

number of vernal pools in this region have been destroyed, fragmented, and degraded by conversion to intensive agriculture and housing developments.

Shaffer *et al.* (1993) were unable to find breeding habitat to sample for presence of the California tiger salamander over most of the original grassland habitat of the San Joaquin Valley. Where ponds were located, California tiger salamanders generally were absent (72 percent of 324 ponds sampled were absent). The rarity of this species in the San Joaquin Valley, in habitat that was apparently suitable historically, suggests widespread extirpation of California tiger salamanders from habitat conversion to agricultural and urban uses (Stebbins 1989). Large areas of California tiger salamander habitat were destroyed and degraded by major urbanization in this region during the 1970s and 1980s (Shaffer *et al.* 1993). Agricultural, housing, road, and commercial developments on the valley floor of Fresno, Madera, and Tulare Counties have reduced suitable habitat to a fraction of the species' historical range (J. Halstead, Kings River Conservation District, *in litt.* 1994). Most remaining salamander habitat on the eastern side of the Central Valley occurs on tracts of privately-owned ranch land (Seymour and Westphal 1994).

California tiger salamander localities in the South San Joaquin population may be affected by proposed development projects, including housing developments and highway construction. These development projects would likely destroy upland habitat and wetland breeding habitat, likely killing salamanders and reducing the viability of populations at the affected localities.

Several large water storage and delivery projects have been constructed in the South San Joaquin population. These projects have flooded large areas of known and potential salamander habitat. Additional habitat has been lost to construction from associated State and County park recreational facilities (e.g., boat ramps, campgrounds, parking lots) and agriculture and urbanization facilitated by water supply development.

Numerous new housing developments and golf courses are planned or in progress around Millerton Lake in Fresno and Madera Counties (J. Halstead, *in litt.* 1994; The Keith Companies 1994). Extensive areas of upland habitat and wetland breeding habitat will likely be destroyed by these developments, potentially killing many salamanders and/or further reducing the

viability of any remaining habitat at these localities.

California tiger salamanders are known from eight localities in Tulare County, most of which are surrounded by a matrix of agricultural lands.

*Central Coast Population* (southern Santa Cruz, Monterey, extreme western San Benito, extreme western Fresno, extreme western Kings, extreme northwestern Kern, and San Luis Obispo Counties): Twelve percent (72 of the 608 localities) of the known California tiger salamander records are in the Central Coast Range population. Nineteen of these sites in the Central Coast population are considered extirpated (CNDDB 2002; Service 2003). From 1996 to 1998, 2,084 ha (5,149 ac) of native habitat were converted to urban and agricultural uses in San Luis Obispo and Monterey Counties (CDC 2000). There are 28,411 ha (70,205 ac) of potential habitat for the California tiger salamander in the Central Coast.

California tiger salamanders in this population occurred predominantly in stock ponds, reservoirs, seasonal lakes, and intermittent streams. Of the California tiger salamander localities in this population where the wetland type was identified, 26 percent (86) were vernal pools. The wetland type localities within the Central Coast Range population of the California tiger salamander occur in the Central Coast and San Joaquin Valley Vernal Pool Regions (Keeler-Wolf *et al.* 1998). The annual loss of vernal pools from 1994 to 2000 in Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties appears to be accelerating to a rate of 2 to 3 percent annually (Holland 2003).

Two California tiger salamander localities occur at a 8,064 ha (19,927 ac) development project site that comprises 14 percent of the Greater Monterey Peninsula Planning Area, which is nearly half of the Planning Area's unimproved land. Construction on this project has been initiated (D. Steeck, Service, pers. comm. 2000). Eleven localities occur on Fort Ord, an 11,220 ha (27,726 ac) former military installation that has been transferred to the U.S. Bureau of Land Management (BLM), California Department of Parks and Recreation, California State University, Santa Cruz, and Monterey County municipalities. The proposed habitat management plan (Jones and Stokes Associates 1993) for Fort Ord includes protection of salamander breeding habitat at seven of these localities within the designated Natural Resource Management Area (NRMA) managed by BLM. Two of the localities in the NRMA are within a highway

easement, and may be imperiled due to future road construction. The protected area has historically been extensively used by ORVs, but recent enforcement of ORV restrictions by BLM has apparently reduced this problem (R. Lewis, BLM, pers. comm. 1999). Excavation for removal of unexploded ordnance could potentially disrupt breeding or upland habitat in the NRMA (Jones and Stokes Associates 1993), but ordnance removal in breeding ponds has not yet been deemed necessary (D. Steeck, pers. comm. 2000). The remaining four localities on Fort Ord are projected for development as recreational areas, commercial centers, and a university campus. Development in these areas may avoid breeding ponds, but additional upland habitat is likely to be lost and fragmented.

#### *B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

There is no evidence that overutilization is a factor causing decline of the California tiger salamander.

#### *C. Disease or Predation*

##### *Disease*

Relatively little is known about the diseases of wild amphibians (Alford and Richards 1999). The specific effects of disease on the Central California tiger salamander are not known and the risks to the animal have not been determined.

Pathogen outbreaks have not been documented in the Central California tiger salamander. Nevertheless, disease must be considered a potential future population threat because of the relatively small, fragmented remaining Central California tiger salamander breeding sites, the many stresses on these sites due to habitat losses and alterations, and the many other potential disease-enhancing anthropogenic changes which have occurred both inside and outside the species' range.

##### *Predation*

A number of nonnative California species have likely adversely affected the Central California tiger salamander in many parts of its range through predation and competition. Bullfrogs prey on California tiger salamanders (P. Anderson 1968; Lawler *et al.* 1999). The bullfrog, native to the United States east of the Great Plains, was introduced into California in the late 1800s and early 1900s, and it rapidly spread throughout the State (Storer 1925 as cited in Moyle 1973; Hayes and Jennings 1986). Morey and Guinn (1992) documented a shift in