FROGLOG

IUCN/SSC Declining Amphibian Populations Task Force

September, 1993, No. 7

Postmetamorphic Death Syndrome

According to Dr. Norman J. Scott, Jr., a disease agent may be the primary cause of certain amphibian declines, which he elucidates in his manuscript entitled, "The Postmetamorphic Death Syndrome in Western North America: A Recurring Pattern or Isolated Incidents?" He offers the following summary of the evidence and his tentative conclusions for consideration by other investigators of these events.

The precipitous declines and disappearances of numerous toad and frog populations in western North America are currently being documented, but the suggested reasons for these declines are almost as numerous as the observers. However, researchers in far removed sites have noted a common sequence of events taking place in the progression of these disappearances. The widespread occurrence of these sequelae may be an indication of a general decimating factor, or set of factors. If so, an epidemiological analysis of the syndrome might provide clues as to its causes.

This Postmetamorphic Death Syndrome (PDS) is characterized by the mortality of all or most postmetamorphic individuals in a short period of time. The proximate causes of death are usually widespread opportunistic pathogens such as *Aeromonas* (Red-leg disease).

Another characteristic of the nearly complete die-offs or extinctions is a pattern of synchrony in local sites but not among different regions. *Rana tarahumarae* disappearances in Arizona and Sonora were essentially complete by the mid-1980s, but die-offs of other *Rana* in Arizona were not noted until 1993. In the Sierra Nevada of California mortality of *Bufo canorus* occurred between 1976 and 1982, and that of *R. muscosa* between 1979 and 1990. The Sierra Nevada ranid extinctions seem to have proceeded sequentially through different watersheds; indeed, some drainages still have viable populations. In Grant County, New Mexico, disappearances of ranid frogs occurred in the late 1980s.

There may be a "ripple effect," that is, when frogs disappear first from one site, they then disappear from the surrounding area along a gradually expanding perimeter. The observations described above seem to fit this pattern. In New Mexico, the die-off of *R. chiricahuensis* in Gillette Tank, Grant County, New Mexico, was a year later than in Cooney Tanks less than 2 km away; in this general region all of the stocktank populations of leopard frogs disappeared within a three-year period. This ripple effect also seems to describe the pattern of disappearance of *R. tarahumarae* throughout the northern part of its range; extinctions first appeared in Arizona, then spread southward into northern Sonora. A die-off moved upstream in a population of *R. tarahumarae* in Sonora, Mexico.

A fourth characteristic of the PDS is that the dead and moribund animals are usually encountered during or immediately after brumation, or unusually cold periods.

The PDS does not appear to affect all species equally, Leopard Frog populations (*R. yavapaiensis* or *R. chiricahuensis*, or both) survived the die-off that eliminated *R. tarahumarae* in Sycamore Canyon, Arizona. Ranids seem to be more immediately affected than *Bufo*, although the final outcome, extinction, may be inevitable. Ranid die-offs can often happen very quickly and completely; all of the postmetamorphic frogs appear dead in the spring, then the tadpoles metamorphose and die. Die-offs are usually less complete in *Bufo*. *Bufo boreas* and *B. hemiophrys baxteri* in Colorado have been noted to have as much as 80% adult mortality during the winter. Many sick and dead adult Yosemite Toads (*B. canorus*) were reported in the Sierra Nevada of California in 1977 and 1978. However, none of the *Bufo* die-offs were completed in one year, and some of the sick *B. canorus* recovered to be recaptured in the following years.

Carey [1993, Conserv. Biol. 7(2):355-362] formulated a hypothesis to explain disappearances of *B. boreas* in Colorado whereby unspecified environmental factors cause sublethal stress, which suppresses the immune system: this condition combined with cold stress leads to infection by *Aeromonas* or other agents

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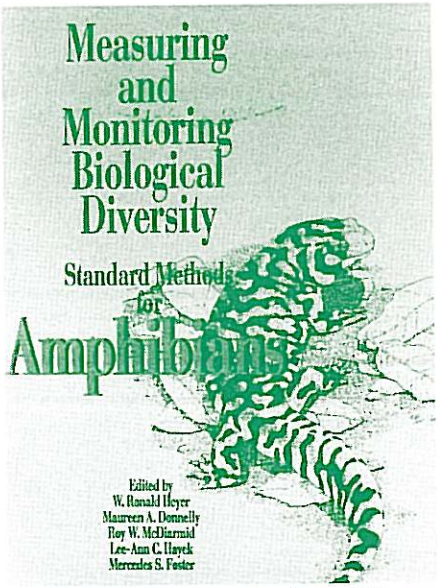

At long last! We are pleased to announce the publication of the Smithsonian Institution's, "Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians."

This essential 320 page guide, available in December, 1993, is the first book to provide comprehensive coverage of standardized methods for sampling of amphibians, with information on analyzing and using data that will interest biologists in general.

Nearly fifty herpetologists collaborate in describing ten standard sampling procedures.

For each procedure there are recommendations for appropriate use, a detailed protocol for implementation, a list of necessary equipment and personnel, as well as suggestions for analyzing the acquired data.

These methods will be extremely useful for making comparisons among populations and species, as well as decisions about habitat protection, sustained use, and restoration—decisions particularly relevant for threatened amphibians.

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(continued from page 1, column 2)
that produce death (see FROGLOG No. 6). Pollution, pesticides, acid precipitation, habitat destruction, increases in UV radiation, and introduction of predators or competitors have been proposed as environmental factors that could operate as the primary sublethal stressor.

Another possibility that has been overlooked is that a disease novel to North America might be the primary factor responsible for the die-offs. The lack of synchrony of die-offs within regions and the apparent ripple effect suggests that a disease organism might be moving within and among populations.

Dr. Scott would welcome comments from interested parties. Anyone desiring to review the extensive documentation and evidence he has assembled regarding the PDS is invited to contact him at: USFWS/NERC, Piedras Blancas Research Station, P.O. Box 70, San Simeon, CA 93452-0700, USA (805-927-3893).

Batrachians as Bioindicators

The appearance of a recent title, "The Utilization of Batrachians [Amphibians] and Reptiles as Bio-Indicators," by G.H. Parent [1992. L'utilisation des batracians et des reptiles comme bio-indicateurs. Les Naturalistes Belges. 73(2):33-63] attracted the attention of numerous Task Force participants. Thanks are extended to Darryl Frost and Annie Zuiderwijk for providing copies of the article (Dr. Parent also forwarded a reprint); to Bob Johnson, and to Paul Kent who provided the English translation. This summary was composed by Jim Vial, who must be held responsible for the content.

In the context of Parent, the term "bio-indicators" is not used in reference to those species sensitive to perturbations of the environment on the global or continental scale, nor to a species response to a particular environmental change. Rather, it is applied to the establishment of a sustained research program of the environment within a prescribed region, aided by species whose decline or numerical fluctuations can at times be related to some well defined environmental parameters. To be successful, such studies require:

* an extended period of time;
* concentration of effort to a limited number of sites and subjects; and
* management of data under the aegis of a scientific institution.

Parent proposes a number of research topics, some of which include amphibians, designed to study the state of the environment. His selection is based on "the fact that results can be obtained quickly and implementation is within the capability of a versatile naturalist." He describes some special characteristics of *Triturus cristatus* (Crested Newt), *T. vulgaris* (Smooth Newt), *Rana esculenta* (European Green Frog), *R. temporaria* (Common Frog), and *Salamandra salamandra* (Fire Salamander).

To adopt what Parent refers to as the "much broader context of bio-indicators," the following should be considered:

* the tolerance thresholds of a species to changes in the environment;
* behavioral and life history peculiarities;
* ecological characteristics related to site protection and management; and
* potential teratological effects.

Anurans are apparently sensitive to radioactive pollution. Parent recites K. Rimpp's (1980) description of a population of *Bufo viridis* (Green Toads) near Stuttgart in which 35 to 55% of the tadpoles exhibited abnormalities. These defects were similar to those displayed by larvae developing from irradiated sperm and eggs in studies conducted at the University of Hiroshima, Japan. In certain regions of France, slightly radioactive waters have been observed to accelerate growth and metamorphosis of amphibians.

It would be valuable to study amphibians in areas where natural levels of radon, thorium or uranium are known to be high. There are numerous locations listed by Parent in which radioactivity is an industrial contaminant, that he recommends for study.

Parent associates the disappearance of some frog species with thermal pollution resulting from the hot effluents of nuclear power plant cooling systems.

More frequently it is chemical contamination that contributes to amphibian declines or disappearances. Progressive acidification of ponds has been responsible for the disappearance of numerous colonies of *Bufo calamita* in Great Britain. Ponds in France and Belgium have been found devoid of amphibians for any of several reasons, specifically: the pond is of recent origin - as yet uncolonized; introduced predatory fish; general absence of amphibians in the region; and most commonly, because of extreme pollution by waste products, pesticides (in agricultural zones), heavy metals, etc.

Certain defects do not appear to be induced by the environment, but are the manifestation of genetic phenomena. For example, albinism in some species, supernumerary appendages or aberrant coloration would only be suspected of being environmentally prompted if such abnormalities attained a high frequency in a population and/or have been restricted to a particular site.

Determining the size of a population may be essential in order to enhance the chances of its survival and/or design effective conservation measures. While certain species are extremely difficult to census, observations during rainstorms and of overwintering retreats have proved valuable. It is advisable in studying population dynamics to organize a team that will continue the work over many (ten) years.

Annual monitoring should be conducted by local observers. Declines of *Bombina variegata* and *Bufo calamita* in Belgium probably took place between 1920 and 1960. Yearly monitoring would likely have provided much information as to actual time frame and probable causes. The same may be said for rareness of *Rana temporaria* in the central Ardennes and of *B. variegata* in the Liege District.

Parent concludes his paper with a brief discussion of plans for updating a regional herpetological atlas and recent changes in the local distribution of the *Rana esculenta*, the Little Green Frog (*R. lessonae*) and the Laughing Frog (*R. ridibunda*).

Copies of the original article (in French) or of the Paul Kent translation (to English) are available upon request from the DAPTF Coordinator's office.

A Report on *Rana capito*

The Carolina Gopher Frog (*Rana capito capito*) is a USA federal candidate species for listing as Endangered or Threatened. In North Carolina, it is listed as a species of Special Concern. This project was designed to gather additional information on the Gopher Frog in North Carolina in order to make informed management and protection decisions.

Historical breeding sites dating between 1933, when the species was first recorded in North Carolina, and 1987 were visited to evaluate their physical status and to look for evidence of current use by the Gopher Frog. Additional sites representing both breeding ponds and road collected specimens were also checked. The total number of sites was 32. Five (16%) of these had been destroyed, 10 (31%) were considered inactive, six (19%) represented road collected frogs with no known breeding pond, and 11 (34%) were listed as active breeding sites. All but one of the active sites were associated with large tracts of relatively good terrestrial habitat for the frog and potential alternative breeding sites.

These conditions likely are important for the long-term survival of a population. Anthropogenic activities impacting upon *R. c. capito* populations are primarily the fragmentation of habitats, reducing the number of available breeding sites and increasing the hazards during migrations. Water table reduction and pond acidification are also significant. Because of the few remaining historic sites for the species, the great reduction in aquatic and terrestrial habitats, and the low number of active breeding sites, listing of the Carolina Gopher Frog as a Threatened Species in North Carolina is recommended.

Summarized from: "Status Report on *Rana capito capito* Le Conte, the Carolina Gopher Frog in North Carolina." Final Report to North Carolina Wildlife Commission, January 1993, by Alvin L. Braswell, North Carolina State Museum of Natural Sciences, P.O. Box 27647, Raleigh, NC 27611-7647, USA.

Abstracts from Recent Meetings

The following abstracts have been selected from the programs for the 1993 annual meetings of the American Society of Ichthyologists and Herpetologists (ASIH), Herpetologist's League (HL) and the American Elasmobranch Society (AES) in May/June at Austin, Texas, USA, and those of the Ecological Society of America (ESA), July/August, at Madison, Wisconsin, USA.

POPULATIONS OF ANURAN AMPHIBIANS IN AN AMAZONIAN RAINFOREST:STABILITY OR DECLINE?

Anuran amphibians were sampled over a period of six years at Cuzco Amazónico in southern Amazonian Peru. Three sampling periods were at the beginning of the rainy seasons in 1986, 1989, and 1991; two were in the middle of the rainy seasons of 1986 and 1990, and one was in the dry season of 1989. Temperature and rainfall were recorded throughout all sampling periods.

Sampling was along a series of trails and in a system of 100 20 X 20 m quadrants. A total of 65 species of anurans was recorded from the site. As expected, fewer species and far fewer individuals were recorded during the dry seasons than in the rainy seasons. Initial analyses revealed fewer species and individuals recorded at the beginning of the rainy seasons of 1989 and 1991 than in 1986 and fewer individuals in the middle of the rainy season of 1990 compared with that in 1986.

However, analyses of anuran abundance with respect to rainfall revealed that the number of individual anurans recorded was correlated positively with high average rainfall and the amount of the heaviest rainfall but not the number of rainy days during the sampling period.

The numbers of anuran amphibians observed at Cuzco Amazónico are highly variable among sampling periods, even during the same period of time in different years. The abundance of observed individuals is a reflection of rainfall patterns and does not indicate a decline in the number of individuals or species.

ASIH/HL/AES abstract by William E. Duellman; Museum of Natural History and Department of Systematics and Ecology, The University of Kansas, Lawrence, KS 66045-2454, USA.

ANURAN BIODIVERSITY ON A PERIODICALLY BURNED XERIC UPLAND HABITAT IN CENTRAL FLORIDA

Recent reports have alerted the scientific community to a possible global decline in amphibian populations. The paucity of long term studies, however, coupled with acute fluctuations of amphibian populations have hampered attempts to verify changes in amphibian populations. We report our findings from a seven year study (1982-88) of anuran occurrence on a xeric upland sandhill habitat which is partially surrounded by a riverine swamp.

We captured 2,396 individuals from 13 species; the four most abundant species comprised over 98% of the anuran community. Repeated controlled burning had little influence on the abundance of most anurans. Distance of a plot from the edge of the nearby wetlands was correlated inversely to the number of anurans captured. We found positive correlations among monthly rainfall patterns and monthly captures of anurans.

Anuran abundance varied by an order of magnitude, from a high of 22.8, in 1982, to a low of 1.8 individuals per trap array in 1984. Three of the four most abundant species, *Bufo terrestris*, *Gastrophryne carolinensis*, and *Scaphiopus holbrooki*, are burrowing species that likely spend much time on the upland sandhill habitat. Each of these species exhibited considerable annual variation in number of individuals captured per unit effort and their variation was asynchronous.

ASIH/HL/AES abstract by H. R. Mushinsky, P.R. Delis and E.D. McCoy; Department of Biology, University of South Florida, Tampa, FL, USA.

RESOURCE UTILIZATION BY FOUR AMAZONIAN TADPOLE COMMUNITIES

Four tadpole communities were studied for the duration of a rainy season at the Reserva Cuzco Amazónico located on the Río Madre de Dios, in Amazonian Peru. Aspects of macrohabitat, microhabitat, seasonal time, diel time, and food were examined for patterns of differential utilization among species.

Netting sampled 3,820 tadpoles of 19 species, plus 1,413 individuals of fish and aquatic insects considered to be potential predators or competitors. Patterns of differential utilization among anuran species were evident for most of the resource dimensions. Twenty-five other species were never encountered at the study ponds. These species probably used other macrohabitats and not other times because most aquatic habitats existed only during the rainy season. Macrohabitat and time (limited to within the rainy season) appeared to be the most important resource dimensions followed by food, microhabitat, and diel time. The potential for competition to act as a causal factor resulting in the observed patterns of differential resource utilization probably was rare, whereas predation was more likely because of the many fish species present. Rainfall was the factor most influential in determining patterns of resource utilization primarily because it determined the degree to which the macrohabitats could be utilized temporally.

ASIH/HL/AES abstract by E.R.Wild; Museum of Natural History and Department of Systematics and Ecology, the University of Kansas, Lawrence, KS, USA.

METAPOPULATION DYNAMICS AND PERSISTENCE OF TWO AMPHIBIAN SPECIES IN RELATION TO VARIATION IN HABITAT QUALITY

Local populations persist by various means, one of which is dispersal among local populations. Dispersal has long been viewed as important in fugitive plant and many invertebrate species, but less so for some vertebrate groups.

Two amphibian metapopulations (*Rana sylvatica* and *Ambystoma maculatum*), which consist of many breeding populations, were censused over a six to eight year period. Field experiments and observations assessed the importance of abiotic and biotic factors on reproductive output of breeding populations.

Breeding habitats were of unpredictable quality for *Rana sylvatica*; strong predation by newts or disease outbreak during warm springs commonly eliminated entire larval cohorts. Many breeding populations were sustained by dispersal from successful breeding populations in certain years. Breeding habitats were of predictable quality for *Ambystoma maculatum*; predation by salamanders was not strong, disease outbreak of minor importance, and pond desiccation rare.

Most breeding populations were self-sustaining and dispersal acted primarily as a means of colonization.

ESA abstract by Spencer A. Cortwright; Indiana University Northwest, Gary, IN 46408, USA.

EPISODIC ACIDIFICATION IS NOT RESPONSIBLE FOR AMPHIBIAN DECLINES IN THE ROCKY MOUNTAINS, USA

We examine whether episodic acidification is responsible for observed declines of amphibian populations in the Rocky Mountains. Criteria for the documentation of episodic acidification of amphibian breeding habitats are defined. Monitoring pH and acid neutralizing capacity (ANC) alone cannot provide evidence of anthropogenic episodic acidification of amphibian habitats. There is very limited evidence that anthropogenic episodic acidification occurs in high elevation habitats in the Rocky Mountains, but there is no evidence that episodic acidification has led to acidic conditions (ANC < 0) or that amphibian embryos are present during the initial phase of snowmelt when episodic acidification might occur.

Previously published reports of amphibian declines, which do not meet with the criteria outlined here, cannot be credibly attributed to the effects of acidic deposition. Our surveys of amphibian decline habitats in the Rocky Mountain region show no evidence of either chronic or episodic acidification as the cause of observed declines.

ESA abstract by Frank A. Vertucci and P. Stephen Corn, Colorado State University, Fort Collins, CO, 80523, USA and U.S. Fish & Wildlife Service, Fort Collins, CO, 80525, USA.

BULLFROGS (*Rana catesbeiana*) INVADE A NORTHERN CALIFORNIA RIVER: A PLAGUE OR SPECIES COEXISTENCE?

Range expansion of the bullfrog, *Rana catesbeiana*, has coincided with declines of western ranid frogs, but the cause has not been established. I monitored the invasion of bullfrogs into a pristine northern California river system, dominated by the native frogs, *R. boylei* and *Hyla regilla*, by mapping oviposition sites and tadpole habitat utilization along 8 km of the S. Fork Eel River.

Where bullfrogs were well established, natives were rare. At invasion fronts, native and invading larvae overlapped spatially even when timing and location of hatching did not. These results suggest larval competition with bullfrog tadpoles might contribute to the exclusion of native species from previously occupied stream habitat. I tested this hypothesis by manipulating tadpole species composition and density. Bullfrog tadpoles had a great impact on *R. boylei*, causing a 48% reduction in survivorship, and a 24% decline in mass at metamorphosis, but only a slight impact on *H. regilla* (16% reduction in metamorph size, and no significant effect on survivorship).

Benthic algae and macroinvertebrate assemblages were also significantly altered in the presence of bullfrog tadpoles, although patterns varied across the spatially heterogeneous patches included in the manipulations. These results indicate that through larval interactions, bullfrog invasion can perturb aquatic community structure and exert differential effects on native frogs.

ESA abstract by Sara J. Kupferberg; University of California, Berkeley, CA, 94720, USA.

DAPCAN III in B C

DAPCAN III, the third annual meeting of the Task Force on Declining Amphibian Populations in Canada, will be hosted by the Royal British Columbia Museum, Victoria, BC, October 15-18, 1993. The Canadian Wildlife Service (Pacific and Yukon Regions) and Environment Canada are co-sponsors.

To provide an overview of the program and express concerns before an audience of resource managers throughout North America, the initial session will be shared with the Western States and Provinces Non-Game and Watchable Wildlife Conference. Subsequent sessions will consist of amphibian research papers and a full day of discussion relating to DAPCAN objectives.

The DAPCAN Task Force is preparing a multi-authored final report, "Amphibians of Canada: Population Status and Decline," edited by David Green. Data presented, recommendations and resolutions formulated at DAPCAN III will be included. It will be here that the Canadian perspective is defined for presentation to the Second World Congress of Herpetology to be held in Adelaide, Australia, in December, 1993.

For further information contact Stan Orchard, DAPCAN Regional Coordinator for Western Canada, Royal British Columbia Museum, 675 Belleville St., Victoria, BC V8V 1X4 , Canada (phone: 604-387-3649).

Endangered Frogs Survey

The Frog and Tadpole Study Group (FATSG) based in Sydney, Australia, has started surveys of the 21 species that are known or suspected to be in decline in New South Wales (NSW). The surveys will be concentrated in the more humid eastern half of the state. Data will be taken on habitat characteristics and population sizes at previously sampled sites (based on museum records) as well as additional locations that show promise. The work is funded in part by the Australian Heritage Commission (Aust. $31,000). There is also a substantial voluntary input from FATSG members. The survey will continue until about March, 1995.

November 1 to 7, 1993, has been officially declared "Frog Week" in NSW and during that week FATSG members will undertake an intensive spot survey of 20 key sites/areas throughout the state. Media coverage is planned and as a result it is hoped there will be a statewide CALL-IN. The public will be asked to mail a tape recording of their local ponds, swamps, etc. (with locality and date) for which they will receive species identifications. This will be the most comprehensive state wide survey of frogs ever undertaken in NSW.

Persons who wish to help or obtain further information may contact Harald Ehmann (Convenor), Frog and Tadpole Study Group, P.O. Box E405, St. James, NSW 2000, Australia.

United Kingdom Convenes Workshop

In January of this year an Amphibian Ecology Workshop was convened at the Open University, Kent, England, by Nick Barnes and Tim Halliday. Current research initiatives were discussed with the ultimate objective of developing a comprehensive action plan for the United Kingdom.

In his resurvey of 200 ponds assessed in 1975, Carlos Abrahams, University of Leicester, found that 183 remained, 95 were occupied (20 of which were new records). Site characteristics were identified although correlations with occupancy were inconclusive.

The Crested Newt (a protected species) Project was described by Bob Bray, consultant to British Coal Opencast. Two years after introduction of premetamorphic larvae to reclaimed sites, only minimal supporting vegetation was present and "some aquatic animals." Success of the project is yet to be determined.

Andrew Cunningham, Institute of Zoology, reported on mass mortalities of the Common Frog (*Rana temporaria*) in southeast England that have occurred eleven times since 1988. Post mortem examinations revealed skin ulceration, digit necrosis, emaciation, haemorrhagic syndrome, and skin necrosis and sloughing. The problem appears confined to frogs, rather than other amphibians.

The concept of a National Herpetological Conservation Strategy was described by Tony Gent, English Nature. The initial step was to determine precise conservation objectives and required resources, by bringing together various Societies and Trusts.

Site desiccation was reported by Arnold Cooke, English Nature, to be an important factor in Crested Newt declines. Based on 20 years of DOR (dead on road) toad counts near Ramsey, there appears to be a slight increase in population numbers.

Mary Swan, De Montford University, elaborated upon the National Long-Term Amphibian Monitoring Scheme, which began in 1983. The project has resulted in habitat data on over 11,000 pond sites throughout the UK. (A summary of the results of the project was reported in FROGLOG No. 6).

Problems relating to determination of the extent and causes of amphibian declines were presented by Richard Griffiths, Durrell Institute of Conservation and Ecology. He suggests a better understanding of the "basic ecology" of amphibian species would allow a more informed judgment as to causes. Present concerns should be placed in an overall ecological and historical context.

FROGLOG

Newsletter of the World Conservation Union (IUCN), Species Survival Commission (SSC) Declining Amphibian Populations Task Force (DAPTF) and Center for Analysis of Environmental Change (CAEC). Available to interested parties upon request.

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