



RED-BELLIED NEWT

Taricha rivularis (Twitty 1935)

Status Summary

Taricha rivularis is a Priority 2 Species of Special Concern, receiving a Total Score/Total Possible of 81% (69/85). During the previous evaluation, *T. rivularis* was determined to not merit Species of Special Concern status (Jennings and Hayes 1994a). *Taricha rivularis* ranked high enough to warrant status in the current evaluation, although very little information is available on population distribution or abundance trends.

Identification

All species in the genus *Taricha* are stocky, medium-to-large newts with granular skin, dark dorsal coloration, and indistinct or absent costal grooves (Petranka 1998, Stebbins 2003). *Taricha rivularis* has bright, tomato red ventral coloration and reaches up to 8 cm SVL (Stebbins 2003). In all members of the genus *Taricha*, breeding males seasonally acquire smooth skin and an enlarged tail fin (Petranka 1998). Larvae have a stream-type-like morphol-

ogy where the tail fin does not extend all the way to the shoulders (Stebbins 2003). The range of *T. rivularis* overlaps with the range of the rough-skinned newt (*T. granulosa*), and the

Red-Bellied Newt: Risk Factors

Ranking Criteria (Maximum Score)	Score
i. Range size (10)	10
ii. Distribution trend (25)	15
iii. Population concentration/ migration (10)	10
iv. Endemism (10)	10
v. Ecological tolerance (10)	10
vi. Population trend (25)	Data deficient
vii. Vulnerability to climate change (10)	7
viii. Projected impacts (10)	7
	Total Score 69
	Total Possible 85
	Total Score/Total Possible .81

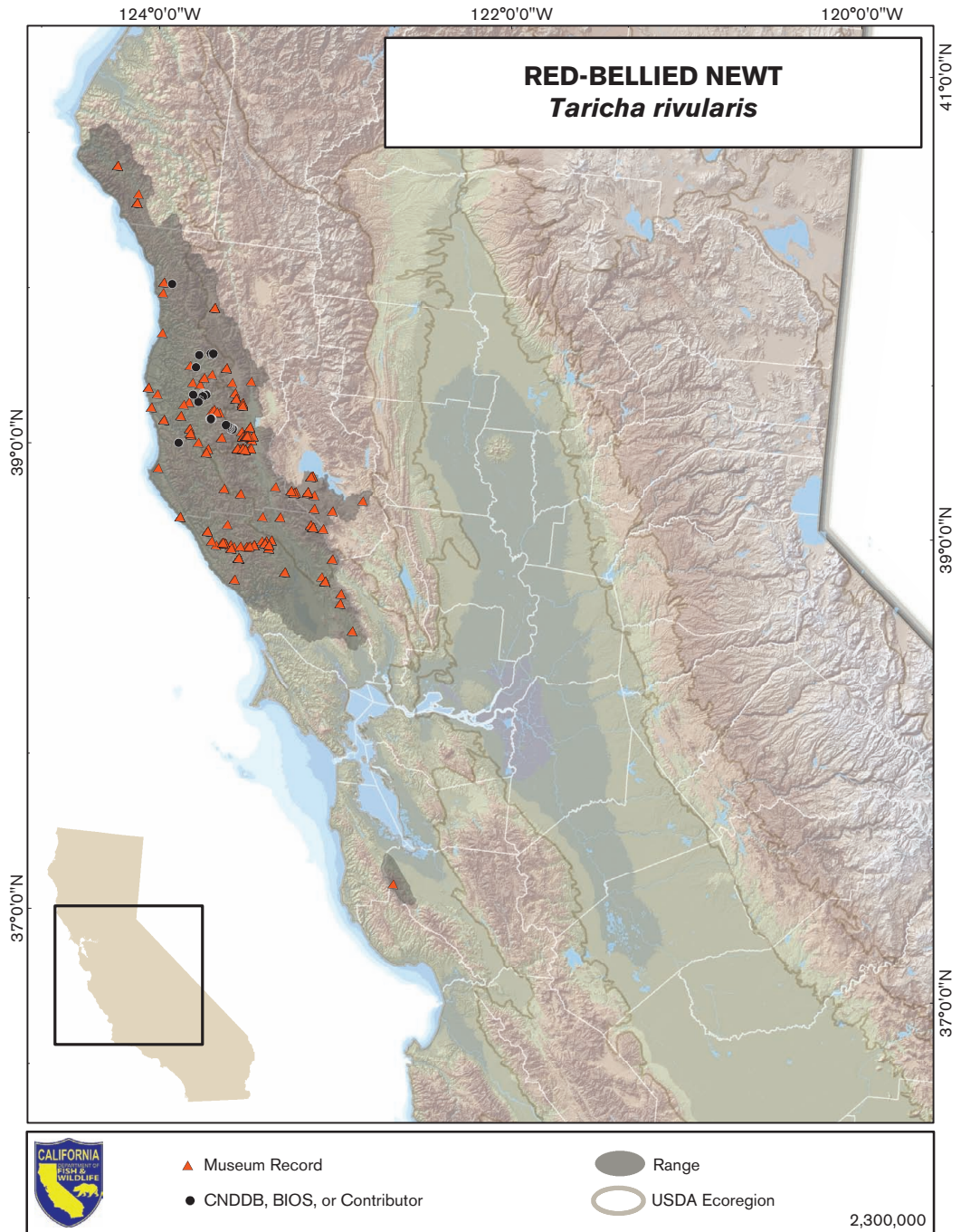


PHOTO ON PREVIOUS PAGE: Red-bellied newt, Mendocino County, California. Courtesy of Adam Clause.

southeastern edge of its range overlaps with the Coast Range newt (*T. torosa*). These species can be distinguished based on several morphological and color characteristics. In addition to distinctive red ventral coloration, *T. rivularis* has dark brown eyes, compared to the yellow or silvery irises in the other species (Twitty 1935).

Taxonomic Relationships

Taricha rivularis was described on the basis of the clear morphological differences existing between it and other California *Taricha* (Twitty 1935), and its species status has never been questioned. Gene flow among populations was previously thought to be very low because animals return to the same stream areas for breeding and show very strong homing behavior (Hedgecock and Ayala 1974, Hedgecock 1978; see the “Life History” section). Kuchta and Tan (2006a) found low levels of allozyme and mitochondrial DNA divergence among four populations in the north and south of the range, which may suggest that gene flow is higher than previously thought. Although *T. rivularis* shows a high degree of philopatry, long-distance movements are well documented, and this may explain the observed low levels of divergence (Kuchta and Tan 2006a).

Life History

Breeding coincides with the receding of streams after heavy winter rains (Twitty 1942). Adults are terrestrial, and the aquatic breeding phase lasts from February to May, with most breeding occurring between March and early April (Twitty 1955, Packer 1960, Twitty 1966, Stebbins 1985). Males typically breed annually, whereas most females breed every 2–3 years (Twitty 1961, Twitty et al. 1964). Adults have been observed returning to the same ~15 m segment of creek to breed across multiple years (Twitty 1959, Packer 1962, Packer 1963, Twitty et al. 1967a). Adults tend to use a small reach of stream during the breeding season, although movements of a couple hundred meters within a season have been observed (Packer 1962). Adults are also capable of moving several kilom-

eters across years and have excellent homing abilities (Twitty 1959, Packer 1962, Twitty et al. 1964, Twitty et al. 1967a). After breeding, adults leave streams but usually remain in the same drainage (Twitty et al. 1967b). Fall rainfall triggers movement, but heavy rainfall can inhibit overland movement (Packer 1960, Grant et al. 1968), and sustained rainfall, increased stream volume, or increased sediment load can stimulate animals to temporarily leave breeding streams (Packer 1960). Little is known about terrestrial habitat use by metamorphs. Underground retreats are used from May to October, and adults forage on the surface before and as they migrate to streams (Twitty 1966, Licht and Brown 1967, Marks and Doyle 2005).

Eggs are attached in a single layer to the bottom of stones or submerged vegetation in fast-flowing water (Twitty 1935, Twitty 1942). The average size of an egg mass is 10 eggs (range 6–16) (Twitty 1935, Riemer 1958, Twitty 1964), and as many as 70 egg masses have been observed attached to a single stone (Twitty 1935, Twitty 1942). The incubation period in the lab is 16–34 days, with faster development times at warmer temperatures (Licht and Brown 1967). Larvae hatch at a minimum of 10 mm TL (Riemer 1958, Twitty 1964) in mid to late April and metamorphose in late August (Licht and Brown 1967) at 45–55 mm TL (Stebbins 1951). There is no evidence that larvae overwinter in streams (Riemer 1958, Twitty 1964). It is unknown how far or to what habitats metamorphs travel, but they go into hiding shortly after metamorphosis (Twitty 1955, Twitty 1961, Twitty 1966, Twitty et al. 1967b). Juveniles are not captured in terrestrial habitats when adults are abundant, suggesting that they remain underground, or at least in a distinct, unknown microhabitat, for several years (Twitty et al. 1967a). It takes approximately 5 years to reach sexual maturity (Licht and Brown 1967). Hedgecock (1978) estimated life spans on the order of 20–30 years based on Twitty’s (1966) data, and annual survivorship of adults is probably >90% in most years (Twitty 1961). At one site in Sonoma County, 40% of originally

marked adult animals were still being recaptured 11 years later (Twitty 1966).

Insects and other small invertebrates presumably make up the bulk of the diet of larvae and adults. In one study, adult stomach contents contained exclusively terrestrial organisms (mostly insects), and adults apparently do not feed while in the water during the breeding season (Packer 1961, Licht and Brown 1967).

Habitat Requirements

Taricha rivularis is found in redwood forests along the coast, although other forest types such as Douglas fir, tan oak, and madrone are also used (Marks and Doyle 2005). Aquatic breeding habitats are moderate to fast-flowing mountain streams with rocky bottoms (Twitty 1935, Stebbins 1951). In the Mattole Watershed (northern Mendocino and southern Humboldt Counties), *T. rivularis* was reported to use both steep headwater and 2–4% gradient step-pool reaches, but was most abundant in lower-gradient plane-bed channels (Welsh and Hodgson 2011). Other features of occupied stream habitats were water temperatures ranging between 15°C and 26°C, a mix of coarse streambed substrates, and intermediate levels of canopy closure (Welsh and Hodgson 2011). Unlike other members of the genus, *T. rivularis* rarely breed in ponds or other standing water habitats (Riemer 1958, Stebbins 1985) and seem to avoid streams used by *T. torosa* (Twitty 1942, Twitty 1955). *Taricha rivularis* will breed in the same streams as *T. granulosa* but tend to use faster-flowing reaches (Twitty 1942).

Distribution (Past and Present)

Taricha rivularis is endemic to California and has the smallest geographic distribution among its congeners (Stebbins 2003). The species occurs in coastal northern California in Sonoma, Lake, Mendocino, and southern Humboldt Counties, at elevations from 150 to 450 m (Stebbins 2003, Marks and Doyle 2005). An isolated population is known from the Stevens Creek watershed in Santa Clara County, although it is unclear if this is an introduction or a native population (Reilly et al., in press).

Some habitat has likely been lost to vineyard and other agricultural development in Sonoma and Mendocino Counties, although systematic surveys are not available (H. Welsh, pers. comm.). Some populations have been lost due to damming of creeks and rivers (e.g., Skaggs Spring, which was inundated during the formation of Lake Sonoma). Data from the Mattole Watershed in the mid-1990s documented *T. rivularis* presence in 35% of sampled streams (Welsh et al. 2005), with *T. rivularis* restricted to the forested southern portions of the watershed (Welsh and Hodgson 2011).

Trends in Abundance

Few abundance data are available for this species. Hedgecock (1978) used Twitty's (1961, 1966) census data to estimate that ~60,000 breeding adults occurred along a ~2.5 km stretch of creek in Sonoma County. In the Mattole Watershed, 300 m stretches of randomly selected stream reaches ($n = 83$ stream reaches) yielded 24 metamorphs and 104 aquatic larvae (Welsh and Hodgson 2011).

Nature and Degree of Threat

The paucity of distribution and abundance data makes it difficult to determine the status of most *Taricha rivularis* populations. However, the species has a small range in an area that has experienced high levels of habitat conversion to vineyards and subdivisions, rendering them vulnerable to habitat loss and fragmentation (Marks and Doyle 2005). *Taricha rivularis* may also be experiencing increasing mortality from vehicular traffic (Marks and Doyle 2005), especially during breeding migrations.

Climate change poses potential risks to *T. rivularis* through increased temperatures, changes in hydrology, changes in fire regime, and vegetation shifts. Mean annual temperatures are expected to increase throughout northwestern California (reviewed in PRBO 2011); however, maximum temperature tolerances of *T. rivularis* are unknown. *Taricha rivularis* populations on the coast may be less affected by temperature increases because upwelling is

expected to intensify, potentially leading to increased fog development and cooler, moister conditions (Snyder et al. 2003, Lebassi et al. 2009). Potential changes in precipitation are less clear, with some models predicting little change and others reductions in rainfall of up to 28% (reviewed in PRBO 2011). If conditions become warmer and drier, especially in inland sites, this may restrict terrestrial habitat use and overland dispersal. Changes in precipitation may affect stream hydrology, although how *T. rivularis* will respond to such changes is unknown. How fire regime will be affected by climate change in northwestern California is not well understood. Some models predict little change in fire regime or even decreases in area burned along the northern coast (Fried et al. 2004, Lenihan et al. 2008). Increases in area burned have been predicted for the southern coast of northwestern California and inland areas (Lenihan et al. 2008). Westerling et al. (2011) projected a 100% increase in area burned in northwestern California under some scenarios. How fire impacts *T. rivularis* needs more study, although direct mortality and habitat degradation due to fire has been documented in other stream-breeding amphibians in similar habitats (e.g., Gamradt and Kats 1997, Pilliod et al. 2003). Vegetation communities are expected to shift from moist conifer to drier mixed evergreen forest, with reductions in Douglas fir and redwood forest in particular (Lenihan et al. 2008, PRBO 2011). *Taricha rivularis* may not be severely negatively affected by such shifts, as they use multiple forest types.

Status Determination

Taricha rivularis has a small range in an area that has experienced increased levels of habitat loss and fragmentation in recent decades, resulting in a Priority 2 Species of Special Concern status for this endemic salamander.

Management Recommendations

Given the limited ecological information on this species outside of a handful of sites, it is difficult

to make management recommendations other than protecting known breeding habitats. Disturbances such as timber harvest, roadbuilding and use, housing development, agricultural development, and water diversions should be minimized or eliminated in *Taricha rivularis* habitat. Occupied habitat should be protected, with a focus on protecting the entire stream network (Olson et al. 2007, Welsh 2011). Retaining streamside buffers on managed lands can help mitigate the effects of logging and roadbuilding, but more research is needed to determine buffer prescriptions, particularly how to protect stream network processes (Olson et al. 2007). The ecological effects of buffer protections may vary across habitat types, and narrower buffers may be effective in more mesic coastal habitat compared to more xeric inland sites. One model recommends riparian management zones 40–150 m wide and patch reserves along headwater streams to accommodate upland habitat use and promote connectivity among drainages (Olson et al. 2007). Given the long-range movements documented in this species, large terrestrial habitat patches may be necessary to maintain connectivity among populations. Any efforts to translocate individuals should also take the strong evidence for adult homing behavior into account, as animals are likely to try and return to their original streams. Construction of new roads should be minimized or avoided in areas where protecting *T. rivularis* is a high conservation priority. To reduce the sedimentation impacts of runoff from roads, forest roads should be disconnected from stream systems (e.g., through the use of ditch-relief culverts). Use of heavy equipment should be avoided or restricted on forest roads when larvae are present in nearby aquatic habitat. Road management strategies should be applied to all forest roads, not just those used for timber harvest. In areas that are known to suffer high road mortality, migration barriers and under-road tunnels may reduce vehicular death (e.g., see review in Schmidt and Zumbach 2008), although research is needed into the design and efficacy of such interventions.

Monitoring, Research, and Survey Needs

Surveys to determine the current distribution of occupied breeding habitats are a first step to documenting potential extirpations. Resurveys of Twitty's field sites along Pepperwood Creek, a tributary along the Wheatfield Fork of the Gualala River in northwestern Sonoma County, would be useful for assessing whether population abundance has changed, as this is one of the few areas where demographic data have been collected (e.g., Twitty 1961, Twitty 1966). However, locating the original sites has proven difficult, and they may occur on private lands that are largely inaccessible (S. Kuchta, pers. comm.). Basic ecological research into habitat preferences (both terrestrial and aquatic) are needed as well as demographic data on all life stages (Petranka 1998, Marks and Doyle 2005). Additional research is needed on dispersal,

using both field and genetic techniques. Experiments that moved individuals to different streams found that animals traveled overland to return to their native streams, moving as much as 8 km through terrestrial habitat (Twitty 1959, Twitty et al. 1966). If such terrestrial movements are typical of naturally dispersing animals, then large patches of terrestrial habitat will be needed to maintain connectivity among populations. Finally, although it is assumed that introduced trout and bullfrogs are not a threat to *Taricha* due to their toxic skin secretions, this should be examined for eggs, larvae, and breeding adults. In other California newts, recent experimental research has shown that larval *T. torosa* are highly susceptible to predation by *Ambystoma* (Ryan et al. 2009), and tetrodotoxins have not been isolated from larvae or eggs of *T. granulosa* (Fuhrman 1967).