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Bats: status, threats and conservation successes. Introduction

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This Theme Section is the first issue of a conservation journal devoted entirely to bats. Such a landmark is timely in view of the fact that the Global Mammal Assessment recently revealed that unprecedented numbers of bat species fall into the International Union for Conservation of Nature (IUCN) threat categories, with pteropodids (old world fruit bats) significantly more threatened than other groups (Schipper et al. 2008). The most pervasive reason for such a situation is widespread loss of roosts and foraging habitat, and in the old world tropics particularly, hunting for bushmeat (Mickleburgh et al. 2009).

Bat conservation organisations are stepping up to the challenge of attempting to counter these threats. Since the establishment of the Bat Conservation Trust in 1990, similar national non-governmental organisations (NGOs) for bat conservation have been established in most European countries. In the USA, Bat Conservation International is a long-established organisation and in recent years has been particularly effective in drawing attention to the threats posed to bats by wind turbines, and has established an international scholarship programme for young conservationists seeking postgraduate qualifications. The Lubee Bat Conservancy supports research on plant-visiting bats throughout the tropics. In Asia, the Chiroptera Conservation and Information Network for South Asia (CCINSA) links and trains conservationists, and the most recently established NGOs range from the South East Asia Bat Conservation Research Unit (SEABCRU) in Malaysia to Madagasikara Voakajy in Madagascar, both of which train graduates and local wildlife officers in bat conservation biology. All these organisations are affiliated to the IUCN's Bat Specialist Group, which recently established a conservation network in Central and South America.

Other conservation NGOs with a broad conservation remit have also been active in bat conservation. Fauna and Flora International has played a major role in the recovery of *Pteropus voeltzkowi* on Pemba Island, Tanzania, where hunting was driving it towards extinction. Durrell Wildlife and The Mauritian Wildlife Foundation did the same for *Pteropus rodricensis* on Rodrigues Island also in the Indian Ocean.

The wide range of papers in the current Theme Section reveals the range of threats faced by bats. It is an irony, therefore, that the reasons why the subject of Gerlach's (2009, this Theme Section) paper, *Coleura seychellensis*, is the rarest bat in the world remain speculative. Recorded as common in the nineteenth century, it is the only endemic insectivorous bat in the granitic Seychelles. On Silhouette, where The Nature Preservation Trust of the Seychelles has done so much to protect roosts and foraging habitats and successfully to encourage the establishment of a national park, bat numbers have doubled in the past decade to 32 (Gerlach 2009). On Mahé, the 2003 Aberdeen University Expedition counted 18 individuals over 3 mo (Bambini et al. 2006). Several reasons have been suggested for the decline: disturbance of boulder cave roosts, loss of foraging habitat, predation by rats and owls, earlier use of chlorinated hydrocarbon insecticides and low densities of insect food. Although several roost sites are known, most bats roost in 2 sites — one on Silhouette, and one on Mahé which is threatened by proposed tourist developments. Unless affirmative action to protect this latter roost is taken by the Seychelles government, *C. seychellensis* will join the 9 other species of bats known to have become extinct.

Two other species which have been placed in Red List threat categories because of declining populations and which are featured in this Theme Section are *Craseonycteris thonglonygai* and *Hipposideros turpis* (Puechmaille et al. 2009, this Theme Section). The former is the bumble bee bat, which at 2 g is the smallest bat in the world, with a population of about 5000 in 32

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caves around Kanchanaburi, Thailand. The practice of embedding them in plastic to sell to tourists as paper weights now seems to have been suppressed, but the bats are still threatened by disturbance and incense burning, since many of their cave roosts are used by monks. More recently, a smaller population has been discovered in Myanmar with a 10 kHz difference in echolocation calls. Puechmaille (2009) devoted his PhD to establishing whether these populations are in the process of speciating. *Hipposideros turpis* is also declining. It has a disjunct population, since it occurs in Japan as well as Thailand and Vietnam, and faces threats common to all karst-dependent bats, i.e. those stemming from the fact that limestone is needed to make cement.

The planning procedures and building regulations of developed countries increasingly take account of wildlife legislation and, in the EU for example, environmental impact assessments are now mandatory. That has been one of the drivers of attempts to translocate bats when their roosts are threatened, which is the subject of reviews by Ruffell et al. (2009, this Theme Section) and case studies from New Zealand (Ruffell & Parsons 2009, this Theme Section) and Switzerland (Weinberger et al. 2009, this Theme Section), both of which show that, although fraught with difficulty, translocation can work.

Tunnels for badgers under highways and for otters beneath bridges are now among the established tools of conservation practitioners. The first bat bridge above a highway has worked in Germany, and more may now be constructed following the work of Russell et al. (2009, this Theme Section) which shows how potentially dangerous to bats the deforestation of verges following highway upgrades is. The fact that 27 of the 26 000 little brown bats *Myotis lucifugus,* a common North American species, observed crossing a highway were killed is less likely to stimulate conservation action than the single mortality of *Myotis sodalis,* because the latter is listed as federally endangered.

Although not always achievable, surveys before and after major land use changes are fundamental to inferring the consequences. Fortunately, such assessments were achieved in the case of the Alquera dam (Rebelo & Rainho 2009, this Theme Section) in Portugal, which is the largest water reservoir in Europe created with the loss of 250 km^2 of land, including 200 km of riparian habitat favoured by many bat species, with a consequent reduction in the number of foraging bats.

Legislation to protect bat roosts exists in many European countries, and infringements are often prosecuted. Although it is more difficult to protect the foraging habitat of bats using a particular roost, there have been some encouraging initiatives using the Country Stewardship Scheme for greater horseshoe bats *Rhinolphus ferrumequinum* in England and Wales (Racey 1998). Almenar et al. (2009, this Theme Section) suggest that it is necessary to conserve a radius of 20 km around a roost of *Myotis capaccini* to safeguard the individuals using the roosts.Within such foraging areas, Knight & Jones (2009, this Theme Section) have shown how important night roosts are to species such as *R. hipposideros* and provide convincing reasons why they should be protected.

Counting bats is never easy, particularly when large numbers emerge from small holes. Ammerman et al. (2009, this Theme Section) report the use of thermal imaging cameras to count up to 3000 endangered *Leptonycteris nivalis* emerging from a Texas cave. This is clearly a more manageable task than counting tens of millions of Mexican free-tailed bats *Tadarida brasiliensis*, which has long been the goal of the same research group.

In a review of the importance of bats as bioindicators, Jones et al. (2009, this Theme Section) consider, inter alia, the effects of climate change and the possible consequences of unusually warm and climatically erratic winters on hibernating bats. Such bats may exhaust their fat reserves to such an extent that they may become more susceptible to pathogens. In the northeastern United States, mass die-offs involving >75% of populations and hundreds of thousands of bats have continued to occur at the end of winter, and the bats typically have a growth of a hitherto undescribed *Geomyces* fungus on their noses, hence the term white-nose syndrome. Lethal skin fungi are rare, although chytrid (*Batrachochytrium dendrobatidis*) has wrought similar havoc among amphibian populations worldwide. There are serious concerns that white-nose syndrome may be spreading to other continents, and there have been unconfirmed reports of its occurrence in hibernacula in Europe.

It is also gratifying to see the bats of Ishigaki Island in the Ryukus receiving attention in a paper by Fukui et al. (2009, this Theme Section) which discusses their diet, because the controversial planned runway extension to the island's airport will destroy the cave roosts of the species studied. The next step, as the authors point out, is to establish the preferred foraging areas of these bats.

Such a reductionist contribution is counterbalanced by the holistic approach of Weller et al. (2009, this Theme Section), who advocate the need to broaden the focus of bat research and conservation from the much studied maternity colonies to other reproductive groups such as males and non-breeding females. In Madagascar, we can find only males of the sucker-footed bat *Myzopoda aurita*, whereas maternity colonies, generally the easiest social group to locate, remain elusive (M. Ralisata & P. A. Racey unpubl.).

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