



■ **Pesticides linked to frog decline**

Researchers have found a significant correlation between agricultural pesticide drift and the decline of the California-red-legged frog.

Once abundant from Point Reyes to the Sierra Nevada and Redding to Baha, the California red-legged frog has been extirpated from more than 70% of its historic range, and many of the remaining populations have declined precipitously.

"If it turns out that pesticides are the cause, we'll have to do more than set aside habitats if we are to protect the species," says Carlos Davidson, California State University-Sacramento environmental studies professor. "We'll have to do something about the amounts of pesticides that are used and how they are applied."

The study, published in *Ecological Applications* (April 2001), encompassed almost all of California. Davidson (a UC Davis Ph.D.), UC Davis population biology professor H. Bradley Shaffer and Mark R. Jennings of the California Academy of Sciences, mapped the disappearance of red-legged frog populations using museum records dating back to the mid-1800s.

Of 237 identified sites that once had frog populations, the authors found that 48% no longer do. Using a geographic information system (GIS) approach, they compared the patterns of decline with various hypotheses, including global climate change, increased ultraviolet radiation, pesticides and habitat destruction. Other theories for the frog's decline, such as disease and introduced exotic fish or bullfrogs, did not lend themselves to this analysis and therefore could not be tested.



H. Bradley Shaffer

**The California red-legged frog has been extirpated from 70% of its historic range. Windborne agricultural pesticides may be an important contributing factor.**

The percentage of upwind land use in agriculture for sites where the red-legged frog had disappeared was 6.5 times greater than for sites where the frogs still exist, suggesting that windborne agrochemicals may be an important factor.

"The impact of pesticides on aquatic ecosystems in California almost certainly goes far beyond red-legged frogs," Shaffer says. "Amphibians, by virtue of their aquatic habits and permeable skin, may be one of the first groups to show the effects. As such, they may well be a harbinger of things to come for other species if we continue applying pesticides at current levels."

The U.S. Fish and Wildlife Service placed the frog on its threatened list in 1996. In March 2001, the agency designated 4.1 million acres of critical habitat for the frog, the largest such designation in California. The habitat includes 29 separate areas in 28 counties, along more than 500 miles of streams and rivers.

■ **Lake Tahoe clarity falls again**

After 2 years of improvement, the clarity of Lake Tahoe declined to 67.3 feet in 2000, a drop of 2 feet from the previous year, UC Davis Tahoe Research Group announced recently.

UC Davis professor Charles Goldman, director of the research group, notes that while year-to-year clarity measurements have gone up and down in the past, the long-term trend is declining transparency. If unchecked, the decline will turn Tahoe's famous cobalt-blue waters to green.

"We are beginning to see benefits from many changes being made in the Tahoe Basin, but as this year's clarity data show, the lake is still at risk," says Goldman, who has studied Lake Tahoe for 42 years.

The lake's transparency reached a record low of 64 feet in 1997. In 1968, when UC Davis researchers began their groundbreaking clarity studies, the white disk used to assess transparency could be seen at a depth of 102.4 feet.

Year-to-year variations in Tahoe annual clarity data depend upon a combination of environmental factors. The most significant

Declining clarity trend for Lake Tahoe	
Year	Average clarity depth (feet)*
1968	102.4
1969	93.7
1970	99
1971	94.3
1972	89.9
1973	85.5
1974	89.2
1975	85.6
1976	89.8
1977	91
1978	85.1
1979	87.6
1980	81.4
1981	89.8
1982	79.7
1983	73.4
1984	74.8
1985	79.4
1986	79
1987	80.9
1988	80.9
1989	77.5
1990	77.5
1991	73.6
1992	78.4
1993	70.4
1994	73.9
1995	70.4
1996	76.9
1997	64
1998	66
1999	69
2000	67.3

\*Determined from the average of about 35 measurements taken with a Secchi disk during favorable viewing conditions.  
Source: UC Davis Tahoe Research Group