Plate 1. *Plectrohyla dasypus*. A Honduran endemic with all known populations believed to be declining.
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The conservation status of the herpetofauna of Honduras

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***Abstract.*—The conservation status of the members of the Honduran herpetofauna is discussed. Based on current and projected future human population growth, it is posited that the entire herpetofauna is endangered. The known herpetofauna of Honduras currently consists of 334 species, including 117 amphibians and 217 reptiles (including six marine reptiles, which are not discussed in this paper). The greatest number of species occur at low and moderate elevations in lowland and/or mesic forest formations, in the Northern and Southern Cordilleras of the *Serranía*, and the ecophysiographic areas of the Caribbean coastal plain and foothills. Slightly more than one-third of the herpetofauna consists of endemic species or those otherwise restricted to Nuclear Middle America. Honduras is an area severely affected by amphibian population decline, with close to one-half of the amphibian fauna threatened, endangered, or extinct. The principal threats to the survival of members of the herpetofauna are uncontrolled human population growth and its corollaries, habitat alteration and destruction, pollution, pest and predator control, overhunting, and overexploitation. No Honduran amphibians or reptiles are entirely free of human impact. A gauge is used to estimate environmental vulnerability of amphibian species, using measures of extent of geographic range, extent of ecological distribution, and degree of specialization of reproductive mode. A similar gauge is developed for reptiles, using the first two measures for amphibian vulnerability, and a third scale for the degree of human persecution. Based on these gauges, amphibians and reptiles show an actual range of Environmental Vulnerability Scores (EVS) almost as broad as the theoretical range. Based on the actual EVS, both amphibian and reptilian species are divided into three categories of low, medium, and high vulnerability. There are 24 low vulnerability amphibians and 47 reptiles, 43 medium vulnerability amphibians and 111 reptiles, and 50 high vulnerability amphibians and 53 reptiles. Theoretical EVS values are assessed against available information on current population status of endemic and Nuclear Middle American taxa. Almost half (48.8%) of the endemic species of Honduran amphibians are already extinct or have populations that are in decline. Populations of 40.0% of the Nuclear Middle American amphibian species are extirpated or in decline. A little less than a third (27.0%) of the endemic reptiles are thought to have declining populations. Almost six of every ten (54.5%) of the Nuclear Middle American reptilian species are thought to have declining populations. EVS values provide a useful indicator of potential for endangerment, illustrating that the species whose populations are currently in decline or are extinct or extirpated have relatively high EVS. All high EVS species need to be monitored closely for changes in population status. A set of recommendations are offered, assuming that biotic reserves in Honduras can be safeguarded, that it is hoped will lead to a system of robust, healthy, and economically self-sustaining protected areas for the country's herpetofauna. These recommendations will have to be enacted swiftly, however, due to unremitting pressure from human population growth and the resulting deforestation.**

***Resumen.*—Se discute el estatus de conservación de los miembros de la herpetofauna de Honduras. Basados en el crecimiento presente y proyectado de la población del ser humano, se propone que toda la fauna herpetológica de Honduras está en peligro de extinción. Lo que se conoce de la fauna herpetológica hondureña en el presente consiste de 334 especies, incluyendo 117 anfibios y 217 reptiles (incluyendo seis reptiles marinos, que no se discuten en este artículo). La mayoria de las especies se presentan en bajas y moderadas elevaciones en formaciones forestales de tierras bajas y/o húmedas, en las Cordilleras Septentrional y Meridional de la Serranía, y las áreas ecofisiográficas de la costa y las faldas de la montaña del Caribe. Un poco mas de un tercero de la fauna herpetológica consiste de especies endémicas o sino de esas especies restringidas al Mesoamérica Nuclear. Honduras es una área severemente afectada por la disminución de las poblaciones de anfibios, con cerca de la mitad de la fauna anfibia amenazada, en peligro, o extinta. Las principales amenazas a la sobreviviencia de los miembros de la fauna herpetológica son el crec-**

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imiento sin control de la población humana y sus vástagos, la alteración y destrución de habitación, polución, el control de pestes y predadores, el exceso de caza y explotación. Ningun anfibio o reptil hondureño está totalmente libre de el impacto humano. Se ha desarrollado una regla de medir para estimar la vulnerabilidad ambiental de las especies de anfibios, usando medidas de extensión del rango geografíco, amplitud de distribución ecológica, y estado de especialización del modo de reproducción. Se ha desarrollado una medida similar para los reptiles, usando las dos primeras medidas de vulnerabilidad usados con los anfibios, y una tercera medida para el grado de persecusión humana. Basados en estas medidas, los anfibios y reptiles muestran un rango actual de una marca de vulnerabilidad medioambiental (EVS) casi tan amplia como el rango teorético. Basados en la EVS, ambas especies de anfibios y reptiles están divididas en tres categorías, de baja, media, y alta vulnerabilidad. Hay 24 especies de anfibios y 47 de reptiles de baja vulnerabilidad, 43 especies de anfibios y 111 de reptiles de media vulnerabilidad, y 50 especies de anfibios y 53 de reptiles de alta vulnerabilidad. Teoréticamente, los valores de EVS son determinados de acuerdo de información disponible del estado presente de las taxas endémicas de Mesoamérica Nuclear. Casi la mitad (48.8%) de las especies endémicas de anfibios hondureños están ya extintos o tienen poblaciones en disminución. Poblaciones de 40.0% de las especies de anfibios de Mesoamérica Nuclear están extintas o en disminución. Un poco menos de un tercio (27.0%) de los reptiles endémicos se piensa que tienen poblaciones en disminución. Casi seis de cada diez (54.5%) de las especies de reptiles de Mesoamérica Nuclear se piensa que tienen poblaciones en disminución. Los valores de EVS proporcionan un indicador utíl del riesgo potencial, el cual muestra que las especies cuyas poblaciones actuales están disminuyendo, o son extintos o extirpados tienen EVS relativamente altos. Todas las especies con un EVS alto necesitan ser observadas de cerca para anotar los cambios en el estado de las poblaciones. Ofrecemos un grupo de recomendaciones, asumiendo que las reservas bióticas de Honduras pueden ser preservadas, se espera que esto resulte en un sistema de áreas protegidas que es robusta, saludable, y sostenible economicamente para la fauna herpetológica del país. Estas recomendaciones tienen que ser observados rapidamente, debido a la presión continua causada por el crecimiento de la población humana y la resultante destrucción de los bosques.

Key words. *Conservation status, amphibians, reptiles, herpetofauna, Honduras, distribution*

"To the extent that we depend on prosthetic devices to keep ourselves and the biosphere alive, we will render everything fragile. To the extent that we banish the rest of life, we will impoverish our own species for all time. And if we should surrender our genetic nature to machine-aided ratiocination, and our ethics and art and our very meaning to a habit of careless discursion in the name of progress, imagining ourselves godlike and absolved from our ancient heritage, we will become nothing."

E. O. Wilson

***Consilience: the unity of knowledge*, 1998**

Introduction

The portion of the closing paragraph of E. O. Wilson's (1998) powerful book quoted above provides an extremely serious warning to our species, a warning that in continuing with our plan to place all the natural world in service to ourselves, we risk erasing any meaning for our continued existence. This concept is antipodal to the usual thinking that we encounter our raison d'être as we continue to subjugate Nature to our own designs. One of the central goals of conservation biology, then, is to attempt to bridge the gap between these antithetical worldviews in an effort to salvage and restore as much of the remaining global biodiversity as possible in the shortest time possible.

It is common knowledge among biologists that the greatest amount of biodiversity resides in the area between the Tropics of Cancer and Capricorn—the tropics. It is frequently stated that 40-80% of the diversity of life occurs in this region (Miller 2001; Raven and Berg 2001). Unfortunately, this region also is subject to the highest rates of human population growth. For example, in the Western Hemisphere, there are thirty-one countries that lie wholly within the tropics. The average natural increase for these thirty-one countries is 1.71% (data obtained from the 2000 World Population Data Sheet of the Population Reference Bureau, an insert in Raven and Berg 2001). This translates to an average doubling time of 40.9 years (using the formula DT = 70/natural increase).

The countries of Central America, however, are the fastest growing ones in the American tropics (data obtained from the 2000 World Population Data Sheet of the Population Reference Bureau, an insert in Raven and Berg 2001). Natural increase ranges from a low of 1.7 in Panama to a high of 3.0 in Nicaragua, with doubling times ranging from 23 years for Nicaragua to 41 years for Panama.

Growth rates, however, are significantly higher for the nations of northern Central America than are those for lower Central America. Costa Rica and Panama have growth rates of 1.8 and 1.7, respectively, whereas those for Belize, Guatemala, El Salvador, Honduras, and Nicaragua range from 2.4 to 3.0. For the latter five countries, these figures translate to doubling times ranging from 23 (Nicaragua) to 29 years (El Salvador). The natural increase of Honduras, at 2.8%, is the third highest in Central America, being exceeded only by those of Guatemala (2.9%) and Nicaragua (3.0%). Thus, its doubling time is the third fastest in the region, at 25 years.

The senior author has been working on the herpetofauna of Honduras since 1967. In the 35 years since then, the human population of the country has grown from about 2.4 million to a figure somewhat in excess of 6.7 million (the former figure is from Golenpaul, 1968, and the latter one is from data obtained from the 2001 World Population Data Sheet of the Population Reference Bureau, an insert in later copies of Raven and Berg 2001). In other words, in that 35-year period of time, the population of Honduras has doubled and increased by almost half again as much.

Habitat degradation and destruction are recognized as the major threats to biodiversity today (Raven and Berg 2001). Such degradation and destruction in Honduras is primarily fueled by deforestation (E. Wilson and Perlman 2000), occasioned by shifting agricultural practices, ranching, logging, and fuel gathering. The deforestation models in E. Wilson and Perlman (2000) indicate that the amount of forest remaining in 1995 amounted to 4.1 million hectares. Honduras, however, contains 43,277 sq. mi. or 11,208,935 hectares. Thus, in 1995 only about 37% of the original forested area of the country (i.e., once the entire country) remained. The E. Wilson and Perlman (2000) deforestation model for Honduras also indicates that the time to halve the remaining forest is 30.1 years. Thus, the 1995 figure of 4.1 million hectares will be down to 2.05 million hectares by about 2025. The deforestation rate indicated by E. Wilson and Perlman (2000) is -2.3% and will reduce the remaining forest in the country to 0.5 million hectares by the year 2085. It can be expected that, if these rates continue, no forest will remain in Honduras by the end of the present century.

Measured against this backdrop, it is abundantly clear that the Honduran herpetofauna, and indeed the entire biota, is endangered, in the best sense of the term. Equally clear, thus, is the rationale for an examination of the conservation status of the herpetofauna of the country. If we do not examine it now, we can only look to further deforestation, fueled by the uncontrolled growth of the human population, and increasing threats to the survival of the herpetofauna. We have no idea what the herpetofauna of Honduras looked like at the time of Columbus' arrival at Cabo de Honduras, opposite Trujillo, in 1502, but at least we do know that the known herpetofauna that existed when the senior author began to work in the country in 1967 is not the herpetofauna known today (see below).

It is the purpose of this paper to assess the conservation status of the known members of the Honduran herpetofauna and to construct a set of conservation and research priorities for the foreseeable future. It is hoped that the brutal honesty with which we have approached this work will act to spur the necessary steps to enable these priorities before this segment of the Honduran patrimony is lost for all time.

Status of our knowledge of the Honduran herpetofauna

The modern history of the study of the amphibians and reptiles of Honduras began with the first trip to the country made by John R. Meyer in 1963. Meyer was "in country" for three months with a field crew from Texas A&M University led by the mammalogist Gerald V. Mankins. It was during this trip that Meyer began to formulate an idea for a dissertation topic dealing with a survey of the herpetofauna of Honduras. With his transfer to the University of Southern California under the mentorship of Jay M. Savage, the idea became a reality.

At about the same time, Larry D. Wilson was also working on his dissertation at Louisiana State University in Baton Rouge. Unaware of Meyer's dissertation work, Wilson began to survey various collections around the country to see what material from Honduras existed there. The word got around to Meyer, who then began to correspond with Wilson. In time, Meyer suggested that Wilson join him on a three-month field trip to the country during the summer of 1967. A second three-month journey ensued in the summer of 1968.

At this point, Meyer began to write his dissertation, which was completed in 1969 (Meyer 1969). The known herpetofauna as of that publication consisted of 196 species. Two years later, Meyer and Wilson (1971) provided a checklist of the amphibian fauna containing 52 species and in 1973 a checklist of the turtle, crocodilian, and lizard fauna listing 59 species (not 58, as stated in their abstract and introduction). Wilson and Meyer (1985) treated 95 species of snakes then known to occur in Honduras (Wilson and Meyer 1982, had treated 91 species of snakes in Honduras).

In 1976, Wilson began to work with James R. McCranie, and their first paper together (joined by Louis Porras) on Honduras appeared in 1978 (Wilson et al. 1978). These same three authors described in 1980 the first new species to result from the fieldwork up to that point (McCranie et al. 1980). In 1983, Wilson produced the first list of amphibians and reptiles for the country since the work of Meyer and Wilson (1971, 1973) and Wilson and Meyer (1982). That list consisted of 208 species (56 amphibians and 152 reptiles). Wilson and McCranie (1994) produced a second update of the Honduran herpetofauna, listing a total of 277 species (89 amphibians and 188 reptiles).

The latest accounting of the species of amphibians is in McCranie and Wilson (2002). This book lists 117 species for Honduras, including two species of caecilians, 25 species of salamanders, and 90 species of anurans (one of which is reported in an addendum). The most recent list of the reptiles is in Wilson and McCranie (2002), in which are included 217 species (14 turtles, two crocodilians, 88 lizards, and 113 snakes). The total known herpetofauna, thus, as of these two publications, consists of 334 species (including six marine reptiles).

McCranie and Wilson (2002) hypothesized that seven additional species of amphibians probably reside in Honduras. A similar work in progress on the reptiles of Honduras (McCranie and Wilson, *in preparation*) lists 13 species of probable occurrence. At the present time, then, we know the herpetofauna consists of 334 species, and we think it may contain as many as 20 more species, apart from any new taxa that may be discovered. The above summarizes our current understanding of the composition of the Honduran herpetofauna.

Our understanding of the geographic and ecological distribution of the members of the herpetofauna of Honduras is summarized in McCranie and Wilson (2002) for the amphibians and, to a lesser extent, in Wilson et al. (2001). The latter situation is the case because Wilson et al. (2001) spent over five years in press and could not be consistently updated to the point it appeared in print. For example, Wilson et al. (2001) considered 276 species of amphibians and reptiles, but did not include five species of marine turtles, one species of marine snake, and six reptile species restricted in Honduras to the Swan Islands and the Miskito Keys. Inclusion of these 12

Plate 2 DOI: 10.1514/journal.arc.0000012.g002

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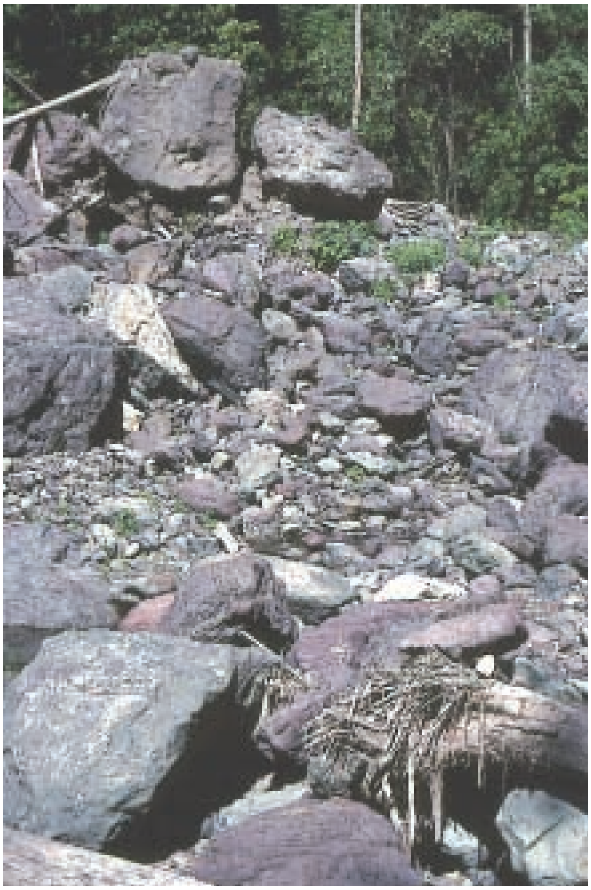

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Plate captions: 2. Primary forest in Parque Nacional El Cusuco, Cortés. Photograph taken from 1820 m elevation on 13 April 1979. **3**. Primary forest along Río de Cusuco, Parque Nacional El Cusuco, Cortés. Photograph taken at 1670 m elevation on 13 April 1979. **4**. Primary forest in Parque Nacional de Celaque, Lempira. Photograph taken from 2440 m elevation on 28 April 1982. **5**. Primary forest along Río Seco, Parque Nacional Sierra de Agalta, Olancho. Photograph taken at 990 m elevation on 8 August 1986. Primary forest like that shown in Plates 1-4 exists today only within the boundaries of some of the biological reserves of Honduras. **6**. Primary forest along Quebrada de Oro, Parque Nacional Pico Bonito, Atlántida. Photograph taken at 950 m elevation on 4 June 1980. **7**. Quebrada de Oro, Parque Nacional Pico Bonito, Atlántida, showing destruction caused by a large landslide in November 1988. Photograph taken at 940 m elevation on 7 August 1989.

Plate 8 DOI: 10.1514/journal.arc.0000012.g008

Plate 9 DOI: 10.1514/journal.arc.0000012.g009

Plate 10 DOI: 10.1514/journal.arc.0000012.g010

Plate 11 DOI: 10.1514/journal.arc.0000012.g011

Plate captions: 8. Collapsed ridge on slope N of Quebrada de Oro, Parque Nacional Pico Bonito, Atlántida. This ridge is part of the two large landslides that severely damaged a large portion of the Quebrada de Oro in November 1988 and November 1995. Photograph taken at ca. 1000 m elevation on 28 May 1996. **9**. Quebrada de Oro, Parque Nacional Pico Bonito, Atlántida. Portion of stream through primary forest that disappeared underground between 28 May and 2 June 1996. Colonies of army ants had invaded the dry stream bed to feed on the perished tadpoles (mostly *Atelophryniscus chrysophorus* and *Ptychohyla spinipollex*) and invertebrate carcasses. Photograph taken at 960 m elevation on 3 June 1996. **10**. El Portillo de Ocotepeque, Ocotepeque. This area was "protected" as part of the Reserva Biológica Güisayote in 1987, even though the vast majority of this reserve was already deforested at that time. Photograph taken at 1900 m elevation on 14 April 1978. **11**. Quebrada Grande, Parque Nacional Cerro Azul, Copán. The haze in the photograph is smoke from slash and burn agriculture. The only forest remaining today in this national park is on some of the steep slopes above this village. The national park was created in 1987 and the photograph was taken on 6 May 1988 (from 1500 m elevation).

species would have raised their tally to 288 species, which is 46 species fewer than the number now known to occur in the country. Thus, the information presented below is somewhat more accurate for the amphibians than it is for the reptiles, although the major distributional patterns discussed are not affected much by the relative lack of currency of the information for the reptiles, nor will it have much affect on the conclusions reached in the remainder of this paper.

Both Wilson et al. (2001) and McCranie and Wilson (2002) discussed ecological distribution of Honduran amphibians and reptiles with respect to ecological formations, physiographic regions, elevation, and ecophysiographic areas. They also discussed the broad patterns of geographic distribution of these animals.

With regard to distribution in ecological formations (modified from those of Holdridge 1967), Wilson et al. (2001) indicated that the greatest number of species occur in lowland formations (Lowland Moist Forest, Lowland Dry Forest, and Lowland Arid Forest formations) and mesic formations (Lowland Moist Forest, Premontane Wet Forest, Lower Montane Wet Forest, and Lower Montane Moist Forest formations). For the amphibians alone, however, the greatest numbers of species are found in only three of the four mesic formations (Premontane Wet Forest, Lowland Moist Forest, and Lower Montane Wet Forest formations).

With reference to distribution in physiographic regions, Wilson et al. (2001) noted that the greatest numbers of species are found in the Northern Cordillera and the Southern Cordillera, these two areas comprising the *Serranía* of Honduras. The same pattern was discovered for the amphibians when considered alone (McCranie and Wilson 2002).

Analysis of distribution with respect to elevation indicates that the greatest number of amphibians and reptiles occur at low elevations (0-600 m), although moderate elevations (601-1500 m) harbor almost as many (Wilson et al. 2001). When amphibians are considered alone, however, there is a significantly greater number of species known from moderate elevations (88 species) than from low elevations (65 species). In addition, a sizable number of species (56) also occurs at intermediate elevations (1501-2700 m).

Combining ecological formations and physiographic regions gives rise to ecophysiographic areas (see Wilson et al. 2001 for a discussion). Thirty-eight such areas were recognized by Wilson et al. (2001), of which 28 were subjected to analysis. McCranie and Wilson (2002), however, presented data on amphibian distribution in 32 of the 38 areas (see McCranie and Wilson 2002 for a map showing the distribution of these areas). Wilson et al. (2001) showed that the highest numbers of species occurred (in decreasing order) in the Eastern Caribbean Lowlands, the West-central Caribbean Lowlands, the Sula Valley, and the Central Caribbean Slope, all of which are Caribbean lowland regions or the foothills above such areas. When the amphibians are considered alone, however, a slightly different pattern emerges. The highest numbers of species of amphibians are found in the Eastern Caribbean Lowlands, the Eastern Caribbean Slope, the Central Caribbean Slope, and the Western Caribbean Slope. The prevalence of foothill regions in this list is reflective of the sizable presence of amphibians at moderate elevations in the country (see above).

Analysis of the broad patterns of geographic distribution by Wilson et al. (2001) showed that the largest numbers of species are endemic to the country or otherwise restricted to Nuclear Middle America (about a third of the herpetofauna therein considered). Slightly more than 90 percent of the herpetofauna were distributed in the area from Mexico to South America. The amphibians, when considered alone (McCranie and Wilson 2002), show the same pattern, with 56.9% either endemic to Honduras or to Nuclear Middle America and 94.0% distributed in the area from Mexico to South America.

The overall outcome of the research on the Honduran herpetofauna that has taken place since 1967 is the description of a large number of new taxa, the discovery of a sizable number of species new to the herpetofauna, and a few resurrections of formerly synonymized taxa. More recently, however, we have entered a new era in our studies in Honduras, as detailed by McCranie and Wilson (*in press*) for the amphibians. As noted above, McCranie and Wilson (2002) treated 116 species of amphibians (and another one in an addendum). The majority of these 116 amphibian species are either endemic to Honduras (41 species) or otherwise endemic to Nuclear Middle America (25 species). Thus, 56.9% of the amphibian fauna falls into these two distributional categories, as noted above. The analysis presented by McCranie and Wilson (*in press*) indicates that of the 41 endemics, six apparently have already disappeared. The populations of an additional 14 are in apparent decline (field work in 2001 indicated that one of the 14 species thought to be in decline by McCranie and Wilson, in press, has also disappeared) and there are four species for which we do not currently know the population status. Thus, only 17 of 41 species (41.5%) appear to have stable populations at the present time. Of the 25 species otherwise restricted to Nuclear Middle America, the populations of nine species appear to be in decline and those of one species appears to have been extirpated in Honduras. We have no data on the populations of an additional four species. Thus, only 11 of 25 species (44.0%) appear to have populations that are stable at this time. Of the 50 remaining amphibian species not discussed above, McCranie and Wilson (*in press*) determined that 25 (50.0%) of them require relatively undisturbed forest regions to survive, and, thus, have lost much of their habitat in recent years. In summary, the populations of only 53 of 116 species of Honduran amphibians (45.7%) appear to be stable or nearly so. Thus, close to half the known amphibian fauna of Honduras is threatened, endangered, or now extinct. This sad picture is being repeated throughout much of Latin America (Young et al. 2001).

In a following section, we attempt to establish a set of conservation priorities for all the members of the Honduran herpetofauna, using revised environmental vulnerability scores, first developed and used by Wilson and McCranie (1992).

Threats to the survival of amphibians and reptiles of Honduras

Wilson et al. (2001:109) opined that, "The most serious of the plethora of environmental problems impacting the planet currently, perhaps, is biodiversity decline, for this is the only one that is irreversible. As species of organisms are pushed to extinction, the information stored in their genomes is irretrievably lost. What importance such creatures have in maintaining the planet's life support systems and what more immediate or direct value that information content may have for humanity is most often extremely imperfectly known to completely unknown. Upon the extinction of the organisms, such enlightenment becomes permanently unattainable." This opinion is based on a cascade of modern research concerning the nature and extent of environmental problems, most specifically about the above-discussed problem of biodiversity decline (see, for example: Ehrlich and Ehrlich 1981, 1996; E. Wilson 1984, 1988 [ed.], 1992; E. Wilson and Perlman 2000; Miller 2001; Raven and Berg 2001).

The anthropogenic threats to the Earth's biota are fairly clearly identified. E. Wilson and Perlman (2000), for example, identify the following threats as most important:

- Habitat loss and fragmentation
- Exotic species
- Overhunting
- Degradation of air, water, and soil
- Synergistic pressures

Raven and Berg (2001) listed the following factors as most important for U.S. plants and animals:

- Habitat loss and degradation
- Exotic species
- Pollution
- Overexploitation

McCranie and Wilson (2002) identified habitat alteration and destruction, pollution, and pest and predator control as the threats of greatest importance to Honduran amphibians. When one considers the reptile segment of the herpetofauna, then overhunting and overexploitation must be added to the list. However, it may be shown that the synergistic interactions of these various threats will represent the ultimate threat (E. Wilson and Perlman 2000), pushing the existing natural systems in Honduras beyond any hope of recovery. Given the rate at which habitat alteration and destruction is proceeding, as especially measured by the rate of deforestation (see the Introduction), it may be hypothesized that the collapse of most to all of the populations of the country's amphibians and reptiles will be complete at or before the end of the present century. In the same period of time, based on Honduras's human population doubling time of 25 years (data obtained from the 2000 World Population Data Sheet of the Population Reference Bureau, an insert in Raven and Berg 2001), its population will increase theoretically by a factor of 16 times! One of the most basic questions facing the populace of Honduras is what the country will be doing with its 107.2 million people it is scheduled to have by the year 2101.

In recent years, additional threats have been manifested. One such threat comes in the form of a chytrid fungus that has been implicated as a proximate cause of mortality for anurans in Australia, Costa Rica, and Panama (see Berger et al. 1998, Lips 1999). This effect is especially startling, inasmuch as it has been occurring "… in pristine areas at moderate to intermediate elevations" (McCranie and Wilson 2002, p. 539). Many tadpoles of several Honduran species of montane hylids of the genus *Plectrohyla*, as well as a species of *Ptychohyla*, have been found to have deformed keratinized mouthparts, likely a symptom of infection by a chytrid fungus (McCranie and Wilson 2002; also see Fellers et al. 2001). Another threat may be connected to "documented climatic changes associated with recent warming" (McCranie and Wilson 2002, p. 527-528), strongly implicated by Pounds et al. (1999) to be responsible for amphibian population crashes in a Costa Rican montane habitat. We suspect "these same climatic changes are also likely taking place in montane habitats within Honduras" (McCranie and Wilson 2002, p. 528) and may be implicated in what is looking like a general trend in the decline or disappearance of several anuran species in pristine regions at moderate to intermediate elevations (essentially above 900 m; see McCranie and Wilson 2002 for a more extended discussion).

What is especially frightening about these recent developments involving pathogens and climatic change is that they produce unanticipated changes that make it difficult to impossible to predict their effects. As such, it becomes difficult to impossible to *plan* for these effects. They appear to have the potential to become an environmental "super-problem," in the sense of Bright (2000). Bright (2000) uses this term to describe environmental synergisms resulting from the interaction of two or more environmental problems, so that their combined effect is greater than the sum of their individual effects. These problems represent an environmental worst-case scenario—the point when environmental problems become so serious that they produce unanticipated results, the successful resolution of which threaten to slip forever from the grasp of humanity. It is against this terrifying backdrop that we proceed with the effort to assign conservation priorities for the members of the herpetofauna of Honduras. It may be stated without fear of contradiction that there are no populations of Honduran amphibians and reptiles that are entirely free of anthropogenic impact (Wilson et al. 2001, McCranie and Wilson 2002, McCranie and Wilson, *in press*).

Establishment of conservation priorities for the Honduran herpetofauna

Prior attempts have been made by us to assess the effectiveness of the current system of biotic reserves in Honduras in protecting the country's herpetofauna (Wilson et al. 2001), to determine the status of amphibian populations (McCranie and Wilson, *in press*), and to anticipate the future of the amphibian faunal component (McCranie and Wilson 2002). Each of these efforts has pointed to significant threats to the integrity of herpetofaunal populations. In a very real sense, this is all we have been able to do—to point to these threats. Addressing these threats in any meaningful way is the responsibility of the people of Honduras—through their government, information media, educational systems, and environmental organizations. We have written this paper in the hope that looking at these problems in a different way than has been done heretofore may act to focus sufficient attention before it is too late—if it is not too late already. An overriding problem is that there is little consensus in the literature concerning the number and individual sizes of the protected areas in the country (see Table 15 in Wilson et al. 2001; Anonymous 2001).

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Plate 19 DOI: 10.1514/journal.arc.0000012.g019

Plate captions: 12. Reserva Biológica El Pital, Ocotepeque. Almost no original forest remains in this reserve. Photograph taken from 1430 m elevation showing secondary gallery forest in foreground and denuded hillsides in background. 12 August 1997. **13**. Reserva de la Biósfera Río Plátano, near Quebrada de Las Marías, Olancho. The forested hillsides in the background lie about 1 km from the southern edge of the "nuclear zone" of this Biosphere Reserve. Photograph taken at 660 m elevation on 1 August 1997. We rode on horseback through this same locality in August 1998, and found the human population to have substantially increased from the previous year, as had the deforestation. **14**. 3.7 km NW of Zambrano, Francisco Morazán. Photograph taken at 1450 m elevation in June 1976. These pine forests are burned annually, thus the trees in this area are now considerably more fire scarred. In addition, tree stumps and logs lying on the ground are now largely burnt remains, offering little refuge for ground dwelling snakes. **15**. *Eleutherodactylus anciano*. **16**. *Eleutherodactylus chrysozetetes*. **17**. *Eleutherodactylus milesi*. **18**. *Eleutherodactylus stadelmani*. **Plates 15 through 18.** Honduran endemics now feared extinct. **19**. *Bolitoglossa carri*. A Honduran endemic with all known populations believed to be declining.

Many others share these concerns, of course. In fact, Honduras is one of the countries in the Western Hemisphere that figures into the Mesoamerican Biological Corridor Project ("Paseo Pantera"), as described by Illueca (1997). While expansive and desirable in concept, there are serious problems in its design and prospects in Honduras. The map of the components of this project in Mesoamerica includes a number of "protected areas" (incidentally, one of these "protected areas," the Mayan ruins of Copán, Honduras, is mismapped; what is shown apparently is the Parque Nacional Montecristo-Trifinio) and "desired green connections." We have previously discussed the pressures existing in the "protected areas" (here and in Wilson et al. 2001). Even more significantly, however, are the problems associated with attempting to turn the "desired green connections" into anything actually "green" (i.e., ecologically restored). For example, one of these connections traverses the area between the Maya Mountains Biosphere Reserve in Belize, the Copán Maya Ruins in the department of Copán in extreme western Honduras, and the Río Plátano Biosphere Reserve in northeastern Honduras. The intervening area encompasses about the western two-thirds of Honduras, in which area lives the large majority of the human population of the country. This is also the area that has suffered greatly at the hands of agriculturists for centuries, to the point that Hondurans, especially the landless poor, are moving in significant numbers to the less heavily exploited Mosquitia in eastern Honduras. Creating a "green connection" through this area of the country appears to us to be an impossibly large task.

Several years ago (Wilson and McCranie 1992), we developed an environmental vulnerability gauge for use with amphibian populations. We then (McCranie and Wilson 2002) updated it for use with the 116 species of amphibians treated in *The Amphibians of Honduras*. For this paper, we have developed a similar gauge for the reptiles. The gauge for amphibians and that for reptiles resemble one another in using scales for extent of geographic range and ecological distribution. The two gauges differ from one another in that susceptibility of reproductive mode to anthropogenic pressure is used for amphibians and extent of human persecution is used for reptiles (see below).

We use these gauges to establish a set of conservation priorities for the remaining species of the Honduran herpetofauna. This is an approach different from the one we adopted in Wilson et al. (2001), which attempted to evaluate the effectiveness of the existing system of biotic reserves to protect *all* members of the herpetofauna known at the time, and to make suggestions about where additional reserves needed to be established. In essence, we have been forced to adopt a different approach, given the mute testimony provided in recent years by disappearing Honduran amphibians.

As noted above, this environmental vulnerability gauge for both amphibians and reptiles has three components, which are described below. The first component of the gauge, applicable to both groups, deals with the extent of the geographic range using the following scale:

1 = widespread in and outside of Honduras
2 = distribution peripheral to Honduras, but widespread elsewhere
3 = distribution restricted to Nuclear Middle America (exclusive of Honduran endemics)
4 = distribution restricted to Honduras
5 = known only from the vicinity of the type locality

As is evident, in a rough sense, the degree of restriction of geographic range increases as the scale number increases.

The second gauge component, also applicable to both groups, indicates the extent of ecological distribution, based on a modified version of the forest formations of Holdridge (1967), using the following scale (omitting consideration of the Montane Rainforest formation, the herpetofauna of which is almost completely unknown):

1 = occurs in eight formations
2 = occurs in seven formations
3 = occurs in six formations
4 = occurs in five formations
5 = occurs in four formations
6 = occurs in three formations
7 = occurs in two formations
8 = occurs in one formation

The degree of restriction of ecological range increases as the scale number increases, similar to that of geographic range in the previous component.

In gauging the degree of specialization of reproductive mode in amphibians, as it relates to the effect of environmental modification, especially deforestation, we use the following scale:

1 = both eggs and tadpoles in large or small bodies of lentic or lotic water
2 = eggs in foam nests, tadpoles in small bodies of lentic or lotic water
3 = tadpoles occur in small bodies of lentic or lotic water, eggs elsewhere
4 = eggs laid in moist situations on land or moist arboreal situations, direct development
5 = eggs and tadpoles in water-retaining arboreal bromeliads or water-filled tree cavities

Again, increase in number signifies probable increase in reproductive vulnerability to the effects of habitat degradation.

In light of the fact that reptiles are amniote vertebrates and, thus, do not possess the biphasic life cycle or the range of reproductive modes typical of amphibians, it is necessary to develop another gauge of human pressure on the populations of these animals. In addition, reptiles, being vertebrates fully adapted to life on land, are often more noticeable to humans and more frequently encountered than are amphibians, especially larval amphibians. Moreover, many, if not most, reptiles are the subjects of superstition, ignorance, fear, and, as a consequence, outright killing upon sight. Finally, given that all Honduran reptiles are scaled vertebrates and some are large enough to be of commercial interest for their hides, meat, and/or eggs, these species are hunted (i.e., actively sought) for these products. Taking these biological and sociological features into consideration, we developed the following scale to indicate the degree of human persecution:

1 = fossorial, usually escape human notice
2 = semifossorial, or nocturnal arboreal or aquatic, nonvenomous and usually nonmimicking, sometimes escape human notice
3 = terrestrial and/or arboreal or aquatic, generally ignored by humans
4 = terrestrial and/or arboreal or aquatic, thought to be harmful, may be killed on sight
5 = venomous species or mimics thereof, killed on sight
6 = commercially or noncommercially exploited for hides and/or meat and/or eggs

As with the previously discussed components, the degree of threat from human beings roughly increases as the scale number increases.

In order to obtain this rough idea of environmental vulnerability, thus, each of the three applicable scores has been determined for each Honduran amphibian and reptilian species. Then the numbers associated with the three scales have been added to obtain a composite score. These composite scores can range theoretically from a low of three to a high of 18 for amphibians and from a low of three to a high of 19 for reptiles.

The composite environmental vulnerability scores (EVS; used either in singular or plural form, as determined by context) for amphibians (Table 1) actually range from a low of three to a high of 17, almost the entire gamut. The numbers of species attaining the various EVS are as follows:

EVS 3-1 species	EVS 11-12 species
EVS 4-1 species	EVS 12-13 species
EVS 5-5 species	EVS 13-13 species
EVS 6-7 species	EVS 14-15 species
EVS 7-2 species	EVS 15-17 species
EVS 8-2 species	EVS 16-10 species
EVS 9-6 species	EVS 17-8 species
EVS 10-5 species	

Using this measure, the least vulnerable amphibian species are *Bufo marinus, B. valliceps, Hyla microcephala, Phrynohyas venulosa, Scinax staufferi, Smilisca baudinii,* and *Rana berlandieri*. They are all 1-1-1, 1-2-1, or 1-3-1 species (species widespread geographically in and outside of Honduras, of broad ecological occurrence, and having the least derived reproductive mode). The most vulnerable species are *Bolitoglossa carri, B. decora, B. longissima, Nototriton lignicola, Eleutherodactylus chrysozetetes, E. coffeus, E. cruzi,* and *E. merendonensis*. They are all 5-8-4 species (species known only from the vicinity of the type locality, in one forest formation, with eggs laid in moist situations on land or moist arboreal situations). In addition, three of the four species of *Eleutherodactylus* (save for *E. coffeus* for which there are no data available) appear to have already disappeared or are in decline (McCranie and Wilson, *in press*).

We have used the same method in this paper as McCranie and Wilson (2002). Thus, we have divided the species of Honduran amphibians into three categories of environmental vulnerability, i.e., low vulnerability, of medium vulnerability, and high vulnerability. This categorization provides an initial rough means of gauging the degree of attention that ought to be focused on the various taxa. Thus, the species that can be expected to have the best chance to survive in the face of continued environmental degradation are those in the first category. These 24 species make up only 20.5% of the Honduran amphibian fauna. A larger group of 43 species, making up 36.8% belongs to the medium category; nonetheless, this is a heterogeneous grouping, created due to a lack of weighting of the three categories used to compute the EVS, in which relatively widespread species, such as *Agalychnis callidryas*, are grouped with highly restricted ones, such as *Plectrohyla chrysopleura*. A larger group of 50 high vulnerability species, making up 42.7%, can be expected to have the poorest chance for survival. Almost all of these species are endemic to Honduras or are otherwise restricted to Nuclear Middle America. Additionally, recent declines or disappearances in amphibian populations from moderate to intermediate elevation, pristine habitats were not considered in this analysis. The importance of these declines and disappearances, however, is discussed in the following section.

The composite environmental vulnerability scores (EVS) for reptiles (Table 2) actually range from a low of four to a high of 19, only one number less than the entire theoretical range (marine species not included). The numbers of species attaining the various EVS are as follows:

EVS 4 - 1 species	EVS 12 - 42 species
EVS 5 -1 species	EVS 13 - 28 species
EVS 6 -2 species	EVS 14 - 15 species
EVS 7 - 9 species	EVS 15 - 23 species
EVS 8 - 11 species	EVS 16 - 11 species
EVS 9 - 23 species	EVS 17 - 2 species
EVS 10 - 19 species	EVS 18 - 1 species
EVS 11 - 22 species	EVS 19 - 1 species

The least vulnerable reptilian species, by this measure, are *Norops tropidonotus, Enulius flavitorques, Imantodes cenchoa*, and *Ninia sebae*. They are 1-1-2, 1-1-3, or 1-3-2 species (widespread geographically, occurring in six or eight forest formations, and semifossorial or terrestrial/arboreal, sometimes escaping human notice). The most vulnerable reptile is *Ctenosaura bakeri*, 5-8-6 species (known only from the vicinity of the type locality, in one forest formation, and used for its meat and eggs locally). The next most vulnerable is *Ctenosaura oedirhina*, a 4-8-6 species (a Honduran endemic, occurring in one forest formation, and used for its meat and eggs locally).

As for the amphibians, we have divided the species of Honduran reptiles into three categories of environmental vulnerability, as indicated in Table 2. As above, this categorization is intended as a coarse gauge as to the degree of attention that should be brought to bear on the various species. There are 47 low vulnerability species, making up only 22.3% of the Honduran reptilian fauna. A slightly larger group of 53 species, making up 25.1% of the taxa, comprises the high vulnerability category. Many of these species (35) are endemic to Honduras. The largest group of 111 species, as with the amphibians, is composed of taxa of intermediate vulnerability (52.6% of total). Most of these species (93) are geographically widespread, although in many cases occurring peripherally to Honduras, and many (66) are known from only one or two forest formations.

Table 1. Environmental vulnerability scores (EVS) for the 117 species of amphibians of Honduras. Numbers for each gauge explained in text. The table is broken into three parts: low vulnerability species (EVS of 3–9; 24 species; 20.5%); medium vulnerability species (EVS of 10–13; 43 species; 36.8%); and high vulnerability species (EVS of 14–17; 50 species; 42.7%). Updated from Table 33 in McCranie and Wilson (2002).

Amphibian Species	Geographic Distribution	Ecological Distribution	Reproductive Mode	Total Score
Low				
Bolitoglossa mexicana	1	4	4	9
Bufo coccifer	1	4	1	6
Bufo luetkenii	1	5	1	7
Bufo marinus	1	3	1	5
Bufo valliceps	1	3	1	5
Hyalinobatrachium fleischmanni	1	5	3	9
Hyla loquax	1	4	1	6
Hyla microcephala	1	3	1	5
Hyla picta	1	7	1	9
Phrynohyas venulosa	1	3	1	5
Plectrohyla guatemalensis	3	5	1	9
Ptychohyla hypomykter	3	5	1	9
Scinax staufferi	1	3	1	5
Smilisca baudinii	1	2	1	4
Eleutherodactylus laevissimus	1	3	4	8
Leptodactylus labialis	1	3	2	6
Leptodactylus melanonotus	1	3	2	6
Physalaemus pustulosus	1	3	2	6
Hypopachus variolosus	1	4	1	6
Rana berlandieri	1	1	1	3
Rana forreri	1	6	1	8
Rana maculata	1	4	1	6
Rana vaillanti	1	5	1	7
Rhinophrynus dorsalis	1	7	1	9
Medium				
Dermophis mexicanus	1	7	4	12
Gymnopis multiplicata	1	7	4	12
Bolitoglossa rufescens complex	3	5	4	12
Oedipina cyclocauda	1	6	4	11
Atelophryniscus chrysophorus	4	7	1	12
Bufo campbelli	2	7	1	10
Bufo haematiticus	2	8	1	11
Bufo leucomyos	4	6	1	11
Centrolene prosoblepon	2	7	3	12
Cochranella albomaculata	2	7	3	12
Cochranella granulosa	2	7	3	12
Cochranella spinosa	2	8	3	13
Hyalinobatrachium pulveratum	2	7	3	12
Agalychnis calcarifer	2	8	3	13
Agalychnis callidryas	1	6	3	10
Agalychnis moreletii	2	8	3	13
Agalychnis saltator	2	8	3	13
Duellmanohyla salvavida	4	7	1	12
Duellmanohyla soralia	3	6	1	10
Hyla catracha	4	8	1	13
Hyla ebraccata	1	7	3	11
Plectrohyla chrysopleura	5	7	1	13
Plectrohyla dasypus	4	8	1	13
Plectrohyla exquisita	4	8	1	13
Plectrohyla hartwegi	3	8	1	12
Plectrohyla matudai	3	6	1	10
Plectrohyla psiloderma	3	8	1	12

Continued on page 18.

Table 1. Continued.

Amphibian Species	Geographic Distribution	Ecological Distribution	Reproductive Mode	Total Score
Ptychohyla salvadorensis	3	7	1	11
Ptychohyla spinipollex	4	6	1	11
Scinax boulengeri	2	8	1	11
Smilisca phaeota	2	7	1	10
Smilisca sordida	2	8	1	11
Triprion petasatus	3	8	1	12
Eleutherodactylus charadra	3	6	4	13
Eleutherodactylus fitzingeri	2	7	4	13
Eleutherodactylus mimus	2	7	4	13
Eleutherodactylus noblei	2	7	4	13
Eleutherodactylus ridens	1	7	4	12
Leptodactylus pentadactylus	2	7	2	11
Leptodactylus silvanimbus	4	7	2	13
Gastrophryne elegans	2	8	1	11
Hypopachus barberi	3	7	1	11
Rana warszewitschii	2	8	1	11
High				
Bolitoglossa carri	5	8	4	17
Bolitoglossa celaque	4	8	4	16
Bolitoglossa conanti	3	7	4	14
Bolitoglossa decora	5	8	4	17
Bolitoglossa diaphora	4	8	4	16
Bolitoglossa dofleini	3	7	4	14
Bolitoglossa dunni	3	7	4	14
Bolitoglossa longissima	5	8	4	17
Bolitoglossa occidentalis	2	8	4	14
Bolitoglossa porrasorum	4	7	4	15
Bolitoglossa striatula	2	8	4	14
Bolitoglossa synoria	3	8	4	15
Cryptotriton nasalis	4	7	4	15
Dendrotriton sanctibarbarus	4	8	4	16
Nototriton barbouri	4	7	4	15
Nototriton lignicola	5	8	4	17
Nototriton limnospectator	4	8	4	16
Oedipina elongata	3	8	4	15
Oedipina gephyra	4	8	4	16
Oedipina ignea	3	7	4	14
Oedipina stuarti	4	7	4	15
Oedipina taylori	3	8	4	15
Hyalinobatrachium cardiacalyptum	4	7	3	14
Hyalinobatrachium crybetes	5	7	3	15
Anotheca spinosa	2	8	5	15
Hyla bromeliacia	3	7	5	15
Hyla insolita	5	8	3	16
Hyla salvaje	3	8	5	16
Eleutherodactylus anciano	4	7	4	15
Eleutherodactylus aurilegulus	4	6	4	14
Eleutherodactylus chac	3	7	4	14
Eleutherodactylus chrysozetetes	5	8	4	17
Eleutherodactylus coffeus	5	8	4	17
Eleutherodactylus cruzi	5	8	4	17
Eleutherodactylus emleni	4	6	4	14
Eleutherodactylus epochthidius	4	7	4	15
Eleutherodactylus fecundus	4	7	4	15

Continued on page 20.

Plate 20 DOI: 10.1514/journal.arc.0000012.g020

Plate 21 DOI: 10.1514/journal.arc.0000012.g021

Plate 22 DOI: 10.1514/journal.arc.0000012.g022

Plate 23 DOI: 10.1514/journal.arc.0000012.g023

Plate 24 DOI: 10.1514/journal.arc.0000012.g024

Plate 25 DOI: 10.1514/journal.arc.0000012.g025

Plate 26 DOI: 10.1514/journal.arc.0000012.g026

Plate 27 DOI: 10.1514/journal.arc.0000012.g027

Plate captions: 20. *Oedipina gephyra*. **21**. *Atelophryniscus chrysophorus*. **22**. *Duellmanohyla salvavida*. **23**. *Hyla catracha*. **24**. *Plectrohyla chrysopleura*. **25**. *Eleutherodactylus epochthidius*. **26**. *Eleutherodactylus fecundus*. **27**. *Eleutherodactylus pechorum*. **Plates 20 through 27.** Honduran endemics with all known populations believed to be declining.

Table 1. Continued.

Amphibian Species	Geographic Distribution	Ecological Distribution	Reproductive Mode	Total Score
Eleutherodactylus laticeps	2	8	4	14
Eleutherodactylus lauraster	3	7	4	14
Eleutherodactylus loki	2	8	4	14
Eleutherodactylus megacephalus	2	8	4	14
Eleutherodactylus merendonensis	5	8	4	17
Eleutherodactylus milesi	4	7	4	15
Eleutherodactylus olanchano	4	8	4	16
Eleutherodactylus omoaensis	4	8	4	16
Eleutherodactylus operosus	4	7	4	15
Eleutherodactylus pechorum	4	7	4	15
Eleutherodactylus rostralis	3	7	4	14
Eleutherodactylus saltuarius	4	8	4	16
Eleutherodactylus stadelmani	4	7	4	15

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Categorization of EVS provides a means to assign conservation priorities, with high vulnerability species given highest priority, medium vulnerability species intermediate priority, and low vulnerability species lowest priority. The highest priority taxa include 50 amphibians and 53 reptiles (total of 103 species or 31.4% of 328 total species); the intermediate priority taxa consist of 43 amphibians and 111 reptiles (total of 154 species or 47.0%); and the low priority taxa comprise 24 amphibians and 47 reptiles (total of 71 species or 21.6%).

Current population status of members of the Honduran herpetofauna

The above discussion attempts to assign conservation priorities to the members of the Honduran herpetofauna on a largely theoretical basis, with the assumption that there are features of distribution (geographic and ecological), life history (reproductive mode), and human persecution that can act as a rough gauge of vulnerability to anthropogenic environmental pressures, in a similar manner as has been done for threatened and endangered species in general (see Raven and Berg 2001 for a discussion of such features).

As noted in a previous section, however, there are factors at work in Honduras, as elsewhere in the world, the effect of which were not predicted by the typical models of species endangerment. The unanticipated factors apparently of greatest importance are chytridiomycosis (Berger et al. 1998) and climatic warming (Pounds et al. 1999), although neither has been conclusively demonstrated to be in effect in Honduras.

Whatever the causative factors that may be involved, it is apparent that populations of many members of the Honduran herpetofauna are in decline or have disappeared since the early years of the 1990s (Wilson and McCranie 1998, McCranie and Wilson 2002, *in press*). The declines have been substantiated best among amphibian populations. Unfortunately, these declines have involved the two most important groups of amphibians, those endemic to Honduras and those otherwise restricted to Nuclear Middle America (Table 3). As noted by McCranie and Wilson (*in press*), of the 41 species of endemic amphibians, six are feared extinct and 14 appear to have declining populations (field work in 2001 indicated that one of the 14 species, *Eleutherodactylus stadelmani*, thought to be in decline by McCranie and Wilson, *in press*, has also disappeared). In addition, we have no data for four species. Only 17 species appear to have stable populations. Thus, 20 of the 41 endemic species of Honduran amphibians (48.8%), or almost half, are already gone or are in decline.

The seven endemic amphibian species feared extinct have EVS ranging between 14 and 17 (mean 15.6). The 13 species whose populations are in decline have EVS from 12 to 17 (mean 14.4). Of considerable interest is the fact that the EVS for the 17 endemics thought to have stable populations range from 11 to 17, with a mean value of 15.0. The implication of these data are that there is an urgent need to monitor populations of these supposed "stable" species, because 14 of the 17 have scores indicative of high vulnerability to environmental pressures.

McCranie and Wilson (*in press*) also discussed the population status of 25 amphibian species not endemic to Honduras, but restricted in distribution to Nuclear Middle America. They considered nine species to be in decline and one to probably have been extirpated. The EVS of the nine in decline range from nine to 16 (mean 12.1). The one species thought extirpated (*Bolitoglossa occidentalis*) has an EVS of 14. These data indicate that EVS of 13 and above are indicative of species that need to be monitored, but that scores below that level do not insulate a species from anthropogenic pressure. As we have noted above, there is no species of Honduran amphibian safe from human depredation, although there are clearly some species capable of persisting as commensals of human beings.

The picture for Honduran reptiles is somewhat less clear. This is due to the fully terrestrial life cycle of most reptiles, which allows for habitation of niches removed from water, in turn increasing the potential breadth of occurrence. Nonetheless, it is possible to comment on the current popula-

Table 2. Environmental vulnerability scores (EVS) for the 211 species of reptiles of Honduras (marine species are not included). Numbers for each gauge explained in text. The table is broken into three parts: low vulnerability species (EVS of 4–9; 47 species; 22.3%); medium vulnerability species (EVS of 10–13; 111 species; 52.6%); and high vulnerability species (EVS of 14–19; 53 species; 25.1%).

Reptilian Species	Geographic Distribution	Ecological Distribution	Human Persecution	Total Score
Low				
Rhinoclemmys pulcherrima	1	5	3	9
Kinosternon leucostomum	1	5	3	9
Kinosternon scorpioides	1	5	3	9
Sphaerodactylus millepunctatus	1	3	3	7
Basiliscus vittatus	1	3	3	7
Laemanctus longipes	1	5	3	9
Sceloporus malachiticus	1	4	3	8
Sceloporus variabilis	1	3	3	7
Norops cupreus	1	5	3	9
Norops laeviventris	1	5	3	9
Norops lemurinus	1	5	3	9
Norops sericeus	1	3	3	7
Norops tropidonotus	1	1	3	5
Mabuya unimarginata	1	3	3	7
Sphenomorphus cherriei	1	3	3	7
Gymnophthalmus speciosus	1	4	3	8
Ameiva undulata	1	3	3	7
Cnemidophorus deppii	1	4	3	8
Cnemidophorus motaguae	1	5	3	9
Leptotyphlops goudotii	1	5	1	7
Boa constrictor	1	3	4	8
Adelphicos quadrivirgatus	1	5	2	8
Coniophanes fissidens	1	4	4	9
Conophis lineatus	1	4	4	9
Dryadophis melanolomus	1	4	4	9
Drymarchon melanurus	1	4	4	9
Drymobius margaritiferus	1	2	4	7
Enulius flavitorques	1	3	2	6
Hydromorphus concolor	1	6	2	9
Imantodes cenchoa	1	3	2	6
Lampropeltis triangulum	1	3	5	9
Leptodeira annulata	1	3	4	8
Leptodeira septentrionalis	1	4	4	9
Leptophis ahaetulla	1	3	4	8
Leptophis mexicanus	1	3	4	8
Ninia diademata	1	5	2	8
Ninia sebae	1	1	2	4
Oxybelis aeneus	1	4	4	9
Rhadinaea godmani	1	6	2	9
Sibon nebulatus	1	5	2	8
Spilotes pullatus	1	4	4	9
Storeria dekayi	1	6	2	9
Tantilla melanocephala	1	6	2	9
Thamnophis proximus	1	4	4	9
Tretanorhinus nigroluteus	1	5	2	8
Micrurus nigrocinctus	1	3	5	9
Porthidium ophryomegas	1	3	5	9
Medium				
Crocodylus acutus	1	6	6	13
Chelydra serpentina	1	6	6	13
Rhinoclemmys annulata	2	8	3	13
Rhinoclemmys areolata	2	7	3	12

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Plate 28 DOI: 10.1514/journal.arc.0000012.g028

Plate 29 DOI: 10.1514/journal.arc.0000012.g029

Plate 30 DOI: 10.1514/journal.arc.0000012.g030

Plate 31 DOI: 10.1514/journal.arc.0000012.g031

Plate 32 DOI: 10.1514/journal.arc.0000012.g032

Plate 33 DOI: 10.1514/journal.arc.0000012.g033

Plate 34 DOI: 10.1514/journal.arc.0000012.g034

Plate 35 DOI: 10.1514/journal.arc.0000012.g035

Plate captions: 28. *Eleutherodactylus saltuarius*. **29**. *Leptodactylus silvanimbus*. **30**. *Abronia salvadorensis*. **31**. *Norops kreutzi*. **32.** *Norops muralla*. **33**. *Norops ocelloscapularis*. **34**. *Norops wampuensis*. **35**. *Typhlops stadelmani*. **Plates 28 through 35.** Honduran endemics with all known populations believed to be declining.

Plate 36 DOI: 10.1514/journal.arc.0000012.g036

Plate 37 DOI: 10.1514/journal.arc.0000012.g037

Plate 38 DOI: 10.1514/journal.arc.0000012.g038

Plate 39 DOI: 10.1514/journal.arc.0000012.g039

Plate 40 DOI: 10.1514/journal.arc.0000012.g040

Plate 41 DOI: 10.1514/journal.arc.0000012.g041

Plate 42 DOI: 10.1514/journal.arc.0000012.g042

Plate 43 DOI: 10.1514/journal.arc.0000012.g043

Plate captions: 36. *Enulius bifoveatus*. **37**. *Tantilla tritaeniata*. **38**. *Bothriechis marchi*. **39**. *Bolitoglossa dofleini*. **40**. *Bolitoglossa synoria*. **41**. *Duellmanohyla soralia*. **42**. *Plectrohyla guatemalensis*. **43**. *Plectrohyla matudai*. **Plates 36 through 38.** Honduran endemics with all known populations believed to be declining. **Plates 39 through 43.** Nuclear Middle American Restricted Species with all known Honduran populations believed to be declining.

Table 2. Continued.

Reptilian Species	Geographic Distribution	Ecological Distribution	Human Persecution	Total Score
Trachemys scripta	1	5	6	12
Celestus bivittatus	3	7	3	13
Mesaspis moreletii	3	7	3	13
Coleonyx mitratus	1	5	4	10
Aristelliger georgeensis	2	8	3	13
Aristelliger praesignis	2	8	3	13
Gonatodes albogularis	1	6	3	10
Hemidactylus brookii	2	8	3	13
Hemidactylus frenatus	2	6	3	11
Hemidactylus mabouia	2	8	3	13
Phyllodactylus tuberculosus	1	6	3	10
Sphaerodactylus glaucus	2	8	3	13
Sphaerodactylus notatus	2	8	3	13
Thecadactylus rapicauda	1	5	4	10
Basiliscus plumifrons	2	8	3	13
Corytophanes cristatus	1	7	3	11
Corytophanes hernandesii	2	7	3	12
Laemanctus serratus[1]	2	7	3	12
Ctenosaura flavidorsalis	3	7	3	13
Ctenosaura similis	1	4	6	11
Iguana iguana	1	5	6	12
Leiocephalus carinatus	2	8	3	13
Sceloporus squamosus	1	6	3	10
Anolis allisoni	2	8	3	13
Norops biporcatus	1	6	3	10
Norops capito	1	7	3	11
Norops crassulus	3	7	3	13
Norops humilis	2	7	3	12
Norops limifrons	2	7	3	12
Norops lionotus	2	8	3	13
Norops pentaprion	1	7	3	11
Norops petersii	2	8	3	13
Norops rodriguezii	2	5	3	10
Norops sagrei	2	8	3	13
Norops uniformis	2	6	3	11
Polychrus gutturosus	1	8	3	12
Eumeces sumichrasti	1	7	3	11
Mesoscincus managuae	2	7	3	12
Sphenomorphus assatus	2	8	3	13
Sphenomorphus incertus	2	7	3	12
Ameiva ameiva[2]	2	8	3	13
Ameiva festiva	1	6	3	10
Cnemidophorus lemniscatus	1	8	3	12
Lepidophyma flavimaculatum	1	6	4	11
Typhlops costaricensis	2	8	1	11
Typhlops stadelmani	4	7	1	12
Loxocemus bicolor	1	6	4	11
Corallus annulatus	1	8	2	11
Ungaliophis continentalis	3	7	2	12
Alsophis cantherigerus	2	8	3	13
Amastridium veliferum	2	8	2	12
Chironius grandisquamis	1	7	4	12
Clelia clelia	1	6	4	11
Coniophanes bipunctatus	1	6	4	11
Coniophanes imperialis	1	6	4	11

Continued on page 25.

Table 2. Continued.

Reptilian Species	Geographic Distribution	Ecological Distribution	Human Persecution	Total Score
Coniophanes piceivittis	1	6	4	11
Dendrophidion nuchale	1	7	4	12
Dendrophidion percarinatum	1	7	4	12
Dipsas bicolor	2	7	2	11
Dryadophis dorsalis	3	5	4	12
Drymobius chloroticus	1	6	4	11
Elaphe flavirufa	1	7	4	12
Erythrolamprus mimus	1	6	5	12
Ficimia publia	1	7	3	11
Geophis fulvoguttatus	3	7	2	12
Geophis hoffmanni	2	8	2	12
Imantodes gemmistratus	1	7	2	10
Imantodes inornatus	1	7	2	10
Leptodeira nigrofasciata	1	5	4	10
Leptodrymus pulcherrimus	1	5	4	10
Masticophis mentovarius	1	6	4	11
Ninia espinali	3	7	2	12
Ninia maculata	2	8	2	12
Nothopsis rugosus	2	8	2	12
Oxybelis brevirostris	2	7	4	13
Oxybelis fulgidus	1	5	4	10
Oxyrhopus petola	1	7	5	13
Pliocercus elapoides	1	4	5	10
Pseustes poecilonotus	1	7	4	12
Rhadinaea kinkelini	3	7	2	12
Rhadinaea lachrymans	3	8	2	13
Rhadinaea montecristi	3	7	2	12
Scaphiodontophis annulatus	1	6	5	12
Senticolis triaspis	1	5	4	10
Sibon carri	3	7	2	12
Sibon dimidiatus	1	6	4	11
Sibon longifrenis	2	7	2	11
Stenorrhina degenhardtii	1	5	4	10
Stenorrhina freminvillei	1	6	4	11
Tantilla impensa	3	7	2	12
Tantilla lempira	4	7	2	13
Tantilla schistosa	1	7	2	10
Tantilla taeniata	3	5	2	10
Tantillita lintoni	3	8	2	13
Thamnophis marcianus	1	8	4	13
Trimorphodon biscutatus	1	5	4	10
Tropidodipsas fischeri	3	7	2	12
Tropidodipsas sartorii	1	6	5	12
Urotheca guentheri	2	8	2	12
Xenodon rabdocephalus	1	6	5	12
Micrurus diastema	2	5	5	12
Atropoides nummifer	1	6	5	12
Bothriechis schlegelii	1	6	5	12
Bothrops asper	1	6	5	12
Cerrophidion godmani	1	6	5	12
Crotalus durissus	1	6	5	12
Porthidium nasutum	1	6	5	12
High				
Caiman crocodilus	2	8	6	16

Continued on page 27.

Plate 44 DOI: 10.1514/journal.arc.0000012.g044

Plate 45 DOI: 10.1514/journal.arc.0000012.g045

Plate 46 DOI: 10.1514/journal.arc.0000012.g046

Plate 47 DOI: 10.1514/journal.arc.0000012.g047

Plate 48 DOI: 10.1514/journal.arc.0000012.g048

Plate 49 DOI: 10.1514/journal.arc.0000012.g049

Plate 50 DOI: 10.1514/journal.arc.0000012.g050

Plate captions: 44. *Plectrohyla psiloderma*. **45**. *Ptychohyla hypomykter*. **46**. *Abronia montecristoi*. **47**. *Celestus bivittatus*. **48**. *Corytophanes percarinatus*. **49**. *Tropidodipsas fischeri*. **50**. *Bothriechis thalassinus*. **Plates 44 through 50.** Nuclear Middle American Restricted Species with all known Honduran populations believed to be declining.

Table 2. Continued.

Reptilian Species	Geographic Distribution	Ecological Distribution	Human Persecution	Total Score
Rhinoclemmys funerea	2	8	6	16
Staurotypus triporcatus	2	7	6	15
Abronia montecristoi	3	8	4	15
Abronia salvadorensis	4	8	4	16
Celestus montanus	4	7	3	14
Celestus scansorius	4	7	3	14
Phyllodactylus palmeus	4	8	3	15
Sphaerodactylus dunni	4	7	3	14
Sphaerodactylus rosaurae	4	8	3	15
Corytophanes percarinatus	3	8	3	14
Ctenosaura bakeri	5	8	6	19
Ctenosaura melanosterna	4	7	6	17
Ctenosaura oedirhina	4	8	6	18
Norops amplisquamosus	5	8	3	16
Norops bicaorum	5	8	3	16
Norops cusuco	5	8	3	16
Norops heteropholidotus	3	8	3	14
Norops johnmeyeri	4	8	3	15
Norops kreutzi	5	8	3	16
Norops loveridgei	4	7	3	14
Norops muralla	4	8	3	15
Norops ocelloscapularis	5	7	3	15
Norops pijolensis	4	7	3	14
Norops purpurgularis	4	8	3	15
Norops roatanensis	4	8	3	15
Norops rubribarbaris	5	8	3	16
Norops sminthus	4	8	3	15
Norops utilensis	5	8	3	16
Norops wampuensis	5	8	3	16
Norops yoroensis	4	7	3	14
Norops zeus	4	7	3	14
Crisantophis nevermanni	2	8	4	14
Drymobius melanotropis	2	8	4	14
Enulius bifoveatus	5	8	2	15
Enulius roatanensis	5	8	2	15
Geophis damiani	5	8	2	15
Leptophis modestus	3	8	4	15
Leptophis nebulosus	2	8	4	14
Omoadiphas aurula	5	8	2	15
Oxybelis wilsoni	4	8	3	15
Rhadinaea tolpanorum	5	8	2	15
Rhinobothryum bovallii	2	8	5	15
Scolecophis atrocinctus	2	7	5	14
Sibon anthracops	1	8	5	14
Tantilla tritaeniata	5	8	2	15
Thamnophis fulvus	3	7	4	14
Micrurus alleni	2	8	5	15
Micrurus browni	2	8	5	15
Micrurus ruatanus	4	8	5	17
Agkistrodon bilineatus	2	8	5	15
Bothriechis marchi	4	7	5	16
Bothriechis thalassinus	3	7	5	15

[1] Based on specimens without precise locality data and one sight record in the Middle Choluteca Valley.
[2] However, this species is extirpated on the Swan Islands, the only place where this species is known in Honduras.
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Table 3. Current status of populations of Honduran amphibian endemics and species otherwise restricted to Nuclear Middle America. Stable = at least some populations stable; Declining = all populations believed to be declining. Extinct category applies to Honduran endemics; extirpated category applies to Nuclear Middle American endemics (excluding those endemic to Honduras).

Species	Stable	Declining	Extinct or Extirpated	No Data
Honduran endemics				
Bolitoglossa carri		X		
Bolitoglossa celaque	X			
Bolitoglossa decora	X			
Bolitoglossa diaphora	X			
Bolitoglossa longissima	X			
Bolitoglossa porrasorum	X			
Cryptotriton nasalis	X			
Dendrotriton sanctibarbarus	X			
Nototriton barbouri	X			
Nototriton lignicola	X			
Nototriton limnospectator	X			
Oedipina gephyra		X		
Oedipina stuarti				X
Atelophryniscus chrysophorus		X		
Bufo leucomyos	X			
Hyalinobatrachium cardiacalyptum	X			
Hyalinobatrachium crybetes				X
Duellmanohyla salvavida		X		
Hyla catracha		X		
Hyla insolita	X			
Plectrohyla chrysopleura		X		
Plectrohyla dasypus		X		
Plectrohyla exquisita	X			
Ptychohyla spinipollex	X			
Eleutherodactylus anciano			X	
Eleutherodactylus aurilegulus	X			
Eleutherodactylus chrysozetetes			X	
Eleutherodactylus coffeus				X
Eleutherodactylus cruzi			X	
Eleutherodactylus emleni			X	
Eleutherodactylus epochthidius		X		
Eleutherodactylus fecundus		X		
Eleutherodactylus merendonensis		X		
Eleutherodactylus milesi			X	
Eleutherodactylus olanchano	X			
Eleutherodactylus omoaensis			X	
Eleutherodactylus operosus				X
Eleutherodactylus pechorum		X		
Eleutherodactylus saltuarius		X		
Eleutherodactylus stadelmani			X	
Leptodactylus silvanimbus		X		
Honduran species otherwise restricted to Nuclear Middle America				
Bolitoglossa conanti	X			
Bolitoglossa dofleini		X		
Bolitoglossa dunni	X			
Bolitoglossa occidentalis			X	
Bolitoglossa rufescens complex	X			
Bolitoglossa synoria		X		
Oedipina elongata				X
Oedipina ignea		X		
Oedipina taylori				X
Duellmanohyla soralia		X		

Continued on page 29.

Table 3. Continued.

Species	Stable	Declining	Extinct or Extirpated	No Data
Hyla bromeliacia	X			
Hyla salvaje		X		
Plectrohyla guatemalensis		X		
Plectrohyla hartwegi				X
Plectrohyla matudai		X		
Plectrohyla psiloderma		X		
Ptychohyla hypomykter		X		
Ptychohyla salvadorensis	X			
Triprion petasatus				X
Eleutherodactylus chac	X			
Eleutherodactylus charadra	X			
Eleutherodactylus lauraster	X			
Eleutherodactylus rostralis	X			
Hypopachus barberi	X			
Rana maculata	X			

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Table 4. Current status of populations of Honduran reptile endemics and species otherwise restricted to Nuclear Middle America. Stable = at least some populations stable; Declining = all populations believed to be declining. Extinct category applies to Honduran endemics; extirpated category applies to Nuclear Middle American endemics (excluding those endemic to Honduras).

Species	Stable	Declining	Extinct or Extirpated	No Data
Honduran endemics				
Abronia salvadorensis		X		
Celestus montanus				X
Celestus scansorius				X
Phyllodactylus palmeus	X			
Sphaerodactylus dunni	X			
Sphaerodactylus rosaurae	X			
Ctenosaura bakeri	X			
Ctenosaura melanosterna	X			
Ctenosaura oedirhina	X			
Norops amplisquamosus	X			
Norops bicaorum	X			
Norops cusuco	X			
Norops johnmeyeri	X			
Norops kreutzi		X		
Norops loveridgei	X			
Norops muralla		X		
Norops ocelloscapularis		X		
Norops pijolensis	X			
Norops purpurgularis	X			
Norops roatanensis	X			
Norops rubribarbaris				X
Norops sminthus	X			
Norops utilensis	X			
Norops wampuensis		X		
Norops yoroensis	X			
Norops zeus	X			
Typhlops stadelmani		X		
Enulius bifoveatus		X		
Enulius roatanensis				X
Geophis damiani				X
Omoadiphas aurula				X

Continued on page 30.

Table 4. Continued.

Species	Stable	Declining	Extinct or Extirpated	No Data
Oxybelis wilsoni	X			
Rhadinaea tolpanorum				X
Tantilla lempira		X		
Tantilla tritaeniata		X		
Micrurus ruatanus				X
Bothriechis marchi		X		
Honduran species otherwise restricted to Nuclear Middle America				
Abronia montecristoi		X		
Celestus bivittatus		X		
Mesaspis moreletii	X			
Corytophanes percarinatus		X		
Ctenosaura flavidorsalis	X			
Norops crassulus	X			
Norops heteropholidotus	X			
Sphenomorphus incertus	X			
Ungaliophis continentalis				X
Dryadophis dorsalis	X			
Geophis fulvoguttatus		X		
Leptophis modestus		X		
Ninia espinali		X		
Rhadinaea kinkelini		X		
Rhadinaea lachrymans				X
Rhadinaea montecristi	X			
Sibon carri		X		
Tantilla impensa		X		
Tantilla taeniata		X		
Thamnophis fulvus	X			
Tropidodipsas fischeri		X		
Bothriechis thalassinus		X		

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tion status of reptiles endemic to Honduras or otherwise restricted to Nuclear Central America. Thirty-seven species of reptiles are endemic to Honduras (Table 4). Of these 37 species, only 19 species (51.4%) are thought to have stable populations. Ten (27.0%) are considered to have declining populations, primarily on the basis of destruction of habitat within their ranges. Finally, eight species (21.6%) are poorly known enough so that we are uncertain of their status.

The ten endemic reptile species considered to have declining populations have EVS ranging between 12 and 16 (mean 14.9). The EVS for the 19 endemics thought to have stable populations range from 14 to 19 (mean 15.4), which is higher than the mean for those species thought to have declining populations. It is interesting that the reptilian endemics thought to have stable populations also have a higher mean EVS than those thought to have declining populations. The implication of these data is same as that for the analogous data for amphibians. The populations of these endemics need to be monitored carefully, inasmuch as all have scores indicating high vulnerability to environmental pressures.

We also determined the population status for those reptile species not endemic to Honduras but restricted in distribution to Nuclear Middle America. Of these 22 species, only eight (36.4%) are considered to have stable populations, at least somewhere in their known ranges in Honduras. Twelve species (54.5%) are thought to have declining populations. Finally, two species (9.1%) are too poorly known to judge their current population status.

The 12 Nuclear Middle American reptile species that appear to have declining populations have EVS ranging between ten and 15 (mean 12.8). Following the same pattern as indicated above, the EVS for the eight species appearing to have stable populations range from 12 to 14 (mean 12.9), which is slightly higher than the mean for the declining population Nuclear Middle American species. The populations of these species also need to be closely monitored.

In general, it should be understood that the population status of amphibian and reptile species in Honduras potentially can change relatively rapidly. As habitats are degraded, the fabric of community structure unravels. The community inhabitants depend on the integrity of this structure in order to obtain the materials and energy necessary to support their life processes. Thus, they are links in biogeochemical cycles and food webs, through which these materials and energy move, respectively. Thus, for example, given that amphibian populations are undergoing apparent increasing decline, this can be expected to adversely affect the populations of amphibian-eating snakes. In turn, decline of these snake populations should affect the populations of ophiophagous snakes, and so on. Thus does the straight edge of much human thinking cut deeply.

Plates 2-14 show some of the primary forest left in Honduras, plus some of the extensive deforestation taking place in the country. Plates 15-18 show some Honduran endemic species now feared extinct. Plates 19-38 show some of the Honduran endemic species in which all known populations are believed to be declining. Finally, plates 39-50 show some of the Nuclear Middle America-restricted species (exclusive of the Honduran endemics) in which all known populations are believed to be declining.

Recommendations

Biodiversity decline is one of the most serious environmental problems, if not the most serious (Wilson et al. 2001). Since it is a problem, it cries out for solutions. Unfortunately, one of the tenets of the problem solving critical thinking strategy (see Chaffee 1994 for a description of the strategy) is that a problem *cannot* be solved by simply treating its symptoms. Biodiversity decline is a symptom of habitat loss and degradation, in turn a symptom of runaway human population growth. Uncontrolled population growth is, in turn, a symptom of the mismanaged human mind, to use a phrase coined by E. O. Wilson (1988). The "cascade of deeper problems arising within the human psyche" (Wilson et al. 2001, p. 109) referred to by E. O. Wilson (1988) has been explored at length by L. D. Wilson in a series of papers (1997 a, b, 1998, 1999, 2000, 2001). L. D. Wilson (2001) concluded, after a lengthy argument presented in this series, that the sustainable society described by the better environmental science texts (see for example Miller 2001, and Raven and Berg 2001) will *only* come about (if it ever does) by a fundamental reform of the educational process, so as to enable us to use education as a kind of species-wide psychotherapy. This view, then, treats the "mismanagement of the human mind" (E. O. Wilson 1988) as a pervasive psychological illness in need of broad-based therapy.

Until and unless the "mismanaged human mind" is treated successfully, then we argue that none of the problems that cascade from it, which are, after all, the persistent problems of humankind, will ever encounter workable and lasting solutions. Having said this, then it must be understood that the recommendations we outline below will *only* work if the geometrically advancing problems of uncontrolled human population growth and its corollaries, habitat loss and degradation, are solved. If not, then the exercise below is merely a monument to futility.

Given the above, we have to assume that it *is* possible to guard the integrity of established biotic reserves in Honduras. Based on our decades-long field experience, this is only happening in a limited way. It is still the case that most biotic reserves in the country exist only on paper, without the appropriate resources dedicated to establish boundaries, hire personnel to police them, build facilities for housing administrative, scientific, and security personnel, and fund the scientific studies necessary to make such reserves sustainable. This situation will have to change and change rapidly, for the pressure of a 25-year doubling time will brook no idleness.

It is also evident that we have been idle too long, and that the study of the Honduran herpetofauna has turned a corner into a torturous maze from which there is no easy exit. It is already clear, as is discussed above, that a new era has been breached—one in which advances in our cataloguing of the herpetodiversity of Honduras is being offset by documented losses of that same diversity over the last decade or so. We are, thus, fighting an uphill battle on very slippery slopes.

In full light of the provisos identified in this section above, the following recommendations concerning the protection of the members of the Honduran herpetofauna are made:

- The system of biotic reserves should be expanded to include areas for protection of species not currently known to reside in any legally established reserve. The locations of such areas are discussed by Wilson et al. (2001) and McCranie and Wilson (2002). Of the Honduran endemics, there are 14 such species. For the Nuclear Middle American species, seven species are involved.
- The entire system should be evaluated to ascertain the health of the populations of amphibians and reptiles resident within the various reserves. At least an initial effort can be accomplished by use of Rapid Ecological Assessment Program methodology (see Parker and Bailey 1991).
- Following this evaluation, the system of reserves should be adjusted to the extent possible to provide maximal protection of the remaining populations of resident amphibians and reptiles. Undoubtedly, this step also would involve establishment of additional reserves. Wilson et al. (2001) and McCranie and Wilson (2002) provide some guidance for such decisions.
- Steps then should be taken to clearly identify the limits of the reserves, build facilities to house personnel, involve local people in planning and decision making, make employment available to local people, and put the resulting revenues into local communities for future improvements. Meyer and Meerman (2001) discussed this type of "participatory" management strategy, which they advocate to replace the traditional "exclusionary" management strategy maintained by them to be ineffective over the long term. These steps, which need to occur as rapidly as possible, will obviously require appropriate allocation of governmental funds. The administration of the new Honduran president, Ricardo Maduro Joest, is just beginning. It remains to be seen what priority is established by the new government to address these issues.
- Once facilities are available for housing personnel, then the longer-term scientific survey work and other sorts of scientific studies can begin, with the goal of establishing the biological worth of the various reserves. Opportunities for cooperation in such studies between resident and foreign scientists should be

explored. We continue to explore such collaborations with various Honduran biologists.

- With completion of facilities and scientific studies can come educational and ecotourist programs, with the goal of making the reserves economically self supporting. Again, cooperative undertakings should be encouraged. Such steps would involve reaching out to various Honduran and foreign governmental and non-governmental organizations.
- Our strongest recommendation is that the steps outlined above be taken with all dispatch possible. We have demonstrated that populations of a highly significant number of species of Honduran amphibians and reptiles are already in decline or have disappeared, especially of the most important segment containing the endemic species and those whose distribution is otherwise restricted to Nuclear Middle America. In addition, deforestation has been demonstrated to be increasing at an exponential rate, commensurate with the increase in human population. Deforestation is the principal type of habitat destruction in Honduras, which is, in turn, the major threat to the highly distinctive and important Honduran herpetofauna. There is, in the final analysis, no time to dawdle.

"We must learn to use our intelligence to live more lightly on the land, so that we do not degrade the only home we have—and the only one we can leave to our children."

E. O. Wilson and D. L. Perlman
***Conserving Earth's Biodiversity*, 2000**

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References

Anonymous. 2001. *Estudio sobre Diversidad Biológica de la República de Honduras*. Dirección General de Biodiversidad, Secretaría de Recursos Naturales y Ambiente, Tegucigalpa. 158 p.

Berger, L., Speare, R., Daszak, P., Green, D. E., Cunningham, A. A., Goggin, C. L., Slocombe, R., Ragan, M. A., Hyatt, A. D., McDonald, K. R., Hines, H. B., Lips, K. R., Marantelli, G., and Parkes, H. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proceedings of the National Academy of Sciences of the United States of America.* **95**:9031–9036.

Bright, C. 2000. Anticipating environmental "surprise," p. 22-38 *in* Brown, L. R., et al. (editors). *State of the World 2000.* W. W. Norton & Company, New York. 276 p.

Chaffee, J. 1994. *Thinking Critically.* Fourth edition. Houghton Mifflin Company, Boston, Massachusetts. 642 p.

Ehrlich, P. and Ehrlich, A. 1981. *Extinction: the causes and consequences of the disappearance of species.* Random House, New York. 305 p.

Ehrlich, P. and Ehrlich, A. 1996. *Betrayal of Science and Reason: how anti-environmental rhetoric threatens our future.* Island Press, Covelo, California. 335 p.

Fellers, G. M., Green, D. E., and Longcore, J. E. 2001. Oral chytridiomycosis in the Mountain Yellow-Legged frog (*Rana muscosa*). *Copeia* **2001(4)**:945-953.

Golenpaul, D. (editor). 1968. *Information Please Almanac, Atlas and Yearbook 1969.* Simon and Schuster, New York. 944 p.

Holdridge, L. 1967. *Life Zone Ecology.* Revised edition. Tropical Science Center, San José, Costa Rica. 206 p.

Illueca, J. 1997. The Paseo Pantera agenda for regional conservation, p. 241-257 *in* Coates, A. G. (editor). *Central America: a natural and cultural history*. Yale University Press, New Haven. 277 p.

Lips, K. R. 1999. Mass mortality and population declines of anurans at an upland site in western Panama. *Conservation Biology* **13(1)**:117–125.

McCranie, J. R. and Wilson, L. D. 2002. *The Amphibians of Honduras.* Society for the Study of Amphibians and Reptiles, Contributions to Herpetology **19**:1-625.

McCranie, J. R. and Wilson, L. D. *In press*. The Honduran amphibian fauna: perched on the brink of decline, *in* Wilkinson, J. W. (editor). *Declining Amphibian Populations Task Force Combined Working Group Report 2001*. IUCN, Switzerland.

McCranie, J. R., Wilson, L. D. and L. Porras. 1980. A new species of *Leptodactylus* from the cloud forests of Honduras. *Journal of Herpetology* **14(4)**:361–367.

Meyer, J. R. 1969. A biogeographic study of the amphibians and reptiles of Honduras. Unpublished Ph.D. Dissertation, University of Southern California, Los Angeles. 589 p.

Meyer, J. R. and Meerman, J. 2001. Amphibians of the Maya Mountains of Belize: biogeographical relationships and implications for ecosystem management, p. 65-79 *in* Johnson, J. D., Webb, R. G., and Flores-Villela, O. A. (editors). *Mesoamerican herpetology: systematics, zoogeography, and conservation.* Centennial Museum, University of Texas at El Paso, Special Publication **1**:1-200.

Meyer, J. R. and Wilson, L. D. 1971. A distributional checklist of the amphibians of Honduras. *Los Angeles County Museum of Natural History, Contributions in Science* **218**:1–47.

Meyer, J. R. and Wilson, L. D. 1973. A distributional checklist of the turtles, crocodilians, and lizards of Honduras. *Los Angeles County Museum of Natural History, Contributions in Science* **244**:1–39.

Miller, G. T. 2001. *Environmental Science: working with the earth.* Brooks/Cole, Thompson Learning, Pacific Grove, California. 549 p.

Parker, T. and Bailey, B. (editors). 1991. A biological assessment of the Alto Madidi Region and adjacent areas of northwest Bolivia May 18-June 15, 1990. *RAP Working Papers* **1**:1-108.

Pounds, J. A., Fogden, M. P. L., and Campbell, J. H. 1999. Biological response to climate change on a tropical mountain. *Nature* **398**:611–615.

Raven, P. H. and L. R. Berg. 2001. *Environment*. Harcourt College Publishers, New York. 612 p.

Wilson, E. O. 1984. *Biophilia*. Harvard University Press, Cambridge, Massachusetts. 157 p.

Wilson, E. O. (editor). 1988. *Biodiversity*. National Academy Press, Washington, D.C. 521 p.

Wilson, E. O. 1992. *The Diversity of Life.* Belknap Press of Harvard University Press, Cambridge, Massachusetts. 424 p.

Wilson, E. O. 1998. *Consilience: the unity of knowledge.* Alfred A. Knopf, New York. 332 p.

Wilson, E. O. and Perlman, D. L. 2000. *Conserving earth's biodiversity with E. O. Wilson* (CD-ROM). Island Press, Covelo, California.

Wilson, L. D. 1983. Update on the list of amphibians and reptiles known from Honduras. *Herpetological Review* **14(4)**:125–126.

Wilson, L. D. 1997a. The life sciences and environmental sustainability: a partnership in survival. *Common Ground* **Fall 97-1**:3-7.

Wilson, L. D. 1997b. Mass denial and the decade of environmental decision. *Common Ground* **Winter 97-2**:3-5.

Wilson, L. D. 1998. The psychology of environmental inertia: the addiction-denial cycle as disease. *Common Ground* **Winter 98-2**:3-5.

Wilson, L. D. 1999. The psychology of environmental inertia: the origin of our collective psychic trauma. *Common Ground* **Fall 99-1**:3-5, 8.

Wilson, L. D. 2000. Slaying the beast within: restructuring the educational process to promote the environmental ethic. *Common Ground* **Spring 99-2**:3-6.

Wilson, L. D. 2001. Education as psychotherapy: reforming the educational process to promote sustainability. *Common Ground* **Winter 1-2**:2-5.

Wilson, L. D. and McCranie, J. R. 1992. Status of amphibian populations in Honduras. Unpublished Report to the Task Force on Declining Amphibian Populations, 15 August 1992. 14 p.

Wilson, L. D. and McCranie, J. R. 1994. Second update on the list of amphibians and reptiles known from Honduras. *Herpetological Review* **25(4)**:146–150.

Wilson, L. D. and McCranie, J. R. 1998. Amphibian population decline in a Honduran national park. *Froglog* **25**:1-2.

Wilson, L. D. and McCranie, J. R. 2002. Update on the list of reptiles known from Honduras. *Herpetological Review* **33(2)**:90-94.

Wilson, L. D., McCranie, J. R. and Espinal, M. R. 2001. The ecogeography of the Honduran herpetofauna and the design of biotic reserves, p. 109-158 *in* Johnson, J. D., Webb, R. G., and Flores-Villela, O. A. (editors). *Mesoamerican herpetology: systematics, zoogeography, and conservation.* Centennial Museum, University of Texas at El Paso, Special Publication **1**:1-200.

Wilson, L. D., McCranie, J. R. and L. Porras. 1978. Two snakes, *Leptophis modestus* and *Pelamis platurus*, new to the herpetofauna of Honduras. *Herpetological Review* **9(2)**:63–64.

Wilson, L. D. and Meyer, J. R. 1982. The snakes of Honduras. *Milwaukee Public Museum, Publications in Biology and Geology* **6**:1-159.

Wilson, L. D. and Meyer, J. R. 1985. *The Snakes of Honduras*. Second edition. Milwaukee Public Museum, Milwaukee, Wisconsin. 150 p.

Young, B. E., Lips, K. R., Reaser, J. K., Ibáñez, R., Salas, A. W., Cedeño, J. R., Coloma, L. A., Ron, S., La Marca, E., Meyer, J. R., Muñoz, A., Bolaños, F., Chaves, G., and Romo, D. 2001. Population declines and priorities for amphibian conservation in Latin America. *Conservation Biology* **15(5)**:1213-1223.

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