Species, while NatureServe considers it to be an imperiled subspecies.

Metric	Score	Justification
Area occupied	1	Isolation of at least four populations provides some security, although "pure" populations are clustered fairly close to each other and all are found in Upper McCloud watershed
Estimated adult abundance	2	Minimum total population today is probably more than 3,000 adults, although individual populations presumably have effective sizes of 100-500 fish in drought years
Intervention dependence	2	Recent drought (2012-2014) has necessitated rescue of several populations and relocation to refuge holding facilities until natural conditions improve; continual monitoring, habitat protection and possible installation of barriers required; ongoing implementation and recent revision and expansion of Conservation Strategy is critical
Tolerance	3	It is likely they are fairly tolerant of high temperatures, as are other redband trout, but water quality in their small streams can become too extreme
Genetic risk	1	Hybridization risk with rainbow trout is high; small isolated populations during drought can create genetic bottlenecks and lead to inbreeding depression
Climate change	1	Vulnerable in all streams because of small size
Anthropogenic threats	2	Alien trout, fires, and reduced flows are constant threats; See Table 2
Average	1.7	12/7
Certainty (1-4)	3	Most published information is on Sheepheaven Creek population

Table 3. Metrics for determining the status of the McCloud River redband trout, where 1 is a major negative factor contributing to status, 5 is a factor with no or positive effects on status, and 2-4 are intermediate values. See methods section for further explanation.

Management Recommendations: Conservation of McCloud River redband trout is active and ongoing, thanks to the leadership of the McCloud Redband Core Group (RCG), a multi-partner organization (California Department of Fish and Wildlife, Shasta-Trinity National Forest, U.S. Fish and Wildlife Service, private landowners, and others), which is dedicated to the conservation of the McCloud River redband trout. The forging of an expanded and updated draft RTCA (2013), based on the original agreement of 1998, is the latest step towards protecting these fish and their habitats. In the past, most management attention focused on the Sheepheaven Creek population because it is so distinctive. Recent attention has focused on the broader populations within the upper basin and four 'core conservation populations' (Sheepheaven, Edson, Swamp, and Moosehead) have been identified and will be managed collectively (J. Weaver, CDFW, pers. comm. 2012). Private and public landowners actively cooperate on conservation,

particularly those who comprise the RCG. On private lands, considerable effort has been made to improve roads in ways that minimize impacts to streams, to fence streams from livestock, and to assist in restoration and management activities. The conservation agreement is an effort to provide a systematic framework for all restoration and management activities in the watershed. It is crucial that this agreement be finalized as the working plan to improve conditions for McCloud River redband trout. The following recommended actions to increase protection for redband trout and their habitats are largely drawn from this agreement. Recommendations are not in order of importance.

1. Establish a McCloud River Redband Refuge. A portion of the upper McCloud River basin should be managed for the protection and enhancement of McCloud redband populations and their habitats. The refuge should include the main stem McCloud River and its tributaries above the confluence with Bundoora Spring Creek and, within this broader refuge, a 'core conservation area' should be established to provide further protections for populations with low (or no) levels of introgression with coastal rainbow trout (Sheepheaven, Swamp, Edson, and Moosehead creeks). While the refuge area contains all the streams known to contain presumed redband trout at the present time, suitable reaches of other perennial streams should, nevertheless, be evaluated for their potential as future translocation/restoration sites. Streams that have potential for expanding the range of redband trout (particularly within-basin, but also outside of the McCloud basin as warranted) would be of great value in terms of offsetting climate change impacts or stochastic events that may lead to the extirpation of one or more existing populations. Management plans that include eradication of non-native trout should be developed and construction of barriers to prevent alien trout invasions considered. In particular, the upper McCloud River itself should be evaluated as a refuge during periods of reduced stream flow caused by prolonged drought or climate change.

2. Maintain and enhance existing habitats. McCloud River redband trout survive in remarkably small and fragile habitats, so continued work is needed to improve the ability of these habitats to support redband trout and to reduce the impacts of human activities. Of particular concern are grazing and logging practices, but other factors such as fire protection, angling, and off-road vehicles have also been taken into consideration. While management plans and agreements are in place to protect streams, continued vigilance is required to avoid long-term loss of habitat. The ongoing project to improve conditions in Trout Creek is a good example of the kind of work that needs to be done in the basin (C. Knight, California Trout, pers. comm. 2007).

3. Protect genetic integrity of existing populations. The present populations of McCloud River redband trout are highly vulnerable to loss of genetic integrity (and phenotypic distinctiveness) due to hybridization with introduced rainbow trout and potential for genetic bottlenecking due to complete isolation of existing redband populations from one another. Efforts are needed, therefore, to protect populations from further inappropriate introductions (e.g., by making vehicle access difficult) or from 'natural' invasions from downstream areas (e.g., through construction of barriers). This program should include genetic and phenotypic monitoring as part of the assessment of population health. Consideration should also be given to active movement of putative redbands in order to promote and restore gene flow and increase genetic heterozygosity,

in order to offset potential impacts from past and ongoing isolation of existing populations (e.g., donor stock from Swamp Creek moved back in to Sheepheaven Creek).

4. Continue to develop and enforce angling regulations appropriate for protection of redband trout. Sheepheaven, Edson, and Moosehead creeks are closed to all fishing all year. Catch-and-release angling is allowed in Swamp Creek from the last Saturday in April to November 15th, using artificial lures with barbless hooks. These regulations need to be strictly enforced with frequent monitoring of streams.

5. Complete genetic evaluations of all populations. Expansion upon recent genetic research (Simmons et al. 2009), to include additional samples from throughout the upper McCloud basin, is planned (M. Dege, CDFW, pers. comm. 2012) and should allow for the development of a genetic management plan, including the potential for enhancing local genetic diversity by translocating fish between populations. Such translocations must be carefully planned and implemented with both a short and long-term strategy in mind, in order to minimize impacts to donor populations and ensure the genetic integrity of all core populations.

6. Establish a regular population monitoring program. This should be established for all putative redband trout populations and monitoring should occur at least once every 4-5 years (one redband generation).

7. *Develop emergency (contingency) plans for rescue of trout from extreme drought conditions, fire, reduction in genetic fitness, or other stressors.* An extended severe drought or catastrophic fire has the potential to reduce or even eliminate stream flows in redband trout streams. Given the existing limited distribution (and isolation) of relatively genetically 'pure' McCloud River redbands, a plan for salvaging fish from drying streams or critically low populations and rearing redbands in captivity or elsewhere is imperative, so action(s) can be taken quickly as needed in a planned and methodical manner.

Figure 1. Distribution of McCloud River redband trout, *Oncorhynchus mykiss stonei* (Jordan), in California.