

Habitat characteristics, a range extension, and an elevational record for Shasta salamanders

LEN LINDSTRAND III*, KURT BAINBRIDGE, AND GABE YOUNGBLOOD

North State Resources, Inc., 5000 Bechelli Lane, Suite 203, Redding, CA 96002, USA

*Correspondent: lindstrand@nsrnet.com

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The Shasta salamander (*Hydromantes shastae*) is a state-listed threatened species known from the southeastern Klamath Mountains located north and northeast of Redding, Shasta County, California. Historically described as a habitat specialist associated with limestone rock formations (Gorman and Camp 1953, Stebbins 2003, Olson 2005), Shasta salamanders were recently found in and are now known to occupy various non-limestone habitats (Lindstrand 2000, Nauman and Olson 2004, Olson 2005). These non-limestone habitats include coniferous forests and mixed woodlands with metasedimentary or metavolcanic rock outcrops and talus, and areas with little or scattered surface rock. The recorded elevations at known localities range from 244 to 1158 m, the highest being limestone habitat (Lindstrand 2008).

During surveys in 2012 we found Shasta salamanders at nine sites in seven general locations where the species previously was unrecorded. All of these locations are in Shasta County, and include sites at South Fork Mountain, Fall Creek, East Fork Clear Creek, Cline Gulch, Whiskey Creek, Highland Ridge, and Tombstone Mountain (Figure 1). These new discoveries provide additional habitat information for the taxon, extend the known distribution considerable distances to the south and west, and provide a new elevation record.

We surveyed a site at the northwestern portion of South Fork Mountain (40° 39' 43" N, 122° 31' 44" W) on 6 and 7 February 2012 and found 4 Shasta salamanders. Two adult individuals (SVL 35 and 48 mm) were in a small patch (46 m²) of scattered metavolcanic rock, and 2 juveniles (SVL 19 and 23 mm) were on small metavolcanic rock outcrops (27 m²) under scattered rock. This site was characterized by sparse (10-24%) to open (25-39%) canopy cover and had a southwesterly aspect; the elevation at this site is 975 m. The vegetation, as classified using the California Wildlife Habitat Relationship system (CWHR habitat; Mayer and Laudenslayer 1988) was characterized as montane hardwood-conifer and dominated by canyon live oak (*Quercus chrysolepis*), Douglas-fir (*Pseudotsuga menziesii*), sugar pine (*Pinus lambertiana*), ponderosa pine (*Pinus ponderosa*), and gray pine (*Pinus sabiniana*). Dominant shrubs included whiteleaf manzanita (*Arctostaphylos viscida*), greenleaf manzanita (*Arctostaphylos patula*), bush poppy (*Dendromecon rigida*), California yerba santa (*Eriodictyon californicum*), and sierra gooseberry (*Ribes roezlii*);

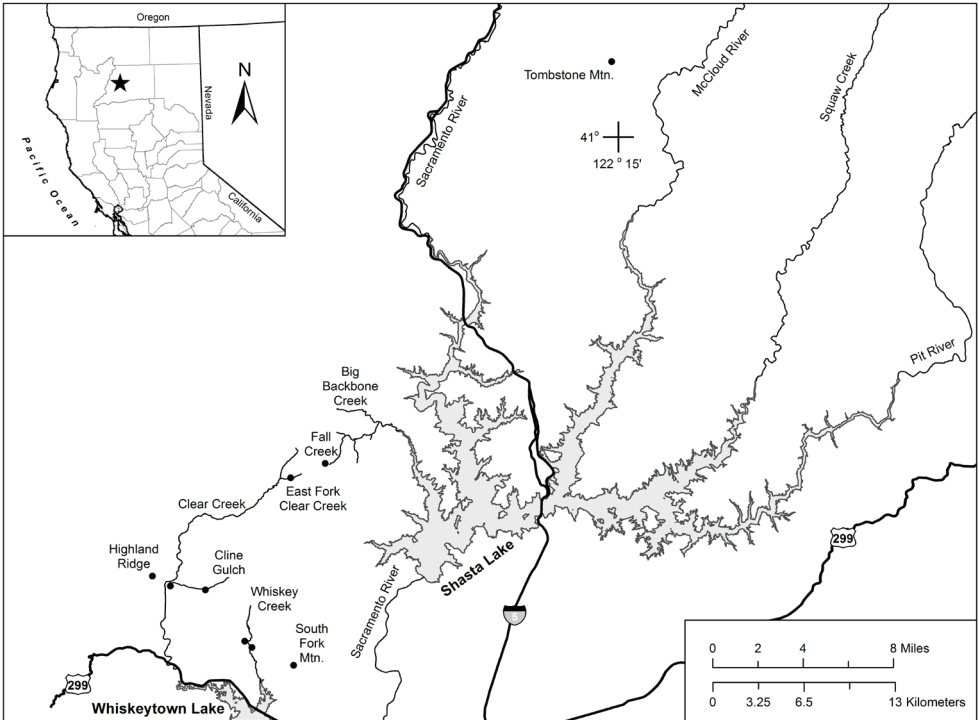


FIGURE 1.— Shasta salamander site locations (black circles), southeastern Klamath Mountains, Shasta County, California, February–May 2012.

plant taxonomy follows Baldwin et al. (2012). Small (12–30 cm diameter) and large (>30 cm diameter) woody debris, and duff or leaf litter were fairly common; however, gravel and boulder or bedrock were the most abundant ground cover attributes. This site burned in the 2008 Motion Fire and the burn severity appeared light to moderate.

We surveyed a site at the southern headwaters of Fall Creek, approximately 2.4 km west of Bohemotash Mountain ($40^{\circ} 47' 29''$ N, $122^{\circ} 30' 4''$ W) on 15 February 2012 and found 1 adult Shasta salamander (SVL 42 mm) on a large (1.4 ha) metasedimentary outcrop under talus rock. The rock outcrop was characterized by sparse canopy cover and had a southeasterly aspect at an elevation of 1158 m; the CWHR habitat was montane hardwood-conifer dominated by canyon live oak, gray pine, and Douglas-fir. Dominant shrubs included whiteleaf manzanita and greenleaf manzanita. Small and large woody debris was uncommon and duff or leaf litter occurred in scattered patches. Rock consisting of gravel, cobble, and boulder or bedrock was the most abundant ground cover attribute.

The East Fork Clear Creek site was located at Stottard Gulch, approximately 12.7 km northeast of French Gulch ($40^{\circ} 46' 56''$ N, $122^{\circ} 31' 49''$ W). We surveyed this site on 17 February 2012 and found 1 adult (SVL 48 mm) Shasta salamander in a crevice on a small (5.5 m²) metavolcanic rock outcrop. This outcrop had sparse canopy cover, moderate (40–59%) shrub cover, a westerly aspect, and the elevation at this site was 792 m. The CWHR habitat was characterized as a mixed chaparral inclusion in a montane hardwood forest

dominated by canyon live oak. Dominant shrub species included birch-leaf mountain-mahogany (*Cercocarpus betuloides*), buckbrush (*Ceanothus cuneatus*), hollyleaf redberry (*Rhamnus ilicifolia*), and poison oak (*Toxicodendron diversilobum*). Small and large woody debris and duff or leaf litter were uncommon. Gravel and bedrock were the most abundant ground cover attributes.

Shasta salamanders were found at two sites in the Whiskey Creek watershed. One site was located along a small unnamed tributary to Whiskey Creek (40° 40' 24" N, 122° 33' 49" W), at which we found 3 Shasta salamanders on 29 February 2012. Two adult individuals (SVL 33 and 35 mm) were found in a small patch (3 m²) of scattered metavolcanic rock, and another adult (SVL 47 mm) in a second small patch (2 m²) of the same rock. This site was characterized by open to moderate canopy cover with a westerly aspect and an elevation of 463 m. The CWHR habitats included montane hardwood-conifer forest and mixed chaparral, as the site was an ecotone of forest and chaparral habitat. Dominant species included canyon live oak, with Douglas-fir, knobcone pine (*Pinus attenuata*), and California black oak (*Quercus kelloggii*). Dominant shrubs included whiteleaf manzanita and poison oak, with toyon (*Heteromeles arbutifolia*), Fremont silktassel (*Garrya fremontii*), snowdrop bush (*Styrax redivivus*), brewer oak (*Quercus garryana* var. *breweri*), Lemmon ceanothus (*Ceanothus lemmonii*), and hollyleaf redberry. Small and large woody debris was fairly common, as were gravel, cobble, and boulders; duff or leaf litter was, however, the most abundant ground-cover attribute. This site burned in the 2008 Motion Fire and the burn severity appeared light in the forest habitat and moderate to high in the chaparral habitat. The second Whiskey Creek site was located in Deadwood Gulch upstream of its confluence with Whiskey Creek (40° 40' 39" N, 122° 34' 11" W). We found 1 adult (SVL 27 mm) Shasta salamander on 1 March 2012 under an isolated metavolcanic rock located on a very old dirt road dug into the hillside. This site was characterized by moderate to dense (40-100%) canopy cover, a northeasterly aspect, and the elevation was 585 m. The CWHR habitat was montane hardwood-conifer forest dominated by Douglas-fir, with canyon live oak and California black oak. Dominant shrubs included poison oak, snowdrop bush, canyon live oak (shrub form), California buckeye (*Aesculus californica*), and toyon. Ground cover attributes at this site included a mosaic of small and large woody debris, scattered gravel, cobbles, boulders, and duff or leaf litter.

We found two Shasta salamander sites in the Cline Gulch watershed on 15 March 2012. One site is located near Rippley Gulch (40° 42' 38" N, 122° 36' 10" W), at which one adult (SVL 44 mm) in breeding condition was found at the base of a small (522 m²) metavolcanic rock outcrop. Canopy cover was sparse, the aspect northerly, and the elevation was 548 m. The CWHR habitat was mixed chaparral and dominated by brewer oak, deerbrush (*Ceanothus integerrimus*), birch-leaf mountain-mahogany, California buckeye, and whiteleaf manzanita. The substrate was gravelly, and a layer of moss covered the ground where shrub cover was absent. Small woody debris was fairly common, while large woody debris was uncommon. Duff or leaf litter, gravel, and boulder or bedrock were the most common ground cover attributes. The second Cline Gulch site was located on the ridge immediately south of the confluence of Cline Gulch and Clear Creek (40° 42' 47" N, 122° 37' 56" W). Four juvenile (SVL 17, 18, 19, and 23 mm) and one adult (SVL 50 mm) Shasta salamanders were found in an area characterized as a rocky ridge with sparse canopy cover and a northerly aspect at an elevation of 548 m. The CWHR habitat was mixed chaparral and dominated by canyon live oak (shrub form), deerbrush, whiteleaf manzanita, brewer

oak, buckbrush, birch-leaf mountain-mahogany, California buckeye, chamise (*Adenostoma fasciculatum*), and poison oak. Rock consisting of gravel, cobble, and boulder or bedrock was the most common ground cover attribute, although small and large woody debris and duff or leaf litter also were present. Both Cline Gulch sites burned in the 2004 French Fire and the burn severity appeared moderate to high.

The Highland Ridge site (40° 43' 11" N, 122° 38' 51" W) was surveyed on 16 March 2012, and we found 2 adult (SVL 47, 54 mm) Shasta salamanders in a small (116 m²) patch of metavolcanic rock dominated by boulder and cobble. This site was on a ridgetop, and characterized by sparse canopy cover, dense (60-100%) shrub cover, a northerly aspect, and was at an elevation of 861 m. The CWHR habitat was mixed chaparral dominated by chamise, canyon live oak (shrub form), brewer oak, birch-leaf mountain-mahogany, buckbrush, California yerba santa, whiteleaf manzanita, greenleaf manzanita, and poison oak. Duff or leaf litter and gravel, cobble, and boulders or bedrock were the most common ground cover attributes. Small and large woody debris was nearly nonexistent. The site burned in the 2004 French Fire and the burn severity appeared moderate to high.

We surveyed a site at Tombstone Mountain (41° 2' 53" N, 122° 15' 22" W) on 15 May 2012 and found 1 adult (SVL 43 mm) Shasta salamander in a small patch (37 m²) of limestone rock below a small limestone outcrop. The limestone outcrop was on a steep, forested slope and was characterized by open canopy cover, a northerly aspect, and the elevation at this site was 1661 m; the CWHR habitat was white fir. Dominant trees included white fir (*Abies concolor*) and Douglas-fir. Dominant shrubs included huckleberry oak (*Quercus vacciniifolia*), Fremont silktassel, Sierra currant (*Ribes nevadense*), tobacco brush (*Ceanothus velutinus*), and greenleaf manzanita. Small and large woody debris was uncommon and there was a thin layer of duff or leaf litter present. Limestone bedrock, boulders, and cobbles were the most abundant ground cover attributes.

Prior to our work, the southern-most and western-most recorded location for Shasta salamanders was in limestone habitat at the headwaters of Butcher Creek above the western portion of Shasta Lake (California Natural Diversity Database 2012, Museum of Vertebrate Zoology 2012). Our observations at South Fork Mountain and Highland Ridge extend the known geographic range approximately 12.3 km and 17.3 km to the south and west of the Butcher Creek site, respectively.

The elevation at the South Fork Mountain site is among the highest at which Shasta salamanders have been recorded, while the elevation at the Fall Creek headwaters site is the same as the previously highest recorded location (Lindstrand 2008). Further, these results confirmed that the species occurs in both limestone and non-limestone habitat at the upper range of its known elevation extent. The Tombstone Mountain site represents a new elevational record for this species, and is 503 m greater than the highest previously recorded location (Lindstrand 2008). Tombstone Mountain is the highest elevation limestone habitat known to occur within the range of this species, suggesting that Shasta salamanders occur in any limestone habitat within its geographic range.

Though likely a result of little or no previous survey efforts, Shasta salamanders have not been previously recorded in three of the five watersheds in which we conducted surveys. The South Fork Mountain and Whiskey Creek sites are in the Whiskey Creek watershed; and the Cline Gulch, East Fork Clear Creek, and Highland Ridge sites are in the Clear Creek watershed; Shasta salamanders have not been previously recorded in those watersheds. The Fall Creek headwaters site is in the Big Backbone Creek watershed and, while Shasta

salamanders previously have been recorded in this watershed, the Fall Creek headwaters site was approximately 2.4 km further west of the nearest known location. Tombstone Mountain is situated along the crest between Tom Dow and Hazel Creeks. Tom Dow Creek is tributary to Squaw Valley Creek, located in the Upper McCloud River watershed, while Hazel Creek is a tributary to the Upper Sacramento River. Shasta salamanders previously have been recorded in the Squaw Valley Creek and Upper McCloud River watershed, the nearest being approximately 3.3 km to the northeast; there are, however, no previously recorded occurrences in the Upper Sacramento River watershed.

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