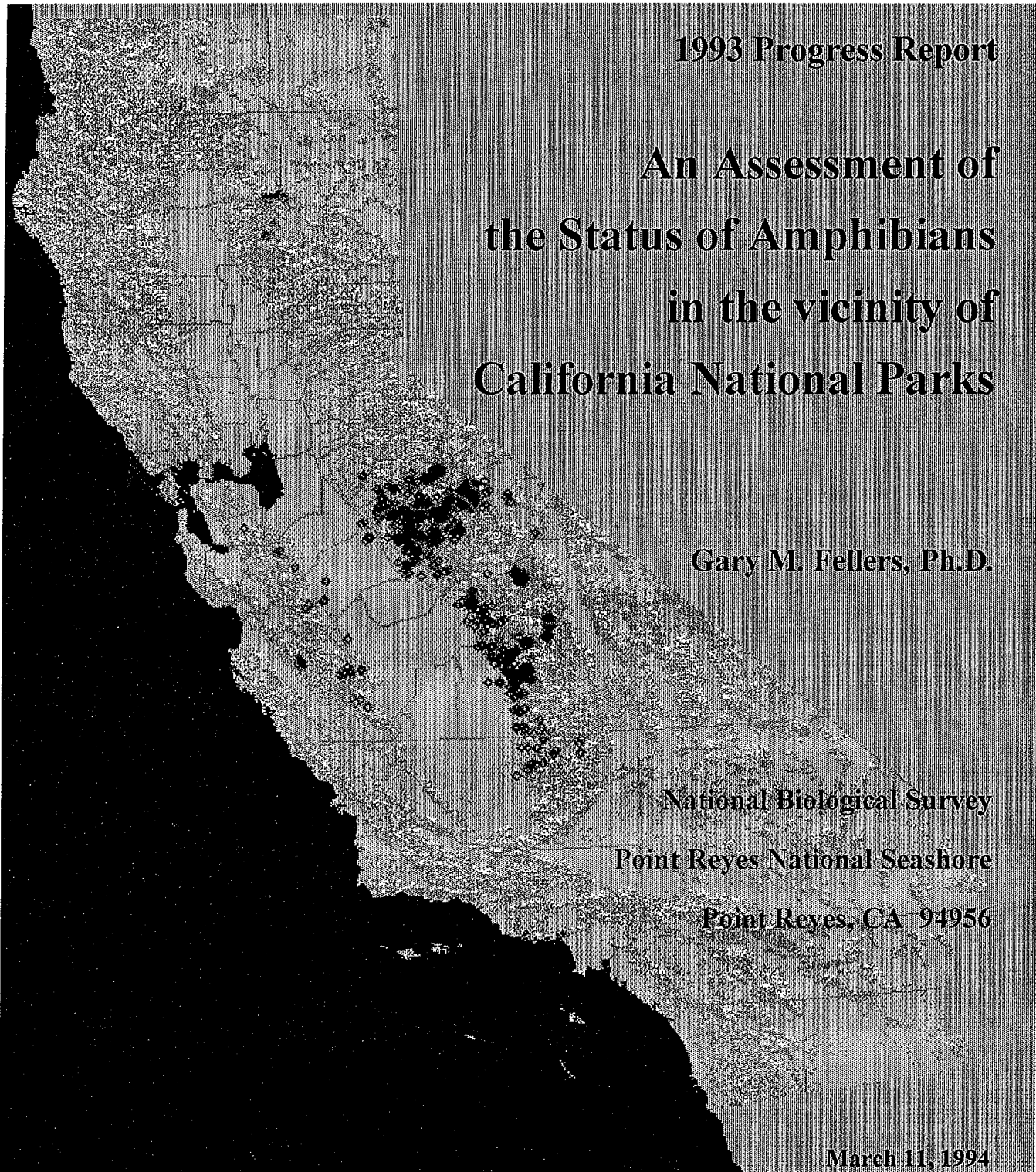




1993 Progress Report

**An Assessment of
the Status of Amphibians
in the vicinity of
California National Parks**

Gary M. Fellers, Ph.D.

National Biological Survey
Point Reyes National Seashore
Point Reyes, CA 94956

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Introduction

Recent evidence indicates that amphibians are declining on a global basis. In the western United States extensive declines in frog, toad, and salamander populations have been widely reported and populations of several species appear to have been extirpated. This may one of the most serious conservation problem in the U.S. today. Healthy, seemingly well-protected populations have disappeared for no obvious reason from the very areas where we would expect them to be best protected.

For example, population declines and extirpations have been documented in National Park areas for the Cascades frog (*Rana cascadae*, Lassen Volcanic NP), the Yosemite toad (*Bufo canorus*, Yosemite NP), the mountain yellow-legged frog (*Rana muscosa*, Yosemite NP, Sequoia NP, Kings Canyon NP), foothill yellow legged frog (*Rana boylei*, Sequoia NP, and Pinnacles National Monument), red-legged frog (*Rana aurora*, Yosemite NP, Pinnacles NM) and others.

The causes of the amphibian losses are largely unknown, but several human and natural factors are suspected, including air pollution, acid precipitation, increases in ultraviolet light, the introduction of native and non-native predatory fish into previously fishless stream and lakes, long-term fire suppression, extended drought, severe freezes, and disease. (Barinaga, 1990; Bradford, 1989, 1991a, 1991b; Corn et al., 1989; Fellers and Drost, 1992, 1993; Hayes and Jennings, 1986; Wyman, 1990; Vitt et al., 1990).

Objectives

Understanding the nature and extent of the amphibian decline has been significantly inhibited by the lack of good baseline data. While some field work has been initiated, major gaps are present. The goals of the current study are:

- To assess the status and distribution of selected amphibians in nine National Park areas in California (Table 1),
- To evaluate possible causes of amphibian declines,
- To determine the feasibility of reestablishing anuran populations that have been lost,
- To determine the genetic diversity of selected amphibians which might be used in experimental reintroductions, and
- To develop a monitoring program that will allow the National Park Service to monitor key populations of selected amphibians.

This study focuses on amphibians in both the aquatic and terrestrial habitats. Even though most of the evidence for amphibian declines has come from observations of frogs and toads, this may be because anurans are more conspicuous in their breeding habits. Terrestrial amphibians (mostly salamanders) have been included in this study in order to assess how widespread the declines actually are.

Field Work

Field work for this project began in the spring of 1993. A project manager, Kathleen Freel, was hired to work at Point Reyes in March. She was responsible for conducting field surveys in Marin County and for assisting with the overall administration of the project. Roberta Larson was hired to enter data. She originally worked at Point Reyes NS and later transferred to Sequoia NP.

The field crews began work March 1993. The crews consisted of two people each and were stationed at Redwood NP (Kathy O'Siggins and Steve Symeonides), Yosemite NP (Jennifer Ellingson and Bridget Keimel), and Sequoia/Kings Canyon NPs (Bruce Christman and Pat Kleeman). Tim Graham, David Bradford, and Hartwell Welsh all assisted with various aspects of the field work.

The declining amphibian study was formally initiated with a week-long training session at Point Reyes. All aspects of the study were discussed including identification of amphibians and reptiles, survey techniques, data recording, and administrative matters. Field work began the first week of April.

Field work consisted of two types of surveys, time constraint surveys (TCS) which emphasized salamanders and aquatic amphibian surveys which emphasized frogs and toads.

Time constraint surveys - In the mid-late 1980s, Hartwell Welsh (US Forest Service) conducted TCS at 30 sites in the northwestern part of California. I am collaborating with him to resurvey all of these sites. The 1980s data will provide a baseline for comparison and allow us to look at trends in salamander populations. All sites were visited in 1993 by the Redwood NP field crew and surveys were conducted at each site. This work was completed during May.

Data for this part of the study are still being entered into a data base, so no statistical comparisons with the Forest Service data have been made yet.

Aquatic Surveys - Most of the work at Redwood NP and all of the field work at the other parks consisted of aquatic surveys which focused on frogs and toads. The field crews were quite productive and a substantial number of survey sites were visited, some of them several times. For example, we accumulated a total of 644 person days while conducting field surveys. This does not include days spent in training, travelling, hiking in the backcountry, or working on administrative matters (e.g. procuring supplies, administrative or research-related paperwork, mapping field sites, or labelling photographs).

Most of the data have been entered into four related databases. Though the final numbers will increase some as the last few data forms are entered, current counts indicate that a 1,376 field sites were visited a total of 1,518 times. These visits break out by field crew as follows:

Redwood	312
Yosemite	503
Sequoia	456
Point Reyes	161
Other	86

The other category includes sites visited by Gary Fellers, Roland Knapp, and Ed Ely.

It should also be noted that not all the sites were in areas managed by the National Park Service. Sites outside parks were Forest Service, Bureau of Land Management, Bureau of Recreation, State of California, County, and private land. For example, the Yosemite crew visited 503 sites of which 317 (63%) were actually within the park boundary.

The figure on the cover shows the distribution of survey sites throughout California. Each of the 1,376 sites is indicated by a red symbol. Since the sites were sometimes close together, many of the symbols overlap on a map which covers the entire state. Similar maps are being developed which include only the data for specific species such as the foothill yellow-legged frog (*Rana boylei*). These maps will be available as part of the final report at the end of the study.

Findings

Data for the time constraint surveys are still being entered into the data base files, so it is not possible to summarize our findings on the abundance of woodland salamanders at this time.

A substantial number of frogs, toads, larvae (tadpoles), and eggs were found as part of the aquatic surveys. There were a 46,471 adult and subadult frogs/toads, 273,544 larvae, and 138,532 eggs found during our surveys. Table 2 gives summary of counts for each life history stage for each species of frog and toad.

Since there are few historic data with which to compare actual numbers of frogs and toads, the more useful comparisons are of the distribution of each species. Relatively good

historical data are available in the form of museum records, published and unpublished research findings, visitor sightings, and even the distribution maps in field guides.

After only the first year of field work, it is clear that there have been significant declines in several species. Our data strongly support the general belief among local biologists that the foothill yellow-legged frog is absent from the southern portion of its range in the Sierra Nevada foothills. We found only one (subadult) frog south of Calaveras County in spite of surveying 310 sites in the southern sierra foothills within this frogs known range. This represents a serious decline. Even if future field work were to locate additional populations in this part of the range, it is clear that this frog has suffered a significant decline.

The distribution of the mountain yellow-legged frog is also substantially restricted compared with historic data. This frog was once found throughout much of the Sierra Nevada above 6,000' elevation. We checked 651 sites within the range of mountain yellow-legged frog and found them at a total of 138 sites. As can be seen from Table 2, there were a lot of frogs found (about 1,500 adults and subadults, and 270,000 tadpoles). While that is an indication that some large populations still exist, the distribution of this frog is significantly reduced in some areas. For example, at Sequoia National Park mountain yellow-legged frogs were entirely absent from entire drainage basins. There were none of these frogs in the South, East, Middle, or Marble forks of the Kaweah River. Some of these drainages once supported large populations of yellow-legged frogs and included the main study site for a doctoral dissertation on this species by David Bradford. For example, Dave Bradford and I visited his main study site in the Tablelands area and were unable to find frogs at any of the historic sites or anywhere else within the Marble Fork of the Kaweah River.

The changes in distribution of mountain yellow-legged frogs at Yosemite is not as obvious. Declines are not occurring on a large drainage basin scale, but rather in a more local lake by lake basis. The reason for this difference is not clear, but probably relates to a difference in factors causing the decline. Non-native trout are well known to eliminate yellow-legged frogs in nearly all situations. This may be the most important factor in Yosemite. While fish are also a problem in many areas of Sequoia and Kings Canyon NP, there seem to be other, more pervasive factors (perhaps poor air quality) which are acting on a broad scale. An increasing amount of effort will be focused on identifying causes of these declines in the next two years of the study.

Genetic Research

Tissue samples were collected from frogs and toads in most of the areas visited during 1994. Analysis of the DNA will allow us to analyze patterns of geographic variation (i.e. the patterns of divergence and relatedness of different populations) within several species of frogs. This information will be valuable for evaluating the conservation and biological consequences of losing local populations and their associated gene pool. This part of the study is being done in collaboration with Dr. Brad Shaffer at the University of California at Davis.

Genetic variability will be evaluated primarily using mitochondrial DNA. Table 3 shows the number of tissue samples that have been analyzed as of February 1994. A significant portion of 1993 was spent refining the analytical techniques and developing primers that were appropriate for the three genera of interest (*Rana*, *Bufo*, and *Hyla*). The number of samples analyzed is expected to increase rapidly as the analysis becomes more of a routine procedure.

World Congress

The realization that there was a world-wide decline in amphibian populations first surfaced at the First World Congress of Herpetology in 1989. It was appropriate that there was a symposium (as well as contributed papers) on this topic at the Second World Congress held in Adelaide, Australia in December 1993. I attended the Congress and was invited to present a paper on the results of my field work in California at the symposium and I chaired the session of contributed papers dealing with declining amphibians.

There were a number of presentations that documented declines both in the U.S. and elsewhere. As with my work, most other researchers had difficulty identifying specific causes of the declines in part because the declines were noticed mostly after the fact, i.e. no one was watching when the frogs actually disappeared.

Two presentations focused on the effects of pesticides on the endocrine systems of amphibians and reptiles. The results were particularly interesting since they suggest that

pesticides in the environment at levels far below those generally believed to be safe can cause infertility. This may be a cause of declines in areas such as Sequoia NP which is downwind from a major source of pollution, the Central Valley. I am in the process of beginning a collaborative study of pesticide effects on California amphibians with one of the two researchers involved in this work.

Experimental Reintroduction of Mountain Yellow-legged Frogs

The possibility of reintroducing mountain yellow-legged frogs in the Tablelands area of Sequoia (during June of 1994) is currently being explored. The goal of a experimental reintroduction would be to identify the operative factor(s) so that mitigation will allow a successful reestablishment of yellow-legged frogs at some point in the future. In essence, we are recreating the conditions that caused the loss of this species, but we are doing so in conjunction with careful monitoring which will help us identify the cause of the original decline.

The proposed reintroduction is not expected to result in the permanent reestablishment of a viable yellow-legged frog population because whatever caused the original loss of the species is still likely to be present.

A proposal which outlines the details of the reintroduction (e.g. number of individuals to move, life history stage, monitoring, logistics) is being developed in collaboration with Dr. David Bradford.

1994 Research

Field surveys similar to those conducted in 1993 will be carried out this season. Field crews will be stationed at the same parks, Point Reyes NS, Redwood NP, Yosemite NP, Sequoia NP. Field work will take place in those parks as well as Lassen Volcanic NP,

Golden Gate NRA, Muir Woods NM, Pinnacles NM, and Whiskeytown NRA. As in 1994, field sites will not be restricted to National Park areas, but will include sites adjacent to the parks and elsewhere in California as necessary to understand the status of amphibians throughout their range. Field work will include both time constraint surveys for salamanders as well as aquatic surveys for frogs and toads.

Summary

The first year of this study was quite productive with 1,376 sites being visited at total of 1,518 times. This resulted in the finding of nearly 500,000 frogs and toads of various life history stages. These data have provided the single best picture of the distribution and abundance of California frogs and toads that is currently available.

Laboratory analysis of the genetic variability has progressed well and we are beginning to obtain data on the extent to which populations of frogs in adjacent ponds, drainages, and regions of the state differ from one another.

A combination of the data on abundance, distribution, and genetic relatedness will be used as a basis for a possible experimental reintroduction of one species of frog in Sequoia National Park.

Table 1. Amphibians and reptiles to be included in surveys of nine National Park areas in California. The occurrence of reptiles will be noted incidental to amphibian field work.

	<u>REDW</u>	<u>PORE+</u>	<u>PINN</u>	<u>LAVO</u>	<u>YOSE</u>	<u>SEKI</u>
Salamanders						
<i>Ambystoma gracile</i>	A	.	.	.	.	.
<i>Ambystoma macrodactylum</i>	.	.	.	A	.	.
<i>Dicamptodon ensatus</i>	.	A	.	.	.	.
<i>Dicamptodon tenebrosus</i>	A	.	.	.	.	.
<i>Taricha granulosa</i>	.	A	A	.	.	.
<i>Taricha torosa</i>	A	A	.	.	.	.
<i>Aneides ferreus</i>	T	.	.	.	.	.
<i>Aneides flavipunctatus</i>	T	.	.	.	.	.
<i>Aneides lugubris</i>	T	T	.	.	.	.
<i>Batrachoseps attenuatus</i>	T	T	T	T	T	.
<i>Batrachoseps reticulatus</i>	.	.	.	.	T	T
<i>Ensatina eschscholtzi</i>	T	T	T	T	T	T
<i>Plethodon elongatus</i>	T	.	.	.	.	.
Anurans						
<i>Scaphiopus hammondi</i>	.	.	A	.	.	.
<i>Bufo boreas</i>	A	A	A	A	A	A
<i>Bufo canorus</i>	.	.	.	.	A	A
<i>Hyla regilla</i>	A	A	A	A	A	A
<i>Rana aurora</i>	A	A	A	.	A	.
<i>Rana boylei</i>	A	A	A	.	A	A
<i>Rana cascadae</i>	.	.	.	A	.	.
<i>Rana catesbeiana</i> *	A	A	.	.	A	A
<i>Rana muscosa</i>	.	.	.	.	A	A

(continued)

Table 1. cont.

	<u>REDW</u>	<u>PORE+</u>	<u>PINN</u>	<u>LAVO</u>	<u>YOSE</u>	<u>SEKI</u>
Reptiles						
<i>Clemmys marmorata</i>	A	A	A	.	.	.
<i>Thamnophis couchi</i>	A	A	.	A	A	.
<i>Thamnophis elegans</i>	A	A	A	A	A	A
<i>Thamnophis hammondi</i>	.	.	A	.	.	.
<i>Thamnophis ordinoides</i>	A	.	.	.	.	.
<i>Thamnophis sirtalis</i>	A	A	A	A	A	.
 Aquatic amphibians	 8	 8	 6	 4	 7	 6
Terrestrial amphibians	6	3	2	2	3	2
Reptiles	5	4	4	4	3	1
 Total	 19	 14	 11	 8	 11	 9
 Park Acreage	 110,000	 147,000	 16,000	 106,000	 761,000	 864,000

A = Aquatic

T = Terrestrial

* = Exotic

SEKI - Sequoia/Kings Canyon NPs

YOSE - Yosemite NP

LAVO - Lassen Volcanic NP

REDW - Redwood NP

PORE - Point Reyes NS, Golden Gate NRA, and Muir Woods NM

PINN - Pinnacles NM

Table 2. Number of frogs and toads of each life history stage counted during 1994 field surveys.

	<u>Adult</u>	<u>Subadult</u>	<u>Larvae</u>	<u>Eggs</u>	<u>Total</u>
Tailed frog	5	39	21	0	65
Western toad	26	3,707	37,053	7,002	47,788
Yosemite toad	14	742	24,995	0	25,451
Pacific chorus frog	2,139	13,211	132,862	31,955	180,167
Red-legged frog	560	1,393	4,141	0	6,094
Foothill yellow-legged frog	334	492	5,704	8,353	14,883
Mtn yellow-legged frog	762	784	13,788	2,218	17,552
All frogs	4,965	20,753	273,544	138,532	437,494

Table 3. Number of tissue samples that have been analyzed for mitochondrial DNA.

	<u>Samples</u>
Western toad	4
Pacific chorus frog	90
Red-legged frog	90
Foothill yellow-legged frog	29
Mtn yellow-legged frog	129
Total	342

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