REPTILE BIODIVERSITY

STANDARD METHODS *for* INVENTORY *and* MONITORING

EDITED BY *Roy W. McDiarmid, Mercedes S. Foster, Craig Guyer, J. Whitfield Gibbons, and Neil Chernoff*

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Cover photographs (clockwise from left to right): *Diploglossus bilobatus* (Tortuguero, Costa Rica), *Terrapene carolina* (Savannah River Site, South Carolina), *Leptophis ahaetulla* (Tortuguero, Costa Rica), photos by John D. Willson; *Corallus hortulanus* (Cerro de la Neblina, Venezuela), photo by Roy W. McDiarmid; *Pseustes sulfureus* (Manu National Park, Peru), photo by Fiona A. Wilkinson, © Maquina Images.

backed Rattlesnakes (*Crotalus adamanteus*; H. Clamp, pers. comm.). Sewer junction boxes to which several 2- to 3-m-long, flexible, corrugated drainage pipes are attached are buried so that the top of the box lies approximately 1 m below the ground surface. The entrances of the pipes are only partially buried, to simulate stump-hole root channels. Research to determine the effectiveness of this latter type of artificial hibernaculum is needed.

Special Considerations

Several factors must be considered when planning surveys and monitoring programs for snake dens. Investigators designing or implementing visual surveys of known or new den sites must incorporate mechanisms to account for bias among observers with different search images, abilities to concentrate, experience, or knowledge of the target species (Rodda 1993). Observer biases should be studied to determine the effectiveness and characteristics of qualified biologists conducting visual studies at hibernacula.

Hibernacula are potentially limiting resources for many snake species (Parker and Brown 1973; Burger et al. 1988). Populations of many species have declined because of the loss of hibernacula to human development and/or the persecution of snakes at den sites (Klauber 1972; Parker and Brown 1973; Galligan and Dunson 1979; Gregory 1984a; Zappalorti and Reinert 1994). Locating hibernacula and monitoring communally denning populations of reptiles can provide information about many aspects of the target species' natural histories and can have important conservation implications. Exact locations of dens of sensitive, threatened, or endangered species should never be casually disclosed and should be reported only in conjunction with legitimate research and conservation efforts (Brown 1993).

Arboreal Reptiles: Tree-Trunk and Canopy-Dwelling Species

Indraneil Das

Sampling invertebrates from plants has been described as difficult, relative to sampling them from the ground or air, a generalization that is also true for sampling reptiles. Factors that impede effective sampling include the heterogeneous and continuous changing nature of plant-generated habitats (Southwood and Henderson 2000, p. 148), as well as their height. Indeed, arboreal habitats, which I define here as vegetation 2 m tall or taller (and, therefore effectively out of the reach of the average observer), are arguably the most difficult to sample. Rain forest trees can tower 30 m or more above the observer, with emergent trees in some areas reaching 50 m, and they have complex canopies (the upper levels of a forest). Many activities of arboreal species take place off the ground, on or in the forest canopy (where primary production takes place). Canopies are physically and biologically the most active part of the forest, and the architectural complexity of such habitats is attributed in part to the high faunal species richness in rain forests. Even when the canopy is accessible, collecting a reptile manually and inspecting the foliage with which it is associated are not always possible and depend considerably on the skills and experience of the collector. Consequently, comparing sample sets is difficult.

In recent years, estimates of the number of species inhabiting the earth have increased dramatically (May 1988, 1990; Stork 1993). Given that the estimates were extrapolated from counts of invertebrates, chiefly coleopterans, from the rainforest canopy (Erwin 1997), it is surprising that relatively little work has been done on canopy and other arboreal reptile communities. Sampling of amphibians from the mid-canopy of forests in the central highlands of Sri Lanka, for example, has recently led to quadrupling of the known fauna (Pethiyagoda and Manamendra-Arachchi 1998). Two groups of reptiles, lizards, and snakes, form a significant part of the arboreal reptile fauna. A single turtle, the Indo-Chinese *Platysternon megacephalum*, is reported to climb trees occasionally, possibly low tree trunks, to search for insects or to bask; I do not consider it here.

Arboreal reptiles may be visible to an observer as they expose themselves on trunks, branches, or surfaces of leaves, or they may be concealed under cover of leaves, flowers, or fruits; under loose bark; or in recesses of the trunk or branches. In the latter case, claw marks, smoothed entrance holes, or shed skin may betray their presence. Sampling protocols need to encompass the enormous variety of habitats and microhabitats used by arboreal reptiles. In general, our present knowledge of the ecology and systematics of many arboreal reptile groups is rudimentary. It would not be surprising to learn that some species categorized as rare or threatened are relatively common in the canopy. Indeed, groups typically thought to be terrestrial or even fossorial have been found in numbers in arboreal situations (Rossi and Feldner 1993; Das and Wallach 1998). Collections of canopy-inhabiting species tend to be fortuitous events, for example, when animals accidentally fall from their elevated perches or when trees are logged or fall during storms. In tropical areas, it is likely that many arboreal species of reptiles remain unknown to science.

Methodological constraints are a major impediment to the growth of our knowledge of arboreal herpetofaunas, for which effective survey methods are either difficult to design or expensive. Access to the high canopy, visibility, and access to the site itself are difficult or sometimes impossible without special equipment (Raxworthy 1988). In this account, I review the various techniques employed to sample reptiles occupying