

## Declining Amphibian Populations Task Force

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During the 1970s and 1980s, researchers in many parts of the world reported seemingly drastic population declines and disappearances of amphibians. International amphibian and reptile scientific societies held special sessions at annual meetings. In February 1990, the U.S. National Academy of Sciences sponsored an international meeting to determine whether there was cause for alarm.

From these meetings, researchers reached two conclusions: (1) although most of the evidence for amphibian declines was anecdotal, the number and geographically dispersed nature of the informal reports indicated that the situation should be addressed and treated as a possible environmental emergency and (2) an international working group should be established to produce scientifically defensible information to determine the extent of the problem as quickly as possible.

The first sobering lessons from these early consultations related to the state of the science. It was readily apparent that information about amphibian populations was largely based on observations in western North America, Middle and South America, and parts of Australia. No generalized conclusions could be valid without an information base that encompassed other areas—especially the tropics, where most of the world's amphibians are located. There was also a need to improve the reliability and compatibility of data. In the absence of generally accepted standard research protocols, trained investigators were completing work that was not comparable with other studies nor readily replicated by other scientists.

Nevertheless, the anecdotal data, while not conclusive, were sufficiently consistent to require attention. If, as is widely accepted, amphibians are reliable bioindicators of environmental change, then these population declines had to be regarded as early warnings signaling an important biodiversity crisis. With such high stakes and with so many scientific disciplines involved, it was necessary to proceed with caution. The coverage of the data would have to be improved, and the field techniques would have to be standardized to ensure reliability and compatibility before reaching generalized conclusions.

The scientific community responded by forming the IUCN/SSC Declining Amphibian Populations Task Force (DAPTF) in December 1990. This Task Force is also affiliated with the World Congress of Herpetology. The Task Force operations are linked to the greater conservation community through the IUCN and

the international DIVERSITAS program; these links ensure that the broader implications of the amphibian declines will be given appropriate attention. The Task Force has been successively chaired by Dr. David B. Wake, Mr. Robert Johnson, Dr. W. Ronald Heyer, Dr. James Hanken, and currently Dr. James Collins. DAPTF headquarters was initially established at the Center for Analysis of Environmental Change, Oregon State University, with Dr. James L. Vial serving as the coordinator, assisted by Lorelei Saylor. In June 1994, the Task Force transferred its office to Dr. Timothy Halliday's home university, The Open University, in Milton Keynes, United Kingdom. Dr. Halliday assumed the position of International Director and Dr. John M.R. Baker was hired as the first International Coordinator; Mr. John W. Wilkinson currently serves in this latter capacity.

Early in 1992, the Task Force board of directors held its first meeting. At that meeting, the following goals were established:

1. Catalyze, catalogue, and coordinate efforts to gain an understanding of declining amphibian populations.
2. Identify those target populations, species, and regions that merit immediate attention.
3. Gather and critically examine evidence concerning causal factors contributing to amphibian declines and identify remedial action.
4. Promote data collection on amphibian populations on a long-term basis.
5. Enlist the support of appropriate scientific disciplines needed to address the issues.
6. Disseminate information on declines to the scientific community and promote public awareness.
7. Advise the IUCN, other conservation organizations, and appropriate governmental bodies on necessary and immediate action.

### Progress Report

#### Overview

With the formation of the Task Force closely linked to the general scientific community, the work has steadily moved ahead.

The Task Force developed a strategy to maintain its office as the nerve center with a worldwide network of investigators to collect data. The highest priority was given to the preparation of a standard research protocol to ensure compatible and reliable information. A program of seed money grants was set up to fund studies directed to filling important information needs.

Among the first projects the Task Force completed was the preparation and adoption of the standard protocols (Heyer et al., 1994), which are now being used by investigators. A database was then established at Task Force headquarters to receive reports from field investigators. This database is now fully operational. Summaries of the field information are disseminated to Task Force participants through FROGLOG (now a bimonthly newsletter) and other forms of communication as particular situations require. More than 3,000 individuals, including all participating investigators, currently receive FROGLOG.

In developed countries where there is an established base of investigators, the network of regional and sub-regional Working Groups is largely complete and in the field. The Canadian Working Group (known as DAPCAN) has completed its DAPTF charge, and it has now become a more conservation-oriented organization.

The Task Force leadership has been actively involved in media work in order to gain public support for the conservation measures that are needed to address the amphibian decline problem. The International Director, International Coordinator, Chair, Board Members, and Regional Coordinators have published several articles in popular magazines. They have also responded to and participated in many radio, television, and newspaper inquiries and interviews. The Task Force headquarters frequently issues media briefings that are sent to targeted science writers throughout the world and are also posted on the DAPTF Web site.

### Specific Accomplishments

While the Task Force headquarters serves as coordinator and nerve center for this worldwide effort, the actual fieldwork is completed by regional and sub-regional Working Groups, which operate under their own leadership and with their own funding. Task Force headquarters provides the database, disseminates progress reports, defines the issues, builds infrastructure, and engages in projects designed to improve research methods and produce reliable results. In other words, the Task Force headquarters empowers local groups so that they can target their work more effectively toward the global effort.

A symposium on recent studies of geography and the causes of amphibian declines was held at the Third World Congress of Herpetology in Prague, Czech Republic, during August 1997. Topics included the role of chemical contaminants, disease processes, declines in specific areas of the world, and controversies related to amphibian declines. The Congress prepared a resolution that commended the DAPTF for its efforts to investigate and understand the decline phenomenon.

On 28–29 May 1998, DAPTF assisted in the development of an amphibian declines workshop, which was organized by the National Science Foundation (NSF) in Washington, D.C., through the efforts of Dr. John A. Phillips. The Chair, Dr. James P. Collins from Arizona State University, invited prominent amphibian biologists and other scientists to participate. The following important topics were covered: the geography of amphibian declines, UV-B radiation, deformities, toxins, viruses

and other diseases, climatic change, and immunology. It became clear that an information system, modified monitoring protocols for specific areas, and a major study of amphibians along the American Cordillera were needed. Several participants mentioned the increased interest by the press (perhaps spurred on by potential human effects) in amphibian deformities (i.e., Kaiser, 1997). The final task was to prepare a list of resolutions that dealt with specific recommendations to address amphibian declines: (1) the need for multi-disciplinary and collaborative studies; (2) increased public and private initiatives to support research, policy, and conservation measures; and (3) the encouragement of researchers to use this broad-based approach as a model for future studies directed toward the larger global biodiversity crisis. Based on information presented at the meeting, NSF funded an additional workshop specifically directed toward disease and immunological issues. Most recently, NSF has funded a multinational, multidisciplinary, multimillion-dollar proposal that addresses the disease aspects of the declining amphibian phenomenon (James Collins, Principal Investigator).

## Procedural and Issue-Oriented Working Groups

### Standardized Protocols

To assure greater reliability in evaluating amphibian populations, the Monitoring Protocols Working Group was created. This Working Group addressed the fact that reports were often based solely on personal observations or on data that were difficult to evaluate due to dissimilar methodologies. The Monitoring Protocols Working Group produced the book, *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*, published by the Smithsonian Institution Press (Heyer et al., 1994). Copies of this book have now been sent to all Regional Working Groups. The Task Force Board set the goal for each Regional Working Group to initiate at least one study in its region utilizing the recommended techniques, if such studies are not already underway. A Spanish translation has also been delivered to a South American press for printing and distribution.

### Disease and Pathology Working Group

The Task Force created the Disease and Pathology Working Group as a resource for the Regional Working Groups. It provides expertise for evaluating the impact of diseases in any amphibian decline event. The first Working Group Chair, Dr. D. Earl Green, then of the Maryland Animal Health/Diagnostic Laboratory, assembled 26 individuals with expertise in environmental toxicology, virology, parasitology, radiation, immunology, and pathology. Dr. Green produced a detailed report, "Diagnostic Assistance for Investigating Amphibian Declines and Mortalities," which has been distributed to all interested parties. Andrew Cunningham succeeded as Chair in 1997. He worked with John Wilkinson to produce information for nonpathologists in the DAPTF leaflet, "Amphibian Mortality Information Sheet." This leaflet provides simple guidelines for dealing with dead and diseased amphibians found during a suspected disease outbreak or amphibian mortality event. Recognizing that researchers could inadvertently be spreading disease organisms as they went from site to site, the Disease and Pathology Working Group assisted John Wilkinson in producing a fieldwork protocol leaflet on procedures that fieldworkers

should follow to avoid spreading disease. One of the most concrete examples of the importance of this working group occurred recently when researcher Karen Lips discovered many dead and dying frogs in Panama. She was able to interact directly with pathologists through the DAPTF network to obtain advice for the collection of samples. This rapid response resulted in finding that chytridiomycosis, a condition caused by what was thought to be a fungal organism only associated with plants and invertebrates may have been the agent responsible for the mortality witnessed in the field. Since that time, this etiologic agent has been identified in other frog populations in Middle America and Australia (Berger et al., 1998), North America (e.g., Fellers et al., 2001), and in captive groups of frogs in zoos.

### Interdisciplinary Working Groups

From the beginning, the Task Force has been aware that amphibians are excellent indicator species for “state of the environment” reporting. The environmental changes affecting their survival may be indicative of underlying threats to life-sustaining ecosystem processes on a global level. The investigation of chemical contaminants, and climatic and atmospheric changes implicated in amphibian population declines requires knowledge beyond the ordinary expertise of many herpetologists. The Task Force has organized two multidisciplinary committees concerned with environmental and climatic changes.

### Chemical Contaminants Working Group

This multidisciplinary Working Group was organized by Michael J. Tyler, Professor of Zoology at the University of Adelaide, and is currently chaired by Christine Bishop of the Canadian Wildlife Service. This Working Group addresses the plethora of chemical compounds which, individually or in combination, constitute a danger to life systems.

### Climatic and Atmospheric Working Group

This multidisciplinary Working Group was organized and originally chaired by Andrew Blaustein, Professor of Zoology at Oregon State University. He studied a potential link between a global causal factor, increased levels of UV-B radiation, and amphibian population declines (Blaustein et al., 1994c). Cynthia Carey, the current chair, is the principal investigator using a National Aeronautics and Space Administration (NASA) grant to determine whether there are NASA data to either support or reject the hypothesis that climatic change factors are contributing to the amphibian decline phenomenon.

### Regional and Sub-Regional Working Groups

A volunteer network of 108 regional and sub-regional Working Groups (with numerous participants from 90 countries) has been organized to secure information from all parts of the world. Each regional and sub-regional group has its own chair. Each group builds its own network of investigators and volunteers, shares research results, pursues answers to the causal questions the Task Force is striving to resolve, and reports its progress to the Task Force headquarters for insertion in the data

bank. Each Working Group determines its own agenda based on guidelines provided by the Task Force office. The progress of each group depends on its ability, enthusiasm, and fundraising efforts.

The organization of Working Groups has rapidly progressed in areas that have traditionally supported amphibian studies, particularly the United States, Canada, and Australia. Efforts to strengthen the Working Groups in Europe and South America advanced notably in 1994, and there is progress toward activating groups to fill the urgent need for data from Africa and Southeast Asia.

The Regional Working Groups’ input at an early stage of Task Force activity is summarized in the report prepared by the first Task Force Coordinator, James L. Vial, and Lorelei Saylor (1993). Regional information is communicated in FROGLOG and DAPTF reports (Alcala, 1996; Tarkhnishvili, 1997; Wilkinson, 1997). The following are completed and published studies on the status of the amphibians from various regional working groups:

- The Conservation Status of Lesser Antillean Frogs. 1994. Hinrich Kaiser and Robert W. Henderson. *Herpetological Natural History* 2:41–56.
- *Amphibian Populations in the Commonwealth of Independent States: Current Status and Declines*. 1995. Edited by Sergius L. Kuzmin, C. Kenneth Dodd Jr., and Mikhail M. Pikulik. Pensoft Publishers, Moscow, Russia.
- *Amphibians in Decline: Canadian Studies of a Global Problem*. 1997. Edited by David M. Green. *Herpetological Conservation* 1:1–338.
- *Status and Conservation of Midwestern Amphibians*. 1998. Edited by Michael J. Lannoo. University of Iowa Press, Iowa City, Iowa.
- The present work is the contribution of the U.S. National Working Group.

### Seed Grants

Work on amphibian declines prior to the formation of the Task Force reflected the interests of investigators and their ability to secure funding. The Task Force board of directors recognized that the worldwide amphibian decline project required more direction if it was to be expeditiously completed. The Task Force Seed Grant Program addresses this important need by awarding modest grants to assist investigators with closing important gaps in information and in accumulating the necessary preliminary data for obtaining support for large, long-term studies. The seed grant awards are competitive and carefully assessed and monitored.

Specific benefits are inherent in the data collection and research programs supported by Task Force seed grants. These projects deal with the complex biological questions stemming from the impact of environmental change on wildlife populations. Basic research is necessary to understand ecosystem dynamics and to allow development of effective strategies for wildlife management.

Several grants have been made to assist in the initiation of monitoring programs for identified “target” species and critical habitats in developing countries where no other financial support exists. Also, in order to maximize Task Force funds, some grants have funded investigators who are working to secure preliminary data to establish a strong base with which to gain



funding for larger, long-term studies. As of 2002, 95 international projects have been awarded almost \$210,000 in seed grants, the important results of which are beginning to appear in the scientific literature (e.g., Carey et al., 1996a,b; Cunningham et al., 1996; Hays et al., 1996; Laurance, 1996; Maniero and Carey, 1997; Berger et al., 1998). Several of the seed grant recipients have successfully obtained further funding based on the results from their seed grant award work.

## The State of Current Knowledge

By 1997, we were able to state as a fact that “amphibian populations, in far-flung locations, are indeed disappearing even in seemingly virgin environments” (Halliday and Heyer, 1997, p. 61). The conservation implication of this finding is that saving habitat is not in itself sufficient for saving amphibians. We must find out what is causing the declines in order to stop or reverse the problem. If there were a straightforward single global factor causing amphibian declines, the amount of research that has gone into the effort would have identified it by now. Rather, the most plausible scenario is that there are multiple causes interacting synergistically with one another, which may vary from region to region. The hypothesized causes include the following:

**Local impact causes**—these include habitat modification, amphibian collection, and species introduction. Habitat modification is the most important cause of overall amphibian population loss. Collecting amphibians for the pet trade, biological supply houses, and food has also posed problems for a few specific amphibians. The introduction of organisms that prey on native amphibians, such as game fish outside their native range, can introduce diseases as well.

**Regional impact causes**—factors such as acid rain and chemical contaminants adversely impact amphibians on a regional scale.

**Global impact causes**—these include ozone depletion, environmental estrogens, climatic change factors, and disease. Although the importance of environmental estrogens has been studied for such groups as fishes, this topic has only recently been initiated for amphibians. Early reports suggest that environmental estrogens may play a role in the declining amphibian phenomenon. However, further studies are needed to evaluate the impact of this factor. Climate change factors that amphibians (as well as the rest of the planet) are experiencing require additional study. Climates are changing and we are in a period of human driven global warming. Although the magnitude of these changes seems no different from past historical records (at scales of millions of years), we are in a period when many amphibians in different parts of the world should be experiencing stress due to these changes. While these changes may not be sufficient in themselves to cause total disappearances of amphibian populations, they may be a contributing stress factor that in combination with other stressors is pushing some amphibians over the brink. The recent discoveries of a chytrid fungus as a vector for amphibians indicate that its impact may be global as well. The research community is working hard to understand the implications of the chytrid fungus on the amphibian decline phenomenon.

## Whither the Task Force?

The mandate the Task Force took upon itself was to determine the nature, extent, and causes of declines of amphibians throughout the world and to promote means by which those declines could be halted or reversed. The Task Force has recently completed the part of the mandate that could realistically be expected of it. When the Task Force was first formed, the major question was whether the anecdotal observations of amphibians declining and disappearing from relatively undisturbed habitats were scientifically true. We now know that amphibians are declining and disappearing from certain habitats at much greater rates than has occurred throughout the millions of years that amphibians have lived on earth. There remains much research to be done before we can begin to fully understand the causes of amphibian declines from relatively pristine habitats. This research, by its nature, will take several years to complete.

Plans were begun in 1997–1998 to assemble a comprehensive summary of information on the declining and disappearing amphibian population phenomenon. At the June 1999 DAPTF board meeting, the following two actions were endorsed:

Three major products, targeted for completion in 2004–2005, will comprise the summary: (1) a multi-authored book providing an assessment of knowledge to date, including an analysis of the ecogeography of declines and evaluation of causal factors and case studies of particularly well-studied declines; (2) a compact disc containing the DAPTF data with database software that will allow users to exhaustively query the data; and (3) a compilation of reports from Regional Working Groups that have not published their reports elsewhere.

The DAPTF Board, after considerable thought and discussion, concluded that it was most unlikely that all the causes of amphibian declines would be resolved by 2001, although substantial progress had been made. Given that situation, the board concluded that the DAPTF should not terminate itself upon completion of the comprehensive summaries described above, but should instead maintain an international presence and focus on the scientific issues involved. The board also enthusiastically agreed that the Seed Grant Program should be continued.

## Summary

The Declining Amphibian Populations Task Force (DAPTF) was created in December 1990 under the aegis of the Species Survival Commission (SSC) of IUCN-The World Conservation Union with the support of the international herpetological community. Its purpose is to organize and coordinate a global investigation of unexplained (and sometimes conflicting) data indicating amphibian population and species declines and worldwide disappearances.

In the fourteen years since it was established, the DAPTF has mobilized numerous investigators within 108 regional and sub-regional Working Groups in all parts of the world, and it has begun to develop a database that pinpoints several factors that appear to relate to the phenomenon.

The Task Force’s plans specified priority to testing the hypothesis that amphibians are useful biological indicators of important environmental changes. As the work progressed,

there was a deepening conviction that some of the factors associated with the declines in amphibian populations were environmental and climatic changes that also influence other life systems. Reflecting this progress, the Task Force priorities were reassessed in 1995. This new assessment called for expanding the participation of specialists from other disciplines who contribute to and review the database information.

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*Addendum.* This article was originally submitted in January 1999 at which time WRH was the DAPTF Chair. The article was first updated in early 2001, at which time WRH was no longer DAPTF Chair. Some updates at the page proof stage in the fall of 2004 have been incorporated into the text, but other items are best incorporated in this addendum. John Wilkinson served as DAPTF International Coordinator from 1996 to 2004. Jeanne McKay is the current International Coordinator. The Climatic and Atmospheric Working Group NASA grant results were reported in Alexander and Eischeid (2001), Carey et al. (2001), Middleton et al. (2001), and Stallard (2001). The current status of the three major products listed in the section "Whither the Task Force" is: (1) the multi-authored book is still in development; (2) the DAPTF database is posted on the DAPTF website, but additional resources are needed to make it readily available to the entire scientific community; and (3) the Regional Working Reports compendium is ready for publication, pending funding.