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CONSERVATION RESEARCH REPORTS

Egg Relocation in Loggerhead Turtles

Relocation of eggs is a common strategy for conserving declining reptilian populations around the world. If individuals exhibit consistency in nest-site selection and if nest-site selection is a heritable trait, relocating eggs deposited in vulnerable locations may impose artificial selection that would maintain traits favoring unsuccessful nest-site selection. Conversely, if most individuals scatter nesting effort and individuals that consistently select unsuccessful nest sites are uncommon, then artificial selection would be less of a concern. During the 2005 nesting season of Loggerhead Turtles (*Caretta caretta*) at Mon Repos Beach, Queensland, Australia, **Pfaller et al.** (2009. *Conservation Biology* 23:72–80) measured the perpendicular distance from the original nest site to a stationary dune baseline for *in situ* (unrelocated) and relocated clutches of eggs. They observed the fate of *in situ* clutches and predicted what would have been the fate of relocated clutches if they had not been moved by mapping tidal inundation and storm erosion lines. In 2005, turtles deposited an average of 3.84 nests and did not consistently select nest sites at particular distances from the stationary dune baseline. Selection of unsuccessful nest sites was distributed across the nesting population; 80.3% of the turtles selected at least one unsuccessful nest site and when previous breeding seasons were included, 97% selected at least one unsuccessful nest site. Females with nesting experience selected more successful nest sites than females with little or no experience. Relocating eggs vulnerable to tidal inundation and erosion saves the progeny from a large percentage of the population and the progeny from individuals that may in subsequent years nest successfully. Results suggest that doomed-egg relocation does not substantially distort the gene pool in the eastern Australian Loggerhead stock and should not be abandoned as a strategy for the conservation of marine turtle populations.


NATBIOINFOINSTRASTRUCTURE

Relocating eggs from unsuccessful Loggerhead Turtle (*Caretta caretta*) nest sites should be retained as a strategy for the conservation of marine turtle populations.

Habitat Quality and Landscape Connectivity Promote Persistence of Endangered Natterjack Toads

The Natterjack Toad (*Bufo calamita*) is endangered in several parts of its range, including Belgium, where it occurs mainly in artificial habitats. **Stevens and Baguette** (2009. *Conservation Biology* 22:1194–1204) tested the sensitivity of a model for Natterjack population viability analysis to changes in the values of basic parameters. The authors then assessed the relative efficiency of various conservation measures in two situations: A small isolated population and a system of four populations connected by rare dispersal movements. Simulated Natterjack populations were highly sensitive to habitat quality (particularly pond drying), to dispersal from surrounding local populations, and to a lesser extent to values of fecundity and survival of terrestrial stages. Population trajectories were nearly insensitive to initial abundances, carrying capacities, and the frequency of extreme climatic conditions. The simulations showed that in habitats with highly ephemeral ponds, where premetamorphic mortality was high, Natterjack populations nearly always had a very high extinction risk. The model also illustrated how low dispersal rates (<1 dispersing individual/generation) efficiently rescued declining local populations. Such source-sink dynamics demonstrate that the identification and management of source populations should be a high priority for conserving the species.


PIET SPAANS

Endangered Natterjack Toads (*Bufo calamita*), which often occur in artificial habitats, are highly sensitive to pond drying and opportunities for dispersal from surrounding local populations.

Savanna Snake Invasions into African Rainforest

Freedman et al. (2009. *Conservation Biology* 23:81–92) used a species-distribution modeling approach, ground-based climate data sets, and newly available remote-sensing data on vegetation to investigate the combined effects of human-caused habitat alterations and climate on potential invasions of rainforest by three savanna snake species in Cameroon, Central Africa: Night Adder (*Causus maculatus*), Olympic Lined Snake (*Dromophis lineatus*), and African House Snake (*Lamprophis fuliginosus*).


TRISHA SHEARS

Models with varying sets of data predict different responses of anthropogenic deforestation and climate change on the likelihood of savanna snakes, such as the African House Snake (*Lamprophis fuliginosus*), invading altered African rainforests.

Models with contemporary climate variables and localities from native savanna habitats showed that the current climate in undisturbed rainforest was unsuitable for any of the snake species due to high precipitation. Limited availability of thermally suitable nest sites and mismatches between important life-history events and prey availability are a likely explanation for the predicted exclusion from undisturbed rainforest. Models with only vegetation variables and savanna localities predicted invasion in disturbed areas within the rainforest zone, which suggests that human removal of forest cover creates suitable microhabitats that facilitate invasions into rainforest. Models with a combination of contemporary climate, vegetation variables, and forest and

savanna localities predicted extensive invasion into rainforest caused by rainforest loss. In contrast, a projection of the present-day species-climate envelope on future climate suggested a reduction in invasion potential within the rainforest zone as a consequence of predicted increases in precipitation. These results emphasize that the combined responses of deforestation and climate change will likely be complex in tropical rainforest systems.

Rapid Evolution in the Wild

Rapid evolution caused by human exploitation of wildlife is not usually addressed in studies of such exploitation despite its direct relevance to population persistence. Japanese Mamushi (*Gloydius blomhoffii*), an endemic venomous snake of the Japanese Archipelago, has been heavily hunted by humans, and many populations appear to be declining or are already extirpated. **Sasaki et al.** (2009. *Conservation Biology* 23:93–102) compared local populations that have been hunted regularly with populations that have not been hunted. Mamushi in hunted populations were smaller, had fewer vertebrae, produced more and smaller offspring, had increased reproductive effort among smaller females, fled at greater distances from an approaching human in nature, and were less defensive than Mamushi in unhunted populations, as predicted from life-history theory. Heritability estimates for body size, number of vertebrae, and antipredator behavior were statistically significant, and neonates from hunted sites showed the same distribution of altered characters (compared with those from unhunted sites) as adults. Thus, distribution of the divergent trait between hunted and unhunted sites appeared in part to be genetically based, which suggests rapid evolution in response to human predation pressures. Trait distributions in hunted populations probably deviate from naturally (as opposed to anthropogenically) selected optima and, therefore, may have long-term negative repercussions on population persistence. Because rapid evolution affects a suite of parameters that characterize exploited populations, accurate understanding of the effects of exploitation and effective resource management and conservation can only be achieved if evolutionary consequences are considered explicitly.

WIKIPEDIA

Evidence suggests that Japanese Mamushi (*Gloydius blomhoffii*) respond rapidly to human predation pressures.

Effects of Burning on Reptilian Assemblages in Tropical Savannas

Fire is frequently used for land management purposes and may be crucial for effective control of invasive non-native plants. Nevertheless, fire modifies environments and may affect nontarget native biodiversity, which can cause conflicts for conservation managers. Native Australian reptiles avoid habitat invaded by the alien Rubber Vine (*Cryptostegia grandiflora*) and may be susceptible to the effects of burning, a situation that provides a model system in which to examine possible conservation trade-offs between managing invasive plants and maintaining native biodiversity. **Valentine and Schwarzkopf** (2009. *Conservation Biology* 23:103–113) used replicated, experimental fire treatments (unburned, dry-season burned, and wet-season burned) in two habitats (riparian and adjacent open woodland) to examine the short- (within 12 months of fire) and longer-term (within 3 years of fire) changes in reptilian assemblages in response to wet- and dry-season burning for weed management in tropical savannas of northern Australia. Within 12 months of fire, abundances of the skink *Carlia munda* were higher in the burned sites, but overall reptilian composition was structured by habitat type rather than by effects of burning. Within three years of a fire, however, effects of fire were evident. Reptiles, especially the gecko *Heteronotia binoei*, were least abundant in dry-season burned sites; litter-associated species, including *Carlia pectoralis*, were rarely observed in burned habitat; and fewer species were present in wet-season burned sites. Reptilian abundance was associated with vegetation structure, which suggests that fire-induced changes detrimentally altered the availability of resources for some species, particularly leaf-litter species. Invasive alien plants, such as Rubber Vine, have severe effects on native biodiversity, and control of such species is a fundamental land management objective. Nevertheless, fire management of invasive alien plants may adversely affect native biodiversity, creating a conservation conundrum. In such scenarios, land managers will need to identify the most desired conservation goal and consider the consequences for native biota.

TEEJAYBEE

Geckos (*Heteronotia binoei*) were least abundant in savanna sites subjected to dry-season burning to control invasive alien plants.

Riparian Buffers and Semiaquatic Amphibians

Studies on riparian buffers have usually focused on the amount of land needed as habitat for the terrestrial life stages of semiaquatic species. Nevertheless, the landscape surrounding wetlands is also important for other key processes, such as dispersal and the dynamics of metapopulations. Multiple elements that influence these processes should therefore be considered in the delineation of buffers. **Ficetola et al.** (2009. *Conservation Biology* 23:114–123) analyzed landscape elements (forest cover, density of roads, and hydrographic network) in concentric buffers to evaluate the scale at which they influence stream amphibians in 77 distinct landscapes. Amphibians required buffers of 100–400 m of suitable terrestrial habitat, but interspecific differences in the amount of habitat were large. The presence of amphibians was related to roads and the hydrographic network at larger spatial scales (300–1,500 m), which suggests that wider buffers are needed when these elements are factors. Furthermore, in some cases, analyses performed on different sets of landscapes provided different results, which suggests that caution should be used when conservation recommendations are applied to disparate areas. Establishment of riparian buffers should not be focused only on riparian habitat, but should take a landscape perspective because semiaquatic species use multiple elements for different functions.

SUZANNE L. COLLINS, CNAH

Semiaquatic amphibians, such as Eastern Tiger Salamanders (*Ambystoma tigrinum*) require buffers of suitable terrestrial habitat surrounding wetlands, but interspecific differences in the amount of habitat were large.

Oxapampa Poison Frog Rediscovered

The Oxapampa Poison Frog (*Ameerega planipaleae*) was discovered in 1996 and described in 1998 based on only four specimens from the central Andes of Peru. The species had been reported just once (in 1999) since its discovery. *Ameerega planipaleae* may have the highest elevational range of any dendrobatid frog. Habitat loss and fragmentation at the type locality led to the species being classified as Critically Endangered on the IUCN Red List and by the Peruvian government. This frog is known only from the type locality, and its ecology and natural history are practically unknown.

GERMÁN CHÁVEZ

The Oxapampa Poison Frog (*Ameerega planipaleae*) was rediscovered in 2007 after only one report of its presence since its original description in 1998.

From 2007 to 2009, **Chávez and Enciso** (2009. *Froglog* 91:1–4) surveyed streams and forest habitats at elevations of 1,900–2,300 m. They found the first individual in August 2007 and, since then, have found eighteen additional animals through January 2009. These frogs appear to prefer rocky habitats close to streams and, like other Poison Frogs, are active by day. The call was not recorded and tadpoles are unknown.

The greatest immediate threat to these frogs is habitat degradation caused by agricultural activities, with increasing amounts of agrochemicals in the soil and water. Additionally, garbage is not recycled in this area, and exotic species are present. To date, no evidence of chytridiomycosis exists, but high-elevation anurans associated with mesic habitats appear to be particularly vulnerable to the disease.

Declines in Neotropical Salamanders

Rovito et al. (2009. *Proceedings of the National Academy of Sciences of the United States of America* 106:3231–3236) documented major declines of many species of salamanders at several sites in Central America and Mexico, with particular emphasis on the San Marcos region of Guatemala, one of the best-studied and most diverse salamander communities in the Neotropics. They revealed profound declines of several formerly abundant species, including two apparent extinctions. Terrestrial microhabitat specialists at mid- to high elevations have declined more than microhabitat generalists. These terrestrial microhabitat specialists have largely disappeared from multiple sites in western Guatemala, including well-protected areas, suggesting that the phenomenon cannot be explained solely by localized habitat destruction. Major declines in southern Mexican plethodontid salamanders occurred in the late 1970s to early 1980s, concurrent with or preceding many reported frog declines. The species in decline comprise several major evolutionary lineages of tropical salamanders, underscoring the risk faced by significant portions of the phylogenetic diversity of Neotropical salamanders. These results highlight the urgent need to document and understand Neotropical salamander declines as part of the larger effort to conserve global amphibian diversity.

BROOKE L. TALLEY

Populations in several major evolutionary lineages of Neotropical plethodontid salamanders, such as this *Cryptotriton nasalis* from Honduras, appear to be declining. Such changes need to be documented as part of the larger effort to conserve global amphibian diversity.

Citizen Science: Can Volunteers Do Real Research?

Nationwide, people are volunteering as "citizen scientists," participating as field assistants in scientific studies. Citizen scientists typically don't analyze data or write scientific papers, but they participate in a vital component of the research process. **Cohn** (2008. *BioScience* 58:192–197) explores what volunteers have to offer to scientific research, and why they are valuable tools to the development of science.

FRED BURTON

Citizen scientists use sophisticated techniques to collect data. Here Desiree Wong is radiotracking Grand Cayman Blue Iguanas (*Cyclura lewisi*) in the Salina Reserve.

The idea of working with citizen scientists isn't a new concept. The National Audubon Society's annual Christmas bird count began in 1900, and currently has 60,000–80,000 volunteers who participate. Additionally, citizen scientists are now collecting data such as documenting behavior and identifying plant or animal species, and monitoring air and water quality to assist wildlife biologists, botanists, and land managers.

The scope of what citizen scientists do today is much larger, from the number of volunteers enlisting in studies to the sophisticated techniques they use to collect data. Citizen scientists range in age and profession, and vary from students to teachers and retirees. The use of volunteers allows

scientists to gather data on a larger scale geographically and over a longer period of time, which in turn helps researchers distinguish trends and understand differences among geographic areas. Citizen scientists have largely been able to learn to use equipment and collect results with a reasonable degree of accuracy as long as they are properly trained and are provided with the correct tools, such as guide books and other printed materials. By pairing trained staff and scientists with volunteers, scientists can compare data to determine its reliability, and therefore keep variable data to a minimum.

The science of citizen research is still a work in progress, but it is evident that it has enabled scientists to broaden their scope of study, while getting people involved in the scientific process and enhancing the appreciation of the natural world.

Earlier Breeding of Japanese Amphibians

Reports of declines in amphibian populations from all over the world have been attributed to global climate change. Warming trends affect a wide range of ecological processes, including epidemic diseases in amphibians. Climate change also has led to documented long-term shifts toward earlier breeding in at least some amphibian populations in Europe and North America.

Kusano and Inoue (2008. *Journal of Herpetology* 42:608–614) monitored four breeding populations of three species of Japanese amphibians (*Hynobius tokyoensis*, *Rana ornativentris*, and *Rhacophorus arboreus*) to identify shifts in breeding patterns of amphibians in eastern Asia. The study was conducted at two sites in the suburbs of Tokyo for 12–31-year periods. The authors analyzed long-term data sets for first spawning and correlations between time of breeding and climatic factors. All of the amphibian populations analyzed showed significant trends toward earlier breeding. A relationship between the monthly mean air temperature in February and the dates of first spawning of *H. tokyoensis* showed that as the mean monthly temperature increased, the timing of breeding tended to become earlier.

AOMORIKUMA

Several species of Japanese amphibians, such as the Montane Brown Frog (*Rana ornativentris*), are breeding earlier in the year, a change almost certainly driven by warming climatic conditions.

The advance in dates of first spawning almost certainly is driven by a warming climate. Dates of first spawning were strongly correlated with temperature. However, earlier spawning may not necessarily imply a shift in entire breeding periods, especially if populations are growing. Consequently, some caution in interpreting the results is appropriate. Nevertheless, this study clearly demonstrated that significant long-term trends of warming in the region have affected timing of breeding in some species or populations.

Clearcut Logging Affects Gray Treefrog Tadpole Performance

Clearcutting is a major cause of many declining amphibian populations due to habitat alteration and loss. However, a previous study determined that Gray Treefrogs (*Hyla versicolor*) prefer breeding in ponds in clearcuts near forested habitat rather than in closed canopy ponds. **Hocking and Semlitsch** (2008. *Journal of Herpetology* 42:689–698) examined how biotic and abiotic factors influenced tadpole performance to test the implications of this apparent preference. The study was conducted in the Daniel Boone Conservation Area in Warren County, Missouri. Cattle tanks were set up in clear cuts and control forests at three replicate sites. Each site represented habitats associated with logged forests: Clearcut, clearcut-edge, forest-edge, and forest treatments. Tadpoles were measured during the larval period, size at metamorphosis, and by survival. The authors also evaluated the influence of temperature and food sources, such as periphyton productivity and invertebrate predator abundances.

SUZANNE L. COLLINS, CNAH

Gray Treefrog (*Hyla versicolor*) tadpoles in clearcuts metamorphosed an average of 6.9 days sooner than tadpoles in forested areas.

Tadpoles in the clearcut treatments metamorphosed an average of 6.9 days sooner than tadpoles in forested treatments. The ability to metamorphose quickly from ephemeral ponds in clearcuts may enhance survival, which was 8.5% higher for tadpoles in clearcut than in forest ponds. However, tadpoles in clearcuts tended to be smaller in size at metamorphosis than those in forest treatments. Smaller size can reduce fitness through lower energy stores, delayed reproductive maturity, reduced fecundity of females, and lower survival, and may make them more susceptible to desiccation. Invertebrate predators did not have an influence. Further research should be done to examine the effects of clearcutting on competitive and predatory interactions among amphibians.

Madagascar's Biodiversity Vastly Underestimated

Amphibians are in decline worldwide. However, patterns of diversity, especially in the tropics, are not well understood, mainly because of incomplete information on taxonomy and distribution. **Vieites et al.** (2009. *Proceedings of the National Academy of Sciences*, published online before print 4 May 2009, doi: 10.1073/pnas.0810821106) assessed morphological, bioacoustic, and genetic variation of Madagascar's amphibians, one of the first near-complete taxon samplings from a biodiversity hotspot. Based on DNA sequences of 2,850 specimens sampled from over 170 localities, their analyses revealed an extreme proportion of amphibian diversity, projecting an almost two-fold increase in species numbers from the currently described 244 species to a minimum of 373 and as many as 465. This diversity is widespread geographically and across most major phylogenetic lineages, except a few previously well-studied genera, and is not restricted to morphologically cryptic clades. Results suggest that the spatial pattern of amphibian richness and endemism in Madagascar must be revisited, and current habitat destruction may be affecting more species than previously thought, in amphibians as well as in other animal groups. This case study suggests that worldwide tropical amphibian diversity is probably underestimated at an unprecedented level and stresses the need for integrated taxonomic surveys as a basis for prioritizing conservation efforts within biodiversity hotspots.

DAVID VIEITES

Guibe's Treefrog (*Guibemantis guibei*) is only one of the species that increased the known amphibian diversity on Madagascar from 244 to a minimum of 373 and as many as 465 species.

NATURAL HISTORY RESEARCH REPORTS

Geographic Overlap Drives Reproductive Character Displacement in Frogs

Theoretical models suggest that populations overlapping geographically with different combinations of other species can evolve traits that increase the likelihood of proper mate recognition. When such phenomena occur, they are recognized as examples of reproductive character displacement. **Lemmon** (2009. *Evolution* 63:1155–1170) tested this hypothesis by assessing differences in mating calls (patterns of acoustic signals) in two- and three-species assemblages of Chorus Frogs (*Pseudacris*), focusing in particular on *P. feriarum* and *P. nigrita*, and determined that only the rarer species displayed substantial displacement in this trait (*P. feriarum* in three cases and *P. nigrita* in one instance). Moreover, the three displaced *P. feriarum* populations diverged in different signal traits across the contact zone, evolving in directions that increased the energetic cost of calling over that incurred by populations free from competition. Divergences invariably maximized differences from other species present. Females in the same geographic area also diverged in their preference for mating calls, thus reducing an inclination to hybridize. Together, signal and preference data suggested that interactions between species can promote diversification within species, potentially contributing to reproductive isolation among conspecific populations.

SUZANNE L. COLLINS, CNAH

Upland Chorus Frogs (*Pseudacris feriarum*) modified their calls when found in the same areas with the Southern Chorus Frog (*P. nigrita*).

Lizard Rolls Over to Avoid Sex

In some lizards, females develop bright coloration to signal reproductive status and exhibit behavioral repertoires to incite male courtship and/or reduce male harassment and forced copulation. Sex steroids, including progesterone and testosterone, might influence female reproductive coloration and behavior. **Jessop et al.** (2009. *Journal of Comparative Physiology. A, Neuroethology, Sensory, Neural, and Behavioral Physiology*. Epub.) measured associations among plasma profiles of testosterone and progesterone with variation in color expression and reproductive behavior, including unique courtship rejection behaviors, in female Lake Eyre Dragon Lizards (*Ctenophorus maculosus*). At onset of breeding, progesterone and testosterone increased with vitellogenesis, coincident with color intensification and sexual receptivity, indicated by acceptance of copulations. As steroid levels peaked around the inferred ovulation time, maximal color development occurred and sexual receptivity declined. When females were gravid and exhibited maximal mate rejection behaviors, progesterone levels remained consistently high, while testosterone exhibited a discrete second peak. At oviposition, significant declines in plasma steroid levels, fading of coloration and a dramatic decrease in male rejection behaviors co-occurred. These results indicate a generally concordant association among steroid levels, coloration, behavior, and reproductive events. However, the prolonged elevation in progesterone and a second peak of testosterone was unrelated to reproductive state or further color change, possibly suggesting selection on females to retain high steroid levels for inducing rejection behaviors.

DEVI MEAN STUART-FOX

Male Lake Eyre Dragon Lizards (*Ctenophorus maculosus*) are really persistent, attempting to force females to copulate, harassing them all through the breeding season. Unreceptive females scare off advancing males by taking on a threatening posture. If that doesn't work, they throw themselves on their backs and reveal their bright orange underside. Males can't force themselves onto a female when she's on her back.

Small Snakes Use Active Ant Nests as Hibernacula

Ant mounds offer potential hibernacula both for small snake species and also for juveniles of many species, although this potential may be offset by aggression from ants in active nests and the concomitant