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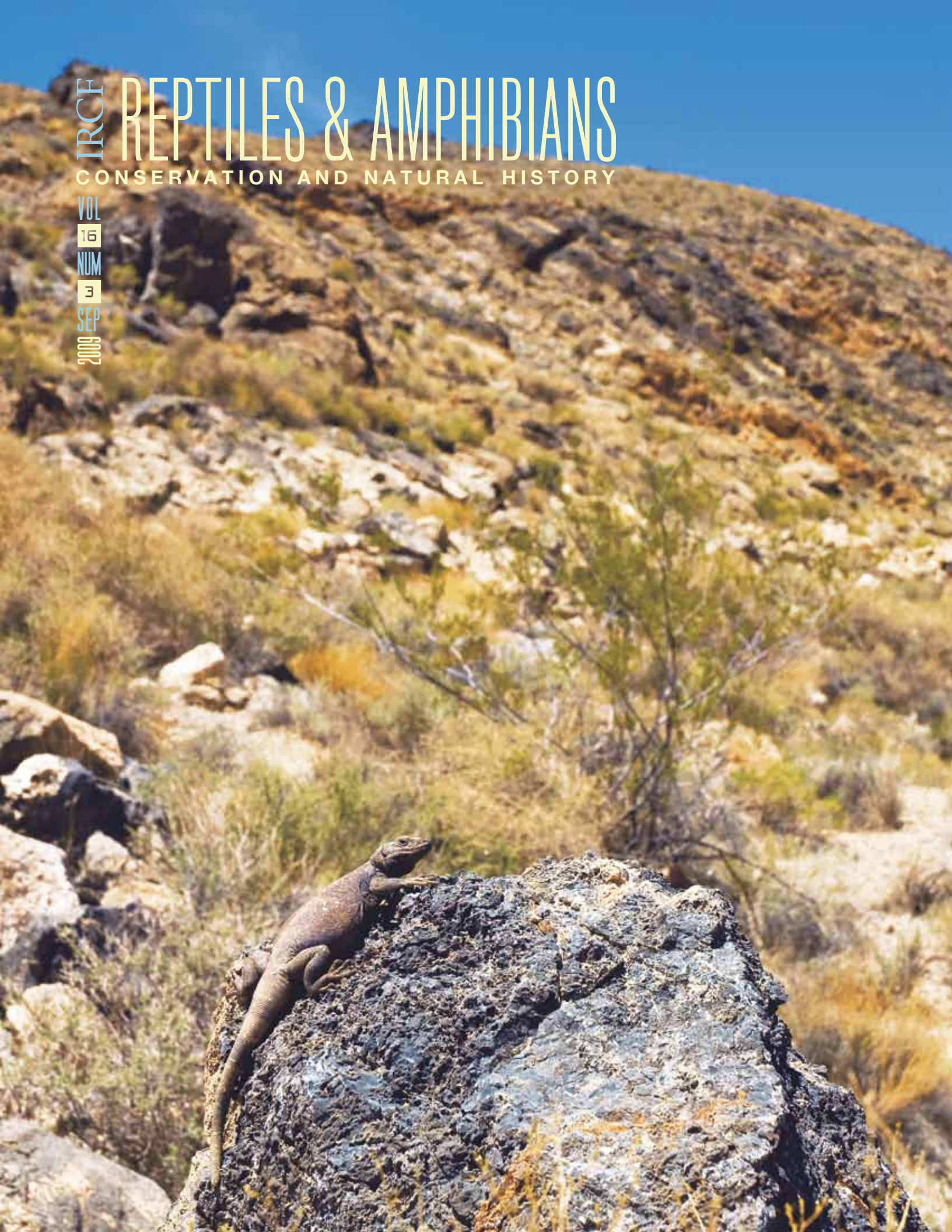


XIAO ZHI

Chinese Skinks (*Plestiodon chinensis*) once were common in farmland and open areas around the Dinghushan Nature Reserve, but populations appear to have declined as succession has filled in previously open areas (see article on p. 130).


DAN SUZIO

If you set your camera down in the desert, be careful picking it up! This Mojave Desert Sidewinder (*Crotalus cerastes cerastes*) in the Ibex Dunes of Death Valley National Park was especially unconcerned. This is how it responded to a camera set down on a rock (see travelogue on p. 152).


SUZANNE L. COLLINS, CNAH

Corn Snakes (*Pantherophis guttatus*) are attractive animals in their wild state, but selective breeding has generated color and pattern morphs not seen in nature (see commentary on p. 190).


CHUCK SCHAFFER

Habitat and nesting sites of the endangered Mary River Turtle (*Elusor macrurus*), one of the world's 25 most endangered turtles, are threatened by a proposed dam (see article on p. 174).

Front Cover: Dan Suzio

A Chuckwalla (*Sauromalus ater*) near Leadfield on the Titus Canyon Road in Death Valley National Park. With enough patience, Chuckwallas can be surprisingly approachable. See the travelogue on p. 152.

Back Cover: Brad Wilson

Endangered Marañón Poison Frogs (*Excitobates mysteriosus*) are known only from a single locality in northeastern Peru at an elevation of ~1,000 m. The main threat to the species is habitat destruction for agricultural use. See the newsbrief on pp. 200.

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XIAO ZHI (GUANGDONG)

Brown Treefrogs (*Rhacophorus megacephalus*; also known as *Polypedates leucomystax*) are abundant in both natural and disturbed habitats in Dinghushan.

CONSERVATION ALERT

Amphibians and Reptiles of Dinghushan in Guangdong Province, China's Oldest Nature Reserve

LI[1] Zhen-Chang, XIAO[1] Zhi, QING[1] Ning, LU[2] Wen-Hua, James LAZELL[2]

[1]South China Normal University, School of Life Science, Guangzhou, Guangdong 510631, China
[2]The Conservation Agency, 6 Swinburne Street, Jamestown, Rhode Island 02835, USA (hq@theconservationagency.org)

Abstract

Dinghushan is the only nature reserve at the Tropic of Cancer in mainland China with extensive old growth monsoonal hardwood forest. We here assemble a comprehensive list, with life history notes, of amphibians and reptiles of Dinghushan. Relevant records were scattered over three centuries since the first in 1886. A total of 71 species are known to occur in the reserve, and this number of species per area far exceeds that predicted by classic island biogeographic theory. Among these 71 species, nine are new records: Five frogs (*Amolops ricketti*, *Hylarana macrodactyla*, *Hylarana taipehensis*, *Odorrana schmackeri*, and *Occidozyga lima*) and four snakes (*Oligodon cinereus*, *Sinonatrix percarinata*, *Sinomicrurus macclellandi*, and *Trimeresurus stejnegeri*). One undetermined skink may confound the generic definitions for the genera of *Scincella* and *Sphenomorphus*. Among these 71 species, 21 that are not closely associated with old growth forest have not been seen recently. Forest recovery and reforestation of farmland over five decades since the nature reserve was established in 1956 may have contributed to the decline of these species. Dinghushan has 97% of its species occurring strictly in the Oriental zone; among them, about 78% (55) occur both in the South China and Central China regions, 21% (15) occur only in the South China region, and one species was previously known only from the Central China region. The unique location of Dinghushan makes long-term monitoring of its herpetofaunal diversity important for future collaborative studies on a global scale.

中国最早的自然保护区--广东省鼎湖山的两栖爬行动物

黎振昌[1]，肖智[1]，庆宁[1]，卢文华[2]，盐司橹[2]

1. 华南师范大学生命科学学院
2. 美国罗德岛州生物保护所

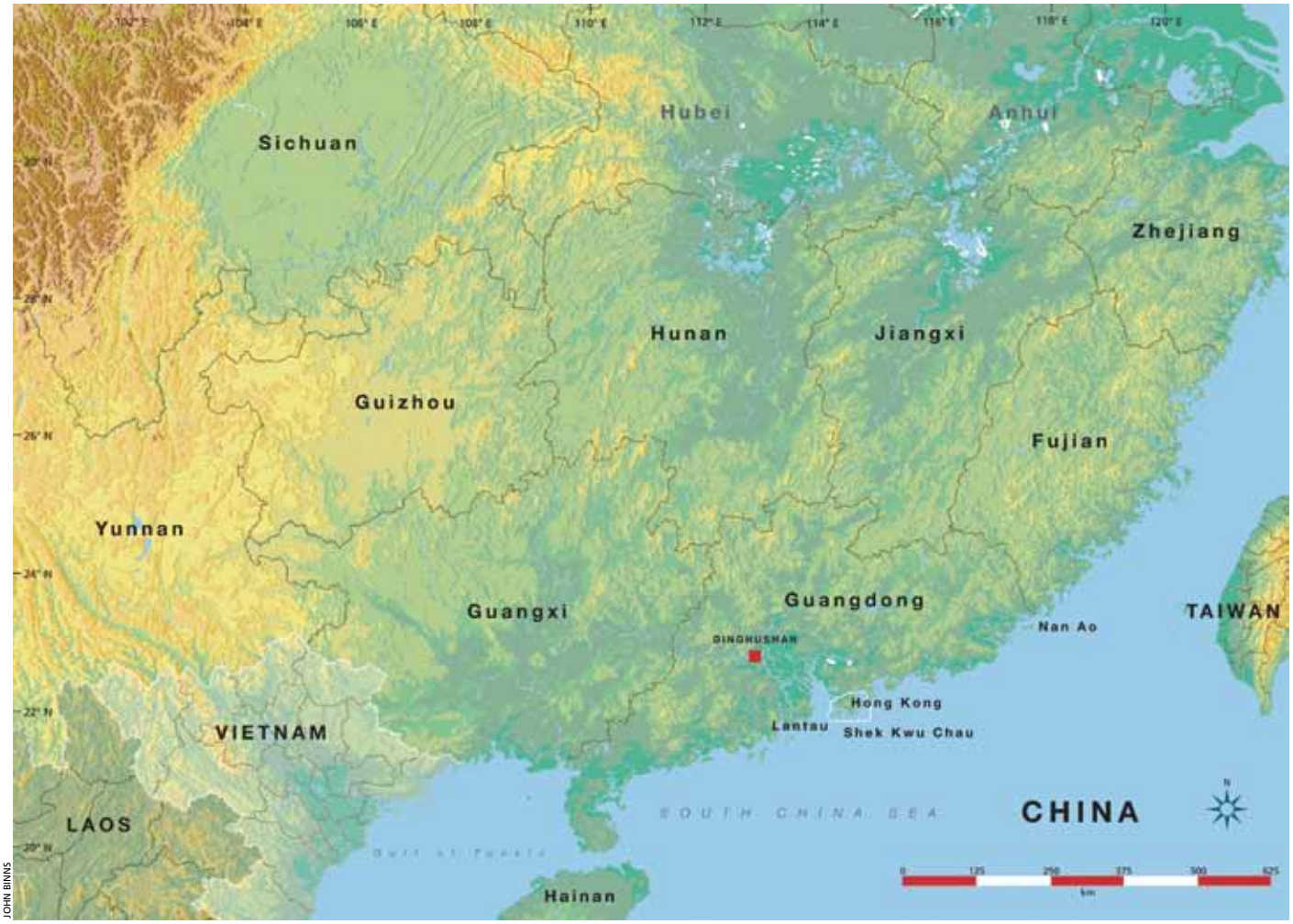
摘要

鼎湖山是中国大陆北回归线上唯一具广袤原生森林的季风雨林自然保护区。我们在此列出了自1886年以来跨越3个世纪的有关鼎湖山的两栖类和爬行类的名录及其生活史记录。至今为止鼎湖山共记录71种两栖爬行动物，这一数目远远超过由经典岛屿生物地理理论预测的种数。其中9种为新记录，含5种蛙类（华南湍蛙*Amolops ricketti*、长趾纤蛙*Hylarana macrodactyla*、台北纤蛙*Hylarana taipehensis*、花臭蛙*Odorrana schmackeri*、尖舌浮蛙*Occidozyga lima*）和4种蛇类（紫棕小头蛇*Oligodon cinereus*、乌华游蛇*Sinonatrix percarinata*、丽纹蛇*Sinomicrurus macclellandi*、福建竹叶青*Trimeresurus stejnegeri*。另有一未定种蜥蜴较为特殊，其分类特征介于滑蜥属*Scincella*和蜓蜥属*Sphenomorphus*之间。21个种类已多年未见，但多数是与原生森林无密切关系的种类。自然保护区自1956年建立至今，经过50余年的保护，使森林恢复及农田缩减，这也许是这些与原生森林无密切关系的种类种群数量减少的原因。鼎湖山97%的种类仅分布于东洋界，其中78%（55种）见于东洋界的华南和华中地区，21%（15种）仅见于华南地区，1%（1种）为以前仅在华中地区有报道的种类。鼎湖山独特的地理位置对其今后的全球性合作研究及长期的两栖爬行动物区系与多样性监测都具重要价值。

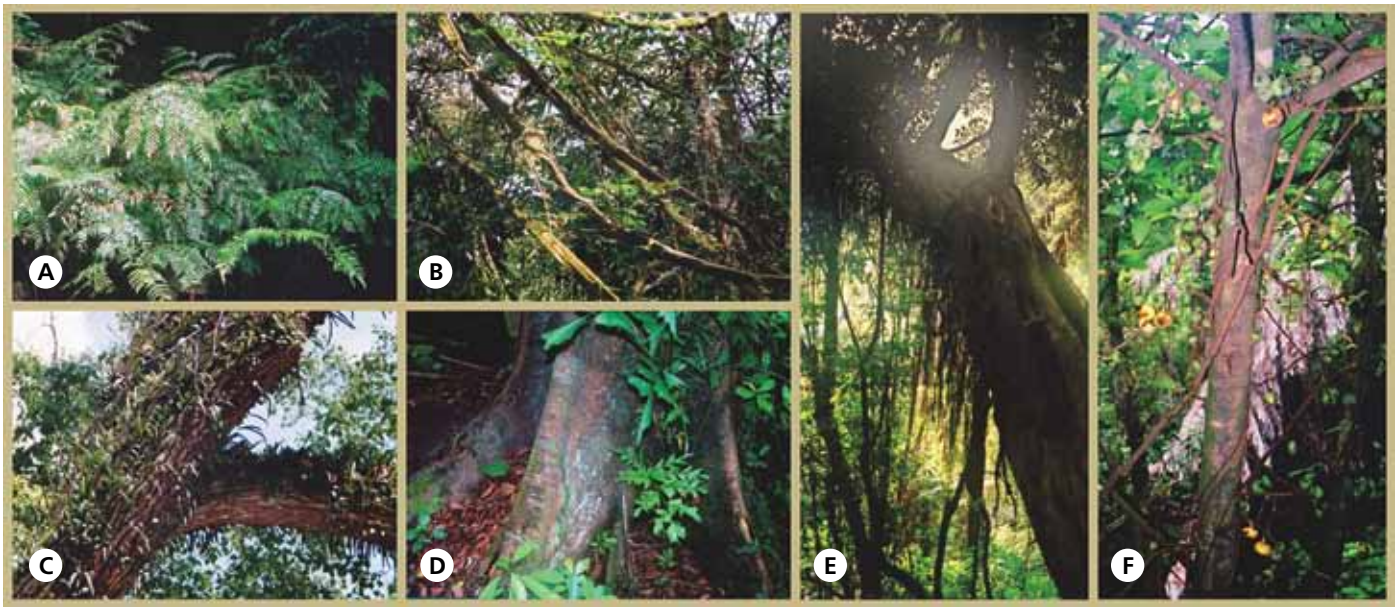
Introduction

Dinghushan is a tropical treasure of extreme conservation and biogeographic importance. The reserve is located in central Guangdong Province, China, at 23°09'21" to 23°11'30"N, 112°30'39" to 112°33'41"E, on the Tropic of Cancer. It is a remnant of old growth monsoonal hardwood forest, whereas most of the world at the same latitude is either desert or ocean. At present the reserve is administered by the City of Zhaoqing in Gaoyao County. According to historical records, Dinghushan became a center of monastic activity during the Tang Dynasty, about two thousand years ago (Kong et al. 1993). The Baiyun Temple, in the heart of today's reserve, dates from this time. The Qingyun Temple, near the reserve entrance, was built during the Ming Dynasty (1633 AD). For religious reasons, the forest surrounding both temples was regarded as sacred; the area has thus had some measure of protection for almost 400 years. For several years after 1949, the area was managed as a national forest, entailing both timber extraction and plantation. In 1956, Dinghushan was designated the first national nature reserve in modern Chinese history. This provided protection for much of the forest, more management, and scientific research. The primary forest is characterized as monsoonal evergreen broadleaf hardwood, with a forest canopy at about 20 m, and some 1,843 recorded wild species of vascular plants (Kong et al. 1993). The forest is rich in tropical species, diverse in relict species of ancient origin, and has a high proportion (50%) of woody species (Wang et al. 1982). Natural populations include tree ferns and cycads. Woody vines, such as *Mucuna birdwoodiana* and *Gnetum montanum*, are abundant and characteristic of tropical rain forests. Parasitic plants, stranglers, buttress roots, and trunk-flowering trees are phenomenal. At present, the reserve includes 1,133 ha (11 km^2). A quarter century ago, this was 272 ha of primary natural forest, 397 ha of former tree plantation, 193 ha of mixed pine and hardwood secondary growth, and 271 ha of succeeding shrubland and meadow (Chen et al. 1982, Wang et al. 1982). Today, succession has proceeded dramatically and almost all of the reserve is in evergreen forest.

Dinghushan's forest is a remnant of the once vast Asian forest corridor that formed the only such continuous band uniting equatorial rainforest with boreal forest and taiga on Earth (Lazell 1987, 2002). It is unique among all such remnants in combining a position intermediate between tropical and subtropical zones with a monsoonal climatic regime. These characteristics in combination with its relatively well-protected status have attracted the attention of researchers worldwide. In 1979, Dinghushan became a United Nations' Man and Biosphere (MAB) Reserve and thus an international base of collaborative ecosystem research (Kong et al. 1993). Nevertheless, Dinghushan today is an island in a sea of deforesta-



Map of the southern provinces of China and four islands with herpetofaunas that are compared with that of Dinghushan in the text. The square marks the location of Dinghushan. Bar (lower right) = 100 km.



Characteristics of the subtropical monsoonal evergreen hardwood forest at Dinghushan Nature Reserve: Natural populations of tree ferns (a), woody vines (b), parasitic plants (c), buttress roots (d), stranglers (e), and trunk-flowering trees (f). Photos a and d–f by Xiao Zhi; b and c by Liu Shao-Rong.

tion, agriculture, and suburban development. The recorded number of amphibian and reptilian species now stands at 71. Of these 71 species, records of nine (13%) have never previously been published, despite the fact that some of them have been known for over four decades. Of these 71 species, 21 (30%) have apparently vanished. Consequently, this report is long overdue.

The massif of Dinghushan is largely Devonian (Paleozoic) marine sandstone and shale strata with some granitic intrusions (Wu et al. 1982, He et al. 1982). Three main ridges rise roughly southeast to northwest and run from lowland less than 30 m above sea level to heights of 491 m at *Sanbao Feng* (Three Treasures Peak — Dinghushan proper), high point of the southern ridge, and 1,003 m at *Jilong Shan* (Chicken Coop Mountain) in the northwest, the highest point of the massif. The ten highest peaks average 450–600 m. Consequently, two major valleys drain to the southeast. Slopes are typically 30-40° and many cliffs and hanging valleys are festooned with permanent waterfalls. The northern stream combines brooks from the Heavenly Lake (*Tian Hu*) and the Swan Lake (*Tiane Tan*), passes the Grassy Pond (*Chao Tang*), and forms Dinghu Lake and the Splashing Water Pool (*Feishui Tan*) — favorite sites for tourists. The western stream forms Old Dragon Pool (*Laolong Tan*) in the core reserve area closed to the public. The two streams meet at the Geological Bureau Retreat, a major landmark outside the Reserve. The combined flow enters the West River (*Xi Jiang*), which flows into the Pearl River (*Zhu Jiang*). Marshes and some cultivated rice paddies are in the valleys. A small area of alpine meadow is found above 980 m only on *Jilong Shan*. Outside the primary forest, soils are generally red to yellow and acidic with pH 4.1–5.0; in the forest, soils are more acidic, but acidity diminishes with elevation (He et al. 1982).

Seasonality is pronounced (Huang and Shen 1982, Kong et al. 1993). The summers are hot and rainy, averaging 28 °C and attaining 36.8 °C in July. The winters are cool and dry, with a January average of 12.6 °C and a record low of –0.2 °C; frost has not been recorded. Rainfall (measured at MAB headquarters, elevation ~30 m) averages 1,927 mm per year, with a record of 2,278 mm. About 80% of rain falls in April–September; relative humidity in summer averages 85%, but drops to 70% in November and December.

Striking changes characterize Dinghushan in the past quarter century. The introduction of natural gas in the adjacent village of *Dinghu* (now a small city) has relieved the woodlands from supplying cooking fuel, resulting in a concomitant burst of regrowth of woody vegetation in the shrub and secondary growth zones. On the other hand, expanding human population pressure and the demand for certain species for food and traditional medicine have apparently eliminated a suite of edible species. Several highly touted features of island biogeography seem evident now with the herpetofauna at Dinghushan: Faunal "relaxation" (species loss) since isolation, species turnover, and perhaps an approach to equilibrium. Whether these apparent factors truly explain the current herpetofauna or are artifacts is addressed after the species accounts.

Herpetofaunal Background and Methods

Although locally Dinghu and Dinghushan are used interchangeably, we use Dinghu for the immediate environment of the lowland town at the edge of the reserve and Dinghushan for the upland region. To the greatest extent possible, we have relied on hand-caught specimens preserved and accessioned into university or museum collections. We also have included written records, both published and as catalogue entries at institutions. Photographs with complete data and, rarely, personal testimonials have been accepted as evidence for the (at least former) presence of a species.

Scientific herpetological nomenclature is in a state of flux. For anuran amphibians we largely followed Fei et al. (2009), but we did adopt some subsequent innovations. For colubrine snakes, we have followed Burbrink and Lawson (2007). In addition to South China Normal University (SCNU), specimens also were examined or deposited at Chengdu Institute of Biology (CIB), Guangdong Institute of Entomology (GIE, which has a Department of Zoology; interestingly, perhaps a reflection of the relative importance of insect

pest management and wildlife conservation in historic perspective), and the Museum of Comparative Zoology, Harvard University (MCZ). Species are listed alphabetically within families as in Karsen et al. (1998).

Formal description of Dinghushan's herpetofauna began with Oskar Boettger's (1886) diagnosis of the Waterside Skink (*Tropidophorus sinicus*). Rupert Mell (1922, 1933) actually collected at Dinghushan (as *Dingwu*), added five species, and described habitats. While Clifford Pope (1935) never visited the site, his book provided an excellent summary of what was known at that time (as *Tinghu* or *Tinghushan*). For those species Pope (1935) listed but for which we lack voucher specimens, we checked the databases of both the American Museum of Natural History and the Field Museum of Natural History. We found no specimen records for these species from Dinghushan (or Guangdong Province) in either. Pope (1935) did not list the specimen repositories for his records.

Global and national events distracted from field biological investigations until the period 1956–1985, when periodic collecting was conducted by field teams from Zhongshan (Sun Yat Sen) University, The Conservation Agency (TCA), SCNU, and GIE. These were summarized by Zhou et al. (1962a, b, c; 1981), who tallied a total of 38 species, but overlooked Boettger's (1886) Waterside Skink, Mell's (1922) Bamboo Viper (*Trimeresurus albolabris*), and Pope's (1935) Chinese Gecko (*Gekko chinensis*). Amazingly, the former two of these three species, both common in the Hong Kong region (Karsen et al. 1998), have never been seen again at Dinghushan. Those specimens from this era deposited at Zhongshan University have all lost their data; labels fell off jars and tags faded to illegibility. Lazell and his TCA teams began systematic surveys during 1982–1995 and returned in July and September 2006 and July 2009 with teams from SCNU, especially to attempt solving some of the reserve's herpetological mysteries and obtain voucher specimens of species reported only as observed. Lazell and Liao (1986) added 10 species to the lists of Zhou et al. (1962a, b, c; 1981), one already recorded by Pope (1935), but missed by them (*Gekko chinensis*), and another misidentified as "*Leiolopisma reevesii*" (see *Scincella* cf. *rupicola*). Lazell (1988) summarized herpetological knowledge at that time. We recorded 19 species and vouchers were obtained for four of the previous sight records in 2006.

Species Accounts

As of 2009 there have been records of 71 species (Table 1). We summarize below habitat, deposition of voucher specimens, and reproductive data if known from Dinghushan. The conservation status at national level (Wang and Zhao 1998) is given first, when relevant, followed by local status. The Chinese language species accounts below do not repeat status, specimen data, and citations provided in the English accounts. They instead provide identifying characteristics and general life history information of direct use to field workers, with specific information on feeding preferences of frogs from Su (1985) and lizards and snakes from Karsen et al. (1998).

1. **Yellow-striped Caecilian** 版纳鱼螈 (*Ichthyophis bannanicus*). Endangered. This is a fossorial, nocturnal species of lowland monsoon forest in riparian habitats. It sometimes travels on the surface, especially at night and during rains. It feeds on earthworms (Wang and Zhao 1998). Eggs are laid in burrows in streams in April and May. Qin (1985) recorded the first specimen from Dinghushan (as *I. glutinosus*), collected 26 February 1978 by Zheng Ci-Yin near the original guesthouse. The specimen was deposited at Jinan University but has apparently been lost. Lazell and Liao (1986) were unaware of this record. Five more Dinghushan observations occurred between 28 April and 31 May 1984–7, all from between MAB headquarters and the power station, at 30–40 m. Vouchers are MCZ 107901 and 112771. This species is widespread in tropical China, reported from the far west of Yunnan Province east to Fujian Province (Fei et al. 2005), but the range is discontinuous. We suggest the taxonomic status of the widely disjunct populations may be worthy of investigation. 无四肢，蠕虫状；成体领褶的第1颈沟离口角较远，为吻端至口间距2/5；第2颈沟从头背看不到其两端；两眼间处的宽大于吻眼间距。冬季气温降至15° 以下进入冬眠，次春气温回暖维持在 20°以上后出来活动。在广东4-5月于溪边作穴产卵。穴居，昼伏夜出。成体主要捕食蚯蚓。生活在鼎湖山海拔较低的林区山溪旁边。

2. **Asian Common Toad** 黑眶蟾蜍 (*Bufo melanostictus*). This is a widespread and abundant species of shrubland, farmland, villages, and forest edges. Breeding commences with the first warm rains of spring and extends into summer. More or less continuous records are available from 1983 to the present, with metamorphs (≤ 8 mm SVL) recorded 23 May 1984–10 May 1986. In mid-July 2006, juveniles were abundant around MAB headquarters and the botanical garden. On 16 July, we measured 10 in this area, 2.5–3.6 cm SVL (average 3.1 cm). These data accord well with this species' ontography at Hong Kong (Lazell 2002). The largest size record for this species is from Hainan Island, 11.5 cm SVL (Lu and Qing 2009). 具耳后腺；鼓膜明显；由吻端至眼后角上方、鼓膜的上缘有黑色骨质棱。在广东3月初春水初成，即行产卵。昼夜活动，捕食多种昆虫，食量大，其中有害昆虫占食物总量的70%以上。在鼎湖山主要分布在林区的灌丛、耕作区、林缘及村落周围。

3. **Chinese Green Treefrog** 华南雨蛙 (*Hyla simplex*). This species is apparently rare, but found in disturbed as well as forested habitats. It is a member of a suite of species showing classical Grayian distribution (*sensu* Lazell and Lu 2000, 2003), with members in both southeastern Asia and southeastern North America — like alligators and magnolias. Adults have been collected as low as the original guesthouse (~35 m; MCZ 113183) and as high as the tea garden (~230 m; MCZ 109527). Metamorphs were found at the latter locality on 28 April 1987. 体背深绿色；体侧和前后肢均无黑斑；指、趾端具吸盘；胫长于足。在广东4月中旬开始产卵。以捕食鳞翅目、鞘翅目、半翅目、直翅目等农林害虫为主。在鼎湖山多夜间活动于近水的草灌丛及林缘。

4. **Cascade Frog** 华南湍蛙 (*Amolops ricketti*). Status uncertain, vanished. Although well within the species' range, and apparently providing ideal habitat, Dinghushan lacks voucher specimens or a published record. Ideal habitat consists of small cascading streams, which are plentiful at Dinghushan, and where we have searched diligently. The sole basis for its inclusion here is a catalog entry at GIE for two specimens dated 25 October 1969. 体扁，有犁骨齿；鼓膜小；指、趾均有吸盘和横沟，背面有横凹痕，腹面呈肉垫状。在广东沿海5月产卵。以水生昆虫为食。栖息于鼎湖山大小山溪急流或瀑布下，多见于黄昏及夜间活动。此蛙匿于石块下，不易发现。

5. **Paddy Frog** 泽陆蛙 (*Fejervarya multistriata*). This abundant farmland species (formerly *Rana limnocharis*) occurs well up into the foothills in shrubland and even forest. Typically cryptic, hiding under objects by day, males call semi-submerged in open, still water at night. Breeding is centered on May, but can take place in most months. This species was common around the botanical garden in mid-July 2006. Specimens are in all of the collections that we checked, including MCZ 100571, collected 10 January 1982. 吻尖钝，上、下颌缘有6-8条深纵纹；无背侧褶，体背纵肤褶长短不一；无跗褶，趾端无横沟。在广东5月是繁殖盛期。以捕食昆虫为主，食性广，食物种类达80种以上，捕食有害昆虫达78%。从鼎湖山耕作区到低山、丘陵的林地、灌丛都有分布。

6. **Chinese Bullfrog** 虎纹蛙 (*Hoplobatrachus rugulosus*). Legally protected. Formerly widespread and abundant in marshlands and rice paddies, this species has been widely reduced to rarity because it is considered a delicacy. This species is farmed in some parts of Guangdong. It prefers larger and more permanent bodies of water than the Paddy Frog. Within

the reserve, we recorded breeding choruses at *Chao Tang* (Grassy Pond) during 4 April–24 May 1984. On 17 July 2006, we encountered many juveniles active in the rain between the botanical garden and Dinghu Lake. Four measured 3.6–4.2 cm SVL (average 3.9 cm). Vouchers are at GIE. 体大，皮肤粗糙，体侧有深色斑纹；无背侧褶，体背有许多长短不一的纵肤褶；下颌前部齿状突显著；趾端无横沟，趾间全蹼，无外跖突。在鼎湖山4月下旬可听到求偶鸣叫声。以捕食鞘翅目、鳞翅目昆虫为主，也捕食其他农林害虫，捕食害虫率达72%。生活在鼎湖山的池沼、湿地及水田中，白昼匿居。虎纹蛙数量在野外已明显减少，政府已立法禁捕野生个体，广东等地已被大量人工繁养。

7. **Musical Frog** 弹琴蛙 (*Hylarana adenopleura*). Status uncertain. This is a species of riparian habitats in forest. Zhou et al. (1981) listed it and LZC records it within the Dinghushan reserve from the 1960s to the present, but no voucher specimens are available. LZC and Peter Lynch of GATP examined and released one in the core area on 8 July 1997. Females can lay 100–350 eggs (Liu and Hu 1961). 头长、宽几相等；指、趾端稍膨大，末端有横沟；背侧褶较宽；雄性有肩上腺，具1对咽侧下外声囊。产卵期及食性不详。分布在鼎湖山保护区内近山溪的潮湿林地。

8. **Gunther's Frog** 沼水蛙 (*Hylarana guentheri*). This widespread and abundant species occurs from farmland and foothills well into the forest. Breeding begins early, typically in late March, and continues through the warmer months. On 19 July 2006, dozens were calling around Heavenly Lake (*Tian Hu*) at midday in the sunshine. It climbs well. On 2 April 1984, JDL and his TCA team encountered one 3 m above the forest floor perched on a tree fern frond. Specimens are in all collections, including MCZ 100560 and 107382. Females can lay up to 1,000 eggs (Liu and Hu 1961). 头长大于头宽；背侧褶明显；指、趾端钝圆，不膨大；趾末端具横沟。雄蛙上臂基部有1肾形肱腺，具1对咽侧下外声囊。在广东3月气温回升即进入繁殖期。全肉食性，以捕食农林害虫为主，食物种类达24种以上。分布在鼎湖山低山丘陵、池沼及耕作区。

9. **Three-striped Grass Frog** 长趾纤蛙 (*Hylarana macrodactyla*). Status uncertain, vanished. This species is widespread in South China; the pond and marsh habitats in the Dinghushan lowlands should provide excellent habitat. However, we have not encountered it. The sole voucher specimen is GIE 117 from Dinghu, dated 29 October 1965, and no record was previously published. Breeding begins mid to late May; these frogs prefer grassy and weed-choked marshes to open water, and breed with the rains. 体背绿色或浅棕色，具背侧褶，体背面有4-5条浅黄色纵线纹，间有黑斑；指、趾端具横沟；指关节下瘤大而明显；后肢纤细而长，胫跗关节前伸超过吻端，左右跟部重叠颇多。在广东5月中下旬进入繁殖期。食物中直翅目昆虫占67%。在鼎湖山见于大山溪两旁的灌丛中；喜生活在低洼的湿草地及山坡的湿草丛中，尤喜在水田耕作区及空旷的荒田中，已极为少见。


LI ZHEN-CHANG (GUANGDONG)

1. Yellow-striped Caecilian 版纳鱼螈
(*Ichthyophis bannanicus*)


LI ZHEN-CHANG (GUANGDONG)

2. Asian Common Toad 黑眶蟾蜍
(*Bufo melanostictus*)


LI ZHEN-CHANG (GUANGDONG)

3. Chinese Green Treefrog 华南雨蛙
(*Hyla simplex*)


LI ZHEN-CHANG (GUANGDONG)

4. Cascade Frog 华南湍蛙
(*Amolops ricketti*)


HOU MIAN (GUANGDONG)

5. Paddy Frog 泽陆蛙
(*Fejervarya multistriata*)


LI ZHEN-CHANG (GUANGDONG)

6. Chinese Bullfrog 虎纹蛙
(*Hoplobatrachus rugulosus*)


LI ZHEN-CHANG (GUANGDONG)

7. Musical Frog 弹琴蛙
(*Hylarana adenopleura*)


LI ZHEN-CHANG (GUANGDONG)

8. Gunther's Frog 沼水蛙
(*Hylarana guentheri*)


LI ZHEN-CHANG (GUANGDONG)

9. Three-striped Grass Frog 长趾纤蛙
(*Hylarana macrodactyla*)

Each photo credit also lists in parentheses the source of the animal in the photograph.

10. Two-striped Grass Frog 台北纤蛙 (*Hylarana taipehensis*)

11. Rough-skinned Floating Frog 尖舌浮蛙 (*Occidozyga lima*)

12. Green Cascade Frog 大绿臭蛙 (*Odorrana chloronota*)

13. Schmacker's Stinking Frog 花臭蛙 (*Odorrana schmackeri*)

14. Lesser Spiny Frog 小棘蛙 (*Paa exilispinosa*)

15. Giant Spiny Frog 棘胸蛙 (*Paa spinosa*)

10. **Two-striped Grass Frog** 台北纤蛙 (*Hylarana taipehensis*). Locally scarce. This widespread species of marshland and rice paddies is unaccountably scarce at Dinghushan. JDL and his TCA team found two on a stream bank just inside the woods at *Chao Tang* (Grassy Pond) on 2 May 1984, but failed to catch one. SCNU has a voucher specimen. Breeding begins in April and May; Karsen et al. (1998) reported tadpoles in May at Hong Kong. 体细长，体背绿色，背侧褶金黄色，股后方有2-3条纵纹；指、趾末端稍膨大成吸盘状；后肢贴体前伸胫跗关节可达鼻眼之间。在广东4-5月产卵。以昆虫为食。喜在鼎湖山周边和区内的水田等湿草地昼夜活动。

11. **Rough-skinned Floating Frog** 尖舌浮蛙 (*Occidozyga lima*). Status uncertain, vanished. This is a species of open-water ponds and permanent wetlands in the lowlands. It has declined dramatically in places like Hong Kong (Karsen et al. 1998) due to habitat loss. Suitable habitat persists around Dinghu, but none of us has yet encountered this species. Breeding coincides with the monsoonal rains. Two of the three specimens from Dinghu at GIE (J005 for both) are dated 3 August 1966; J006 is dated 25 October 1965. 体小，肥硕，体背布满刺疣；口小，舌较狭长，后端尖；无犁骨齿；趾间满蹼；股后方有棕色条纹。在鼎湖山地区4月中旬到6月为繁殖期。以捕食膜翅目昆虫为主。分布在鼎湖山周边和区内的水田等湿地中，已极为少见。

12. **Green Cascade Frog** 大绿臭蛙 (*Odorrana chloronota*). Common. Dinghushan provides ideal habitat for this species along streams in the uplands. Females are much larger than males. This species was the subject of a population study at *Feishui Tan* that estimated a population density of ~123/ha at that site 20 years ago (Lazell et al. 1988; as *Rana livida*; see Che et al. 2007); but that assessment needs to be repeated. Adults typically are perched conspicuously on rocks along streams at night. They produce a noxious, smelly skin secretion said to be toxic to at least other frogs (Karsen et al. 1998). Voucher specimens are MCZ 107898–107900. LZC captured and examined a male found streamside in the core area at 300 m on 30 June 1996; the specimen was released. 体较扁；具背侧褶；活体背纯绿色；指、趾端有吸盘及横沟，趾间全蹼。雄蛙具1对咽侧下外声囊。雌雄个体差异甚为显著，雄蛙小，雌蛙大。在广东5月进入产卵期。食物中鞘翅目昆虫可占67%，有害昆虫可占84%。晚上活动为主。分布在鼎湖山保护区核心区山溪旁。

13. **Schmacker's Stinking Frog** 花臭蛙 (*Odorrana schmackeri*). Status uncertain. This is a stream-dwelling species of forested areas. Females are much larger than males. LZC captured and examined a female found streamside in the core area on 10 July 1997, but the specimen was released. Females can lay up to 1,000 eggs (Liu and Hu 1961). 体侧扁，无背侧褶；体背绿色，间以棕色大斑；指、趾端有吸盘及横沟，趾间全蹼。雄蛙有1对咽侧下外声囊。雌雄个体差异显著，雌蛙大，雄蛙小。在广东5-7月为繁殖期。以昆虫为食，其中直翅目昆虫可占食物总量的70%。白天匿居，夜间活动。生活在鼎湖山林区的山溪或潮湿的溪边。

14. **Lesser Spiny Frog** 小棘蛙 (*Paa exilispinosa*). Status uncertain. This is a species of permanent water in upland streams in forested habitats, but it can occur as low as sealevel. Lau (1996) recorded this species at Dinghushan, and LZC has examined specimens in the field. However, no voucher specimens exist. Museum specimens of its close relative, *P. spinosa* (below) have been rechecked and are not this species. 体形肥硕；趾端无横沟；皮肤粗糙，无背侧褶；雄蛙前肢粗状，仅胸部有刺，但不分成2团。第4趾缺刻较深，其余满蹼。此蛙最大不超过80 mm。在广东4月中下旬开始产卵。主要捕食昆虫。生活在鼎湖山林区山溪附近。

15. **Giant Spiny Frog** 棘胸蛙 (*Paa spinosa*). Vulnerable. This species was formerly common in the steams within the forested core area of the reserve. It is sought for human food. A female (8.5 cm SVL) was attacked by a Diamond-back Water Snake (see species 63) on 2 June 1984 in a stream in the forest, at an elevation of ~230 m, and died of apparent envenomation (MCZ 107897). Specimens were regularly captured between that incident and 28 April 1987. All were checked for diagnostic characters and all fit this species, not *P. exilispinosa*, including a second voucher (MCZ 115325). LZC heard calling and examined one specimen in the core area on 30 June 1996, but the specimen was released. 体大肥硕；体背有长短不一的窄长疣；趾末端无横沟。雄蛙前肢粗短，仅胸部长有黑刺疣。在广东5月进入繁殖期。主要捕食直翅目、鞘翅目、鳞翅目昆虫，食物种类达64种。喜在山溪中生活。棘胸蛙一直以来被大量捕食，在鼎湖山已少见。

16. **Chaochiao Wood Frog** 昭觉林蛙 (*Rana chaochiaoensis*). Status uncertain, vanished. This species (formerly *R. japonica*) was recorded regularly around artificial farm ponds and along streams in shrubland in the foothills. Readily found before the 1980s, it has not been seen recently. We have found no voucher specimen. Females can lay 900–1,500 eggs (Liu and Hu 1961). 颞部具三角形黑斑；背侧褶直，在鼓膜处不弯曲，自眼后直达胯部；雄蛙第1指婚垫分团隆起，上面具刺疣；无声囊。主要捕食昆虫。主要分布在鼎湖山保护区内的山溪灌丛旁，已极为少见。在广西3–8月产卵（Zhang and Wen 2000）。

17. **Dennys' Treefrog** 大树蛙 (*Rhacophorus dennysi*). Status uncertain. Xu (2001) reported this species from Dinghushan for the first time. This record and another reported from the same latitude in Guangdong Province (Chang et al. 1997) are the southernmost localities for this species. In April 2007, we made an effort to locate the published voucher but to no avail. 体大；鼓膜大而圆，犁骨齿列强；指、趾端均具吸盘和横沟；指间蹼发达，第3、4指间全蹼；趾间全蹼，第1、5趾游离缘有缘膜；体背绿色，有镶浅色纹的棕黄色或紫色斑点。在广东3月中旬产卵于田埂壁或水坑壁上，亦产于灌丛或树枝叶上。一般夜间活动。以捕食直翅目、鞘翅目、同翅目昆虫为主。

18. **Brown Treefrog** 斑腿树蛙 (*Rhacophorus megacephalus*; also known as *Polypedates leucomystax* and combinations of those four names). An abundant species in natural and disturbed habitats, these frogs can be found under dead leaves of standing banana trees even in the winter. These frogs can breed in almost any vessel of fresh water. JDL and his TCA team recorded eggs and tadpoles on 12 and 14 May 1984 and 1986. Individuals were encountered 16–19 July 2006 from the entrance area to Heavenly Lake (*Tian Hu*). Vouchers include those at SCNU, GIE, and MCZ 107902 and 113186. 体背有“X”形花纹；指间无蹼；指、趾末端均具吸盘，背面具“Y”形骨迹。雄蛙具1对咽侧下内声囊。在鼎湖山4-5月为繁殖期。捕食鞘翅目昆虫为主，也捕食直翅目、膜翅目、半翅目、同翅目等昆虫。在鼎湖山常见藏在芭蕉叶鞘内越冬。

19. **Spotted Narrow-mouthed Frog** 花细狭口蛙 (*Kalophrynus interlineatus*). Usually scarce, but in May of 1984 and July of 2006, we found this species extremely abundant. Pairs in amplexus were found 16 May, and chorusing was in full voice from MAB headquarters to as high as Heavenly Lake (300 m) until departure on 31 May. During 16–17 July 2006, large choruses were singing in the rain around the botanical garden. When handled, these frogs exude a gummy whitish fluid that they spread with their feet over their bodies; we assume this is toxic or at least distasteful, but we have not sampled it. Specimens bearing field tags Z-19738 and Z-19739 were deposited at GIE, but not found in 2004. Five vouchers from 2006 by QN and her SCNU team are CIB 084528–32. This species has been separated from *K. pleurostigma* by Matsui et al. (1997). 头高而小；吻较尖，无上颌齿；前肢细；后肢短，左右跟部不相遇；皮肤粗糙，全身满布疣粒；体背一般有4-8条黑色纵纹。在广州地区3月中旬天气转暖进入产卵期。主要捕食鞘翅目、直翅目、膜翅目昆虫。分布在鼎湖山低矮山地的林缘及湿草丛中。

20. **Asiatic Painted Frog** 花狭口蛙 (*Kaloula pulchra*). This abundant species is largely fossorial and breeds in ditches and storm sewers in Dinghu, farmland, and tree plantations. It can climb well and sometimes forages well off the ground at night. Heavy rain triggers breeding from March through at least May. Males make their bellowing calls from under cover, such as in drain pipes, leading to the vernacular name “underground ox.” Disturbed individuals secrete a glue-like fluid. Vouchers are at SCNU. 体大，头宽吻短，吻端平直；体背有“/\”形斑；指末端宽阔，前缘平整，呈“▽”；趾基有蹼。在广州地区3月下旬至5月繁殖期间，叫声如牛。大雨过后产卵于水潭中，繁殖期后极少发现成蛙。嗜食蚁类，也捕食其他昆虫和其他节肢动物。在鼎湖山的平原耕作区、人工林及灌丛内都有分布，穴居。

21. **Heymons' Pigmy Frog** 小弧斑姬蛙 (*Microhyla heymonsi*). Status uncertain, but apparently rare. A single specimen was collected along a stream in the core primary forest on 26 September 1995 by Lau (1996), and is in the collection of Kadoorie Farm and Botanical Garden, Hong Kong (Fellowes et al. 2002). Habitat and behavior at Dinghushan remain little-known. 体小，头呈三角形；体背和腹面皮肤光滑；体背面有小纵沟，具脊线；脊线上有1-2个黑色小弧形斑。在广东5月繁殖季节才容易见到。捕食膜翅目、鞘翅目、等翅目、鳞翅目等昆虫。生活在鼎湖山林区山溪旁。

22. **Ornate Pigmy Frog** 饰纹姬蛙 (*Microhyla ornata*). Very common at lower elevations (to ~100 m), but known to occur to elevations as high as 750 m (Karsen et al. 1998). This small frog frequently breeds in roadside ditches, beginning in March and throughout the monsoon season. It lays


XIAO ZHI (GUANGDONG)

16. Chaochiao Wood Frog 昭觉林蛙 (*Rana chaochiaoensis*)


HOU MIAN (GUANGDONG MARKET)

17. Dennys' Treefrog 大树蛙 (*Rhacophorus dennysi*)


LI ZHEN-CHANG (GUANGDONG)

18. Brown Treefrog 斑腿树蛙 (*Rhacophorus megacephalus*)


LI ZHEN-CHANG (GUANGDONG)

19. Spotted Narrow-mouthed Frog 花细狭口蛙 (*Kalophrynus interlineatus*)


LI ZHEN-CHANG (GUANGDONG)

20. Asiatic Painted Frog 花狭口蛙 (*Kaloula pulchra*)


LI ZHEN-CHANG (GUANGDONG)

21. Heymons' Pigmy Frog 小弧斑姬蛙 (*Microhyla heymonsi*)

22. Ornate Pigmy Frog 饰纹姬蛙
(*Microhyla ornata*)

23. Marbled Pigmy Frog 花姬蛙
(*Microhyla pulchra*)

24 Big-headed Terrapin 大头平胸龟
(*Platysternon megacephalum*)

25a. Black-necked Terrapin 黑颈拟水龟
(*Chinemys nigricans*)

25b. Black-necked Terrapin 黑颈拟水龟
(*Chinemys nigricans*)

26. Three-banded Box Terrapin 三线闭壳龟
(*Cuora trifasciata*)

27 Chinese Soft-shelled Turtle 中华鳖
(*Pelodiscus sinensis*)

28. Chinese Gecko 中国壁虎
(*Gekko chinensis*)

29. Bowring's Gecko 原尾蜥虎
(*Hemidactylus bowringi*)

floating eggs. Vouchers are at SCNU. 体小，头短小，呈三角形，吻端钝尖；鼓膜不显；体背有不相套叠的“∧”形斑，第1个起自两眼间；掌突2个；指、趾端圆；趾间仅具蹼迹。广州地区从3月下旬至6月为产卵期。捕食膜翅目、鞘翅目、等翅目、鳞翅目等昆虫。在鼎湖山海拔30-100 m的潮湿的草丛和山路旁常可见到。

23. **Marbled Pigmy Frog** 花姬蛙 (*Microhyla pulchra*). Less common and usually much larger than its relative *M. ornata*, this frog utilizes the same habitats and similarly begins breeding in late March and continues through the rainy season. It also lays floating eggs. Two individuals at the botanical garden on 16 July 2006 measured 1.6 and 3.0 cm SVL. A voucher from the aqueduct above the original guesthouse (elevation ~40 m) is MCZ 112769. 体小，头呈三角形，吻尖钝；体背颜色鲜艳，土黄色或棕黄色，嵌有相互套叠的若干“∧”形斑；指端圆；趾间半蹼。在广东3月下旬进入繁殖期。主要捕食膜翅目、鞘翅目、半翅目昆虫。生活环境与饰纹姬蛙相同。

24. **Big-headed Terrapin** 大头平胸龟 (*Platysternon megacephalum*). Endangered, locally vanished. This stream-dwelling turtle was formerly abundant, but has been hunted to rarity even within the reserve, where the last individual was seen in the 1960s. With stringent law enforcement, it might begin to recover. It is carnivorous and defends itself by snapping. It prefers permanent streams but sometimes will travel overland, presumably from one drainage to another. The first record at Dinghushan was in Mell (1922). No voucher specimens exist. 头大、尾长、都不能宿入壳内，体扁；喙强，上喙钩曲，呈鹰嘴状；具下缘盾。在广东5-7月为产卵期。肉食性。生活在鼎湖山林区山溪中。原为广东的广布种，由于人为大量捕猎，已极为少现。

25. **Black-necked Terrapin** 黑颈拟水龟 (*Chinemys nigricans*). Endangered, locally vanished. Without a specimen, the status of this record is undetermined; what was called *C. nigricans* a decade or two ago has now been fragmented. In any case, the species is almost certainly extirpated at Dinghushan. This is a pond and stream turtle highly sought for food even within the reserve, where the last individual was recorded in the 1960s in natural woodland. The first record for Dinghushan was in Mell (1922). No vouchers are known. 体型较大，吻略突出上缘，向内下侧斜切；甲桥宽，棕褐色或褐色，与腹甲颜色不同；背甲具纵棱，但无侧棱。生活于林区山溪中。杂食性。由于人为大量捕猎，已极为少见。广东市场偶见有售。

26. **Three-banded Box Terrapin** 三线闭壳龟 (*Cuora trifasciata*). Critically endangered, locally vanished. The primary habitat, well-preserved at Dinghushan, is riparian upland woodland. This species is the most highly sought after Chinese turtle because it is believed to enhance longevity. Old, wild individuals are believed to be the best; therefore even successful farming does little to relieve the pressure on wild populations. On 31 May 1984, JDL and his TCA team caught and released one at *Chao Tang* that was photographed by Martin Michener. Those four photographs (MCZ K-965–8) constitute the only voucher. This species has not been

recorded at Dinghushan since, but was listed by most authors beginning with Mell (1922). 背甲与腹甲、胸盾与腹盾由韧带相连，腹甲前、后叶可动，与背甲闭合；头背光滑，黄色；背甲棕色，有3条黑色纵棱；腹甲黑色，边缘近黄色。在广东5月下旬至8月上旬产卵，雌龟性成熟需6-7年，雄龟需4-5年。在人工孵化条件下，70天可孵出（Wu 1987）。杂食性，偏食肉。喜栖于山区林密的山涧溪流。由于人为大量捕猎，已极为少见。

27. **Chinese Soft-shelled Turtle** 中华鳖（*Pelodiscus sinensis*). Vulnerable, locally vanished. This is a species of ponds and large streams in low hills and agricultural areas. It was formerly common in the wild, but most populations today are farmed. The first published record for Dinghushan was in Zhou et al. (1981). We have seen no voucher specimen. 体色青灰色；体被柔软革质皮肤，无角质盾片；吻端有长的肉质吻突，与眼径等长；颈基两侧及背甲前缘均无明显的瘰粒或大疣；腹部散有7个腭胝体。在广东产卵期为4-8月（其中6-7月为产卵盛期）。肉食性。生活在鼎湖山的山塘、鱼池中，野外已极为少见。广东市场常见有售人工养殖个体。

28. **Chinese Gecko** 中国壁虎（*Gekko chinensis*). This common nocturnal species inhabits big trees in the forest and sometimes buildings; the latter especially if not occupied by humans. We have frequent records from the forest and the original guesthouse from 1983 through 1986, and from the botanical garden at MAB headquarters on 30 June 1996. Four adults in mid-July 2006 measuring 7.0–8.1 cm SVL (average 7.5 cm) were notably larger than those at Hong Kong (Karsen et al. 1998, Lazell 2002). Life history traits were described by Lazell (2002) for the Hong Kong region. A comparative study at Dinghushan would be most valuable. These geckos squeal and bite vigorously when captured. These and the other species of geckos in China and America are the subject of mitochondrial DNA investigations by QN and her students at SCNU. Vouchers include MCZ 170511, 174891, GIE Z-08972, and SCNU 39427-8 and 39434-5. 背部粒磷间有疣鳞10-14行；尾基部每侧肛疣1个；指、趾下瓣单行，指、趾间基部有蹼。雄性有肛前孔和股孔17-27个。在广州5月中旬可见产在树缝内的卵。捕捉小型昆虫为食。生活在鼎湖山林区大树上或建筑物中，晚上活动。

29. **Bowring's Gecko** 原尾蜥虎（*Hemidactylus bowringi*). This is the common nocturnal "house gecko" of South China. As the common name implies, it frequents buildings occupied by humans. In the Hong Kong region, this species matures in one year or less; females oviposit in the spring following their hatching (Lazell 2002). These geckos do not bite or squeal when captured. Voucher specimens are SCNU 39423–5 from the guesthouse. 体背粒鳞大小一致，其间有纵向断续的棕褐色斑纹；颏片2对，内侧1对比外侧1对大；指、趾下瓣双行，指、趾间蹼不发达，指、趾端具爪；尾近圆柱形。雄性的肛前孔及股孔在肛前被2-4片鳞分隔。在广东5-8月为繁殖期。常在鼎湖山保护区内的建筑物捕食灯光下的小昆虫。

30. **House Gecko** 疣尾蜥虎（*Hemidactylus frenatus*). Status uncertain anywhere in southern China, locally vanished. This nocturnal species was recorded for Dinghushan by Pope (1935) and a catalog entry at GIE dated 12 August 1966 seems to apply to it, but we have found no voucher specimen. *Hemidactylus frenatus* is probably introduced regionally because it turns up rarely, sporadically, and always in human dwellings (Karsen et al. 1998). 指、趾下瓣双行；尾稍扁，两侧无锯齿；体、尾背面粒鳞间散有稀疏较大疣鳞；尾鳞分节排列，节后缘有大而尖的疣鳞6枚。雄性肛前孔及股孔在肛前相遇。在广东5-6月为繁殖期。主要捕食蚊蝇等小型昆虫。喜生活在近鼎湖山林区及乡村的建筑物中，白天匿居，旁晚及夜间活动。

31. **Changeable Lizard** 变色树蜥（*Calotes versicolor*). This common species frequents stone walls, fences, tree plantations, and forest edges, especially in the lowlands. These lizards bask conspicuously in the sun. Colors change largely from lighter and greener to darker and grayer. We recorded it regularly from 10 January 1982 (MCZ 162843) through May 1986 (MCZ 174890), but rarely at elevations above 100 m. A heavily gravid female 9.6 cm SVL was collected 3 June 2006 (SCNU 0606031) and another was observed active in the rain on 16 July 2006 near the botanical garden. A probable young of the year measured 3.5 cm SVL on 9 September 2006; a subadult measured 7.2 cm SVL on 17 July 2009 (SCNU 26083). 头较大，头顶无对称大鳞；吻端钝圆，吻棱明显；鼓膜裸露；无肩褶；无眶后棘；背鬣发达；后肢贴体前伸最长趾端可达鼓膜；环体中段鳞少于52枚。在广东4月下旬至9月产卵。主要捕食昆虫。分布在鼎湖山的平原耕作区、人工林、灌丛及自然林内。

32. **Grass Lizard** 南草蜥（*Takydromus sexlineatus*). Locally scarce. This is a species of tall grass and low shrubs in farmland, tree plantations, and


LI ZHEN-CHANG (HONG KONG)

30. House Gecko 疣尾蜥虎
(*Hemidactylus frenatus*)


XIAO ZHI (GUANGDONG)

31. Changeable Lizard 变色树蜥
(*Calotes versicolor*)


LI ZHEN-CHANG (GUANGDONG)

32. Grass Lizard 南草蜥
(*Takydromus sexlineatus*)


HOU MIAN (GUANGDONG)

33. Chinese Forest Skink 光蜥
(*Ateuchosaurus chinensis*)


HOU MIAN (GUANGDONG MARKET)

34. Chinese Skink 中华石龙子
(*Plestiodon chinensis*)


LI ZHEN-CHANG (GUANGDONG)

35. Five-lined Blue-tailed Skink 蓝尾石龙子
(*Plestiodon elegans*)

36. Four-lined Blue-tailed Skink 四线石龙子 (*Plestiodon quadrilineatus*)

37. Reeves' Smooth Skink 南滑蜥 (*Scincella reevesi*)

38. "Unidentified" skink 拟滑蜥属新种 (*Scincella* cf. *rupicola*)

39. Thigh-shield Skink 股鳞蜓蜥 (*Sphenomorphus incognitus*)

40. Brown Forest Skink 铜蜓蜥 (*Sphenomorphus indicus*)

41. Chinese Waterside Skink 中国棱蜥 (*Tropidophorus sinicus*)

forest edges. It is swift and an agile climber, often using its prehensile tail. It was common into the 1980s around Dinghu. JDL and his TCA team recorded seeing three in May 1984, two in pine and eucalyptus plantations and one on the Baiyun Temple loop trail. Its recent scarcity probably reflects its popularity as food for cage birds. Oviposition is from May to July. No voucher specimen seems to have been collected until 19 July 2006, when LWH secured CIB 084023 at Heavenly Lake (*Tian Hu*) in bamboo thicket. 体型细长；眶上鳞3枚；下眼睑被细鳞；背鳞起棱大鳞4纵行；体侧被细鳞；腹部起棱大鳞10行；尾细长，约为体长3倍；鼠蹊窝1对。在广东5-7月产卵。主要捕食昆虫。生活在鼎湖山山地草丛或林下。

33. **Chinese Forest Skink** 光蜥 (*Ateuchosaurus chinensis*). Recently common. Remarkably, following Pope's (1935) mention, this species was not recorded again at Dinghushan until 1998 (Fellowes et al. 2002). Individuals have been seen regularly since then; 10 animals were recorded on 17–19 July 2006, far more than any other reptile. Four more were collected 15–18 July 2009. The escalation of *A. chinensis* abundance may directly reflect the cessation of forest litter consumption for human fuel. Of two females caught on 30 June 1996, one contained no ova (SCNU D966309), but the other contained eight (5 large and 3 small) in the right and six (3 large and 3 small) in the left oviduct (SCNU D9663010). Two adults collected 3 June 2006 measured 6.3 and 6.5 cm SVL, but were not dissected (SCNU 0606032–3). Of the 10 observed in July 2006, six adults measured 6.5–8.5 cm SVL (average 7.6 cm) and four juveniles measured 2.6–3.0 cm SVL (average 2.8 cm). Of a dozen measured and released on 8–9 September 2006, 10 were apparent young of the year, measuring 3.1–4.1 cm SVL (average 3.5 cm). The larger two were unremarkable at 6.3 and 7.7 cm SVL. The 17–18 July 2009 specimens were 6.7 and 4.3 cm SVL (SCNU 26082, 26084), respectively. On 15–16 July 2009, two juveniles, both 2.8 cm SVL (SCNU 26067 and 26070), were collected, also below Heavenly Lake. A life history study at Dinghushan comparable to that for Nan Ao Island off eastern Guangdong and the Hong Kong region (Lazell et al. 1999) would be most instructive. A voucher collected 17 July 2006 is CIB 084025. 体丰腴；下眼睑被鳞；无上鼻鳞；额鳞长，中部缢宿；四肢短小，前、后肢贴体相向距离较远，相隔约1个前肢长；无扩大的肛前鳞；环体中段鳞28-30行。在广东5-7月产卵。主要捕食昆虫及蚯蚓等。常可在鼎湖山保护区内落叶较多的石块、枯木下发现。

34. **Chinese Skink** 中华石龙子 (*Plestiodon chinensis*). These are large skinks, reaching about 13 cm SVL; they are golden brown with orange-red blotches as adults, but near-black with three light bright stripes and a blue tail as hatchlings. Formerly common in farmland around Dinghu and in open areas within the reserve, this species may have declined as succession has advanced. JDL and his TCA team observed a large adult that escaped by swimming at *Chao Tang* (Grassy Pond) on 12 May 1983, and individuals there and at the MAB headquarters fish pond on 19–20 May 1995. A catalog entry at GIE is dated 16 August 1966, but we have been unable to locate a voucher specimen. Zhou et al. (1981) listed it. 成体的头、体背面棕黄色或浅棕色，颈侧有红色；有上鼻鳞，无后鼻鳞；下眼睑被小鳞；后颏鳞2枚；背鳞平滑，环体中段鳞22行；尾下鳞正中1行鳞片宽大。在鼎湖山5-6月产卵。主要捕食昆虫。分布在鼎湖山平原耕作区、人工林及灌丛中。

35. **Five-lined Blue-tailed Skink** 蓝尾石龙子 (*Plestiodon elegans*). Status uncertain, vanished. These are small, near-black skinks with striking yellow stripes and bright blue tails. Although the core forest habitat appears perfect for this species, none of us has ever encountered it at Dinghushan. It is included here only on the basis of Pope's (1935) record. It is of considerable biogeographical interest because of its apparent Nearctic affiliations and disjunct distribution between interior upland China and some small islands in the South China Sea (Lazell 2004). 头、体背面黑色，有5条黄白色纵纹，正中1条在顶鳞处分叉向前达吻部；成体尾部依然保持蓝色；有上鼻鳞，无后鼻鳞；后颏鳞1枚；颈鳞1对；股后有1团大鳞。在广东连县大东山7-8月见到产卵。以捕食昆虫为主。在鼎湖山栖息于山区道旁的杂草丛中或乱石堆中，喜在向阳的山坡上活动。

36. **Four-lined Blue-tailed Skink** 四线石龙子 (*Plestiodon quadrilineatus*). This common species was regularly encountered from the vicinity of the original guesthouse (elevation ~35 m) to the top of *Sanbao Feng* (491 m; MCZ 170517) by JDL and his TCA team from June 1984 to May 1995. These skinks regularly bask, especially at higher elevations; they are rare in forests. A specimen collected 17 July 2006 is CIB 084772. Like its close relative, *P. elegans* (above), this species is of great biogeographical interest (Lazell 2002, 2004). Its life history parameters have been chronicled in the Hong Kong region (Lazell and Ota 2000) and a comparison to those in Dinghushan would be most interesting. 体背有4条黄白色纵纹；背中部2行鳞片大于相邻的体鳞；环体中段鳞20-22枚。据在鼎湖山

采到的幼体估计5-6月繁殖。主要捕食甲虫、蟑螂、直翅目昆虫及蚯蚓等。栖息在鼎湖山道旁的杂草丛中或乱石堆中，喜在气温较高的午后活动。

37. **Reeves' Smooth Skink** 南滑蜥 (*Scincella reevesi*). Locally scarce. This generally is a common species in lowlands and disturbed habitats. It is a small species, to perhaps 6 cm SVL, with dorsolateral stripes; males have red tints on the lower sides. Females produce 2–3 live young, typically in June. Evidence from mitochondrial DNA, developed by QN and her students at SCNU, confirms the close relationship of this species, and other Chinese *Scincella*, to the American species *S. lateralis*, as suggested by Pope (1935). Although Zhou et al. (1981) listed this species, we found no voucher specimen. Lazell and Liao (1986) erroneously reported it at Dinghushan, but their record was based on a specimen of the following unidentified species. Not until 9 September 2006 were three vouchers obtained from leaf litter along the cell phone tower trail, just southeast of MAB headquarters, overlooking Dinghu. These adults measured 3.9, 4.9, and 5.1 cm SVL (SCNU 39442–4). 头、体及尾背面棕色，散有黑色斑点；体侧左右各有1条黑色纵纹，黑纵纹间的背鳞为8+2（1/2）行；无上鼻鳞；前额鳞1对，彼此相接；眶上鳞4枚；下眼睑有睑窗。春季繁殖，卵胎生，一次可产幼蜥2-3条。主要捕食蟋蟀、甲虫幼虫等。生活在鼎湖山林地、山溪旁、路旁的落叶下或草灌丛中，喜在每天气温较高的时间活动。

38. **"Unidentified" skink** 拟滑蜥属新种 (*Scincella* cf. *rupicola*). Scarce. JDL and his TCA team collected a skink they mistook for *Scincella reevesi* (above) in primary forest at an elevation of ~150 m on 6 June 1984 (MCZ 170514). The specimen was subsequently examined by Allen Greer, Australian Museum, who pointed out to JDL (in litt.) that this skink was not only unlike *S. reevesi* in several critical ways, it lacked the windowed lower eyelid diagnostic of the genus *Scincella*. Nevertheless, Greer opined that it was most similar to *Scincella rupicola* in most respects, despite the generic character discrepancy. Evidence from mitochondrial DNA, developed by QN and her students at SCNU, confirmed this relationship. Subsequently, LZC collected an individual on 6 May 1998 at Dinghushan and Fellowes et al. (2002) reported finding this mystery skink there. On 19 July 2006, JDL and the SCNU team collected two specimens below Heavenly Lake, a female (5.1 cm SVL) with two shelled eggs (both ~5 mm) in the right oviduct and one (~6 mm) in the left, and a male (4.6 cm SVL). They were field-tagged (Z-39439 and Z-39440) and deposited at CIB. No one yet has had the temerity to describe and name this species because attempting this will require a basic generic revision of small brown skinks. 蜓蜥属和滑蜥属有很多相似的地方，有没有下睑窗是蜓蜥属和滑蜥属的重要分类依据。该种连属的分类都有争议；下眼睑无下睑窗，不属滑蜥属；但体型及大小也不同于蜓蜥属。

39. **Thigh-shield Skink** 股鳞蜓蜥 (*Sphenomorphus incognitus*). This common species typically is found on and among rocks in and beside streams and pools in the forest. First identified at Dinghushan by Fellowes et al. (2002) in September 1995, this species also has been collected by LZC in January 1997 and May 1998. However, no one preserved a voucher specimen prior to the capture of CIB 084026–7 on 17 July 2006. These individuals, a female (8.1 cm SVL) and an unsexed individual (6.0 cm SVL), were in the same woodpile near Dinghu Lake dam as *S. indicus* (see species 40). This species can be distinguished from the following by the enlarged plate-like scales in a patch on the posterior thigh. 体型及体色等颇似铜蜓蜥，但股后外侧有1团大鳞；体侧黑宽纵带纵纹间排有浅黄绿色斑点。卵生。主要捕食昆虫。生活在鼎湖山山溪边、水潭旁的乱石堆中，5-8月上午10时至下午2时常见其活动。

40. **Brown Forest Skink** 铜蜓蜥 (*Sphenomorphus indicus*). Common, like its close relative *S. incognitus* (above), this is a diurnal species frequenting rocks in streams. Of 11 *Sphenomorphus* seen along the aqueduct above the original guesthouse on 24 May 1986, three bearing field tags Z-30305–7 were preserved. One of these was deposited at GIE but could not be found in 2004. Two were accessioned as MCZ 175805–6, but only MCZ 175805 could be located in 2004. That specimen and a second collected 25 May 1986 are definitely this species, as is SCNU 39432, 17 July 2006, noted above. A series collected 15–16 July 2009 included a subadult 5.7 cm SVL (SCNU 26068) and four juveniles 4.1–4.6 (average 4.3) cm SVL (SCNU 26069 and 28071–3). A study of the ecologies and life histories of the two species of *Sphenomorphus* at Dinghushan is clearly needed. 体背古铜色，背脊有1条黑色脊纹；体侧棕黑色宽纵纹从眼后达股后，一般不向尾延伸；环体中段鳞34-38行；第4趾下瓣16-22枚。卵胎生，在8月上中旬产仔。常见于鼎湖山溪旁捕食昆虫。

41. **Chinese Waterside Skink** 中国棱蜥 (*Tropidophorus sinicus*). Status uncertain, vanished. This is a small, stout, brown skink with keeled dorsal scales. This typically is a stream dweller in forested hills, and both the stout body and keeled scales enhance water resistance and facilitate swimming. Dinghushan appears to provide perfect habitat for this species and is, indeed, its type locality (Boettger 1886). However, we have never encountered it at Dinghushan and have seen no voucher specimen. Pope (1935) gives "*Tinghushan*" as Boettger's type locality. 头呈三角形，吻窄长；头背鳞片有线纹；体背鳞片明显起棱；顶鳞一侧与4-5枚鳞片相接；颊鳞2枚；额鼻鳞2枚；后颏鳞纵裂为2；前、后肢贴体相向时，指、趾不相遇。卵胎生，早春繁殖一次可产仔3-6尾。主要捕食昆虫。在鼎湖山溪边的草灌丛活动，日间常匿于水边的枯枝落叶或石砾中。

42. **Common Blind Snake** 钩盲蛇 (*Ramphotyphlops braminus*). Status uncertain, vanished at Dinghushan, but one of the most abundant vertebrates generally in South China and the world. Fossorial, but, as a rule, it is easily and regularly uncovered by herpetologists engaged in their standard activity of turning over rocks, logs, and junk. Features of life history in the Hong Kong region were described by Lazell (2002). It feeds on termites and ant larvae. We have not encountered this species at Dinghushan and have not seen a voucher specimen. Zhou et al. (1962a, 1981) listed it and two catalog entries at GIE are for 30 March and 16 June 1965. 体小，形似蚯蚓，全身被复相同的平滑鳞片；眼隐于眼鳞下；鼻鳞全裂成2。卵生。主要捕食直翅目昆虫、双翅目蛹、蚁类等。穴居，昼伏夜出。

43. **Burmese Python** 蟒蛇 (*Python molurus*). Critically endangered, locally vanished. This is a species of shrubland and forest that was formerly common at Dinghushan. Eggs are laid in April and May. Pythons


XIAO ZHI (GUANGDONG)

42. Common Blind Snake 钩盲蛇 (*Ramphotyphlops braminus*)


LI ZHEN-CHANG AND XIAO ZHI (GUANGDONG)

43. Burmese Python 蟒蛇 (*Python molurus*)


LI ZHEN-CHANG (GUANGDONG)

44. Jade Vine Snake 绿瘦蛇 (*Ahaetulla prasina*)


LI ZHEN-CHANG (GUANGDONG)

45. Buff-striped Keelback 草腹链蛇
(*Amphiesma stolata*)


GUO PENG (HAINAN)

46. Large-spotted Cat Snake 繁花林蛇
(*Boiga multomaculata*)


LI ZHEN-CHANG (GUANGDONG)

47. Northern Reed Snake 钝尾两头蛇
(*Calamaria septentrionalis*)


HOU MIAN (GUANGDONG MARKET)

48. Copperhead Racer 三索锦蛇
(*Coelognathus radiatus*)


HOU MIAN (YUNNAN)

49. Greater Green Snake 翠青蛇
(*Cyclophiops major*)


LI ZHEN-CHANG (GUANGDONG)

50. Chinese Water Snake 中国水蛇
(*Enhydris chinensis*)

are highly sought for meat and fat and have been widely extirpated in South China. We doubt any survive in the wild at Dinghushan, but, on 19 July 1995, a fat captive of unknown provenance about 2.5 m long was on exhibit just inside the reserve entrance. A voucher specimen is at GIE. Given adequate protection, this species could recover (Karsen et al. 1998). Its ability to generate body heat is well known. Females incubate eggs in cold climates, but most likely guard rather than incubate them in warmer climates. 体大；具吻窝；泄殖孔两侧有退化成爪状的后肢残余。在广东4-5月产卵。肉食性。生活在鼎湖山常绿阔叶林区的溪涧或灌丛中。由于人为大量捕猎，已极为少见。

44. **Jade Vine Snake** 绿瘦蛇 (*Ahaetulla prasina*). Locally scarce. This is an arboreal species necessarily confined to woodland and forest; it is viviparous and mildly venomous. Zhou et al. (1962a, 1981) recorded it at Dinghushan and a GIE voucher (YUE006) is dated simply 1961. A specimen (MCZ 174896) was collected 10 May 1983 by JDL and his TCA team in the forest at an elevation of ~200 m. Several more were seen between then and 4 May 1986, when another (MCZ 174899) was found dead on a trail above *Chao Tang* (Grassy Pond). Martin Williams photographed a live individual in April 1991; that photograph is catalogued as MCZ 183643. None have been seen since. These specimens all show the dark infralabial pigmentation characteristic of Chinese specimens. This is something of a mystery snake in South China; specimen records, in keeping with its forest habitat, are few and scattered. A most distinctive variant form is known from just two specimens from the little island of Shek Kwu Chau off Hong Kong (Lazell 2002). 微毒。头大而长，吻尖细，体瘦尾长；瞳孔横置；体呈绿色；颊区成一凹槽；脊鳞稍大；背鳞15-15-13行；腹鳞两侧各有1条白色纵纹；腹鳞及尾下鳞具侧棱。卵胎生。捕食蛙类、蜥蜴类及小鸟等。树栖。

45. **Buff-striped Keelback** 草腹链蛇 (*Amphiesma stolata*). Rare. This is a snake of marshland and pond edges, often quite common in agricultural areas. It closely resembles American Garter and Ribbon snakes in appearance and behavior, but is an egg-layer. It seems to have declined in abundance in South China in recent years. Zhou et al. (1962a, c; 1981) listed it, and an untagged specimen is at GIE in a bottle labeled "*Dinghu.*" SCNU has a specimen. JDL and his TCA team found a decapitated carcass (64 cm long) in a paddy near Dinghu on 8 May 1986, but did not save it. 头、颈部一般棕黄色；体背有2条浅色纵纹及由许多黑斑组成大波纹状的横纹；背鳞19-17-17行，除最外1行平滑外，均起棱。在广东5月进入繁殖期。主要捕食蛙类。生活于鼎湖山周围的平原耕作区及山坡草地，近年已少见。

46. **Large-spotted Cat Snake** 繁花林蛇 (*Boiga multomaculata*). Rare. This is an arboreal, nocturnal species that inhabits plantations and shrubland as well as forest. Zhou et al. (1962c, 1981) listed it, and an undated catalog entry at GIE is for a specimen we could not locate. It is a lizard-hunting specialist. A roadkill found on the main road at an elevation of ~220 m on 14 April 1987 is MCZ 172042. 微毒。头较大，略呈三角形，颈细；头背有1黑色箭形斑，体背及尾部有近圆形黑色斑；脊鳞明显扩大；背鳞19-19-13行。在广东8月间产卵。捕食小鸟、鸟卵及蜥蜴类等。善攀爬，常在树上活动，喜夜间活动。分布在鼎湖山的人工林、灌丛及自然林区内，近年已少见。

47. **Northern Reed Snake** 钝尾两头蛇 (*Calamaria septentrionalis*). Scarce. This is a fossorial species of woodland and forest. It feeds on earthworms and is sometimes found on the surface — even crossing roads — particularly in rainy weather. JDL and his TCA team recorded seven individuals at Dinghushan between 22 May 1984 (MCZ 170515) and 20 July 1995, none at elevations above 230 m. Three of these were salvaged roadkills and bear field tags F-30286, Z-30297, and Z-30319; all were deposited at GIE, but we found none in 2004. 头椭圆形；额鳞长、宽相等，有眶前鳞、鼻间鳞、颊鳞及颞鳞缺；尾端钝圆，色斑似头；体两侧各有1条由白点组成的线纹；尾部腹面中央有1黑线。卵生。以蚯蚓为食。生活在鼎湖山林区内，隐居于泥土下，近年已少见。

48. **Copperhead Racer** 三索锦蛇 (*Coelognathus radiatus*; formerly in *Elaphe*). Endangered. Like the two species of *Ptyas* (below), this is a formerly widespread lowland species that frequented agricultural areas, shrubland, and woodland. It has been widely reduced to rarity because it is very popular as human food. It feeds on rodents and birds. Cornered, this snake defends itself with an open-mouthed threat display involving vertical neck-spreading (opposite to that of the cobras) and hissing. Oviposition is typically in May or June, but Lazell (2002) found hatchlings as late as November. Listed by Zhou et al. (1962a, 1981), two Dinghushan specimens are at GIE (J010 and one untagged), both undated. LZC saw and released an individual in the core primary forest at an elevation of 116 m in the 1980s. 体背棕黄色，头侧、眼后向下有3条放射状黑纹；枕后有1黑横斑；体前部有4条断续的黑色纵纹。5–6月在鼎湖山的人工林和灌丛的落叶下产卵。主要捕食鼠类，也捕食鸟类、蜥蜴类和蛙类等。

49. **Greater Green Snake** 翠青蛇 (*Cyclophiops major*). Regularly encountered at Dinghushan; eight records are from 30 May 1984–June 1989. Interestingly, it was never recorded earlier and no GIE specimens or catalog entries exist. A roadkill on 7 May 1986 (MCZ 174899) was preserved as a voucher. This species specializes on earthworms for its diet. It is generally slow and rarely bites, but will writhe in an attempt to escape and often defecates on its captor. It is generally an upland species and does not occur in agricultural areas. It frequents shrubland, forest, and even grassland at high elevations. 头、颈可区分；眼较大，尾细长；头、体背面草绿色；腹面黄绿色；背鳞通身15行。卵生。以蚯蚓为食。喜夜间活动。分布在鼎湖山的人工林、灌丛及自然林区内。

50. **Chinese Water Snake** 中国水蛇 (*Enhydris chinensis*). Locally scarce or vanished. This is an aquatic species of low-elevation wetlands, especially marshes and rice paddies. The reduction of the habitat around Dinghu has made these snakes hard to find. They also are caught and sold for food. They eat frogs and fish. They bear live young in August and September. Karsen et al. (1998) reported defensive biting and mild envenomation, with symptoms including swelling, headache, and nausea. Zhou et al. (1962a, 1981) listed this species and an untagged specimen is in a bottle labeled "*Dinghu*" at GIE. 微毒。体粗壮，尾短；鼻间鳞1枚，与颊鳞不相切；上唇鳞1枚入眶；背鳞中段23行；体背一般橄榄色。卵胎生，在广东8-9月产仔。以鱼、蛙为食。常栖于水田、池沼。由于鼎湖山附近农田大量开发，栖息地缩小，近年已少见。

51. **Plumbeous Water Snake** 铅色水蛇 (*Enhydris plumbea*). Locally scarce or vanished. Like *E. chinensis* (above), this aquatic marshland and paddy species has lost a great deal of habitat in recent years. Its life history parameters are chronicled from the Hong Kong region (Lazell 2002) and seem similar to *E. chinensis*. Karsen et al. (1998) reported snappy defense behavior, as with its congener above, but no more than slight swelling as a result of envenomation. We have not seen a Dinghushan specimen. Zhou et al. (1962a, 1981) listed it, and a catalog entry at GIE is dated 6 July 1965. 微毒。体型较小，尾短；鼻孔具瓣膜，位于吻端；鼻间鳞1枚，位于左右鼻鳞之后中央，与颊鳞不相切；上唇鳞8枚，2枚入眶；背鳞中段19行。卵胎生，在广东8月产仔。以鱼、蛙类为食。栖息环境和食性与中国水蛇相同，与中国水蛇一样，近年已少见。

52. **Golden Kukri Snake** 紫棕小头蛇 (*Oligodon cinereus*). Rare. This species inhabits grassland, shrubland, and woodland edges (Karsen et al. 1998) and seems rare generally in South China; little is known of its natural history. On 26 May 1986, Numi Mitchell (TCA) found a specimen (MCZ 175895) dead on a trail in *Cha Chang* (Tea Garden) at an elevation of ~320 m at 0100 h. This peculiar snake was first thought to be a new species. Van Wallach of MCZ solved the mystery by identifying it to this species. The name derives from the enlarged, blade-like rear teeth reminiscent of the kukri knives of Gurkha soldiers (Karsen et al. 1998). An untagged specimen is in a bottle labeled "*Dinghu*" at GIE. No previously published records exist for Dinghushan. 头小，与颈不易区分；吻鳞大；头背及体腹面无斑；体背红色，由许多背鳞边缘的黑色形成波状横纹。卵生。捕食蟋蟀、蜘蛛及甲虫等。生活在鼎湖山林区的草灌丛中。

53. **Taiwan Kukri Snake** 台湾小头蛇 (*Oligodon formosanus*). Scarce. This species occupies a broad spectrum of habitats from grassland and pond edges to forest. The primary diet seems to consist of reptilian eggs, the opening of which is facilitated by the enlarged blade-like rear teeth (Karsen et al. 1998). In the Hong Kong region, hatchlings appear in June (Lazell 2002). This species was listed by Zhou et al. (1962a, 1981), and two specimens (J013 and one untagged) from Dinghushan are at GIE, both undated. Richard Lutman (TCA) observed a live individual (~60 cm total length) near Qingyun Temple at ~1000 h on 18 July 2006. 头顶具有"灭"字形的棕黑色斑；体背有距离相等约1鳞片宽的黑色波浪状横纹；背鳞19-19-17行。嗜食爬行动物的卵。栖息于鼎湖山林区路旁、山坡草丛及灌丛下。

54. **Banded Stream Snake** 横纹后棱蛇 (*Opisthotropis balteata*). Status uncertain, vanished. This is a species of upland streams in forest, so the Dinghushan habitat is perfect for it. It is nowhere common in South China and little is known of its life history. Karsen et al. (1998) reported it to be diurnal and docile and willing to eat small fishes. Zhou et al. (1962a, 1981) listed it, but we have not found a specimen. A catalog entry at GIE dated 5 October 1965 may refer to this species. 有颊鳞；背鳞中段19行；上唇鳞7-10枚；全身有黑褐色环纹。捕食小鱼、小虾及蚯蚓等。半水栖，常见于岩石下，近年已极为少见。


LI ZHEN-CHANG (GUANGDONG)

51 Plumbeous Water Snake 铅色水蛇
(*Enhydris plumbea*)


MICHAEL LAU (HONG KONG)

52. Golden Kukri Snake 紫棕小头蛇
(*Oligodon cinereus*)


LI ZHEN-CHANG (GUANGDONG)

53. Taiwan Kukri Snake 台湾小头蛇
(*Oligodon formosanus*)


ANTHONY BOGADEK (HONG KONG)

54 Banded Stream Snake 横纹后棱蛇
(*Opisthotropis balteata*)


HOU MIAN (HAINAN)

55. Red Mountain Racer 紫灰锦蛇
(*Oreophis porphyraceus*)


HOU MIAN (GUANGDONG MARKET)

56. Black-browed Satin Snake 黑眉锦蛇
(*Orthriophis taeniurus*)


ZHOU XING (GUANGDONG)

57. White-spotted Slug Snake 横纹钝头蛇
(*Pareas margaritophorus*)


LI ZHEN-CHANG (GUANGDONG)

58. Mock Viper 紫沙蛇
(*Psammodynastes pulverulentus*)


HOU MIAN (GUANGDONG MARKET)

59. Indo-Chinese Rat Snake 灰鼠蛇
(*Ptyas korros*)


HOU MIAN (GUANGDONG MARKET)

60. Common Rat Snake 滑鼠蛇
(*Ptyas mucosus*)


LIU SHAO-RONG (GUANGDONG)

61. Red-necked Keelback 红脖颈槽蛇
(*Rhabdophis subminiatus*)


HOU MIAN (HAINAN)

62. Chinese Mountain Snake 黑头剑蛇
(*Sibynophis chinensis*)


LI ZHEN-CHANG (GUANGZHOU ZOO)

63. Diamond-back Water Snake 环纹华游蛇
(*Sinonatrix aequifasciata*)


LI ZHEN-CHANG (GUANGDONG)

64. Mountain Water Snake 乌华游蛇
(*Sinonatrix percarinata*)


LI ZHEN-CHANG (GUANGDONG)

65. Checkered Keelback 渔游蛇
(*Xenochrophis piscator*)

55. **Red Mountain Racer** 紫灰锦蛇 (*Oreophis porphyraceus*; formerly in *Elaphe*). Vulnerable. This is a forest species and has probably not been common for centuries. Karsen et al. (1998) reported it to be largely diurnal, usually docile, and easily kept in captivity on a diet of mice. The only Dinghushan record (MCZ 170513) was collected on 30 May 1984 in primary forest at an elevation of 116 m. 成体一般不超过1米；头、体背面紫铜色，头背有3条黑色纵纹；体、尾背面有淡黑色横斑；背鳞平滑，在颈部鳞列不超过19行。在广东7月产卵。以小型啮齿动物等为食。见于鼎湖山林区路旁。

56. **Black-browed Satin Snake** 黑眉锦蛇 (*Orthriophis taeniurus*; formerly in *Elaphe*). Vulnerable. This is a species of diverse habitats ranging from open farmland to forest. It feeds on rodents and frogs and oviposits from May to July. It is highly sought for human food, and populations in South China are widely depleted. It was not recorded at Dinghushan until 11 May 1983, when a 1.5-m male was collected, preserved, and deposited at GIE, bearing field tag Z-08984. We could not locate this specimen in 2004. JDL and his TCA team also examined and released three more individuals between 1983 and 27 May 1986, two of which were in forest at elevations of ~220–300 m elevation, and the last was far back in an artificial cave at an elevation of ~40 m, we suspect hunting bats. 头、体背面黄绿色或棕灰色；眼后有明显黑纹；体前中段有黑色梯状或蝶斑状斑纹，至尾段逐渐不显；从体中段开始两侧有明显的黑纵带达尾端；体背中央数行背鳞稍有起棱。在广东5-7月为产卵期。喜捕食鼠、蛙类。见于鼎湖山人工林和灌丛。

57. **White-spotted Slug Snake** 横纹钝头蛇 (*Pareas margaritophorus*). Locally rare. This is a fairly common snake in much of South China, frequenting woodland, shrubland, and gardens. It is nocturnal and eats slugs and snails; the enlarged teeth facilitate removal of the snails from their shells (Karsen et al. 1998). When captured, this snake balls up with its head tucked in its coils. One roadkill (MCZ 174888) was salvaged on 10 May 1986 at Dinghushan at an elevation of ~70 m. A second roadkill was found on 27 May 1986 and bears field tag Z-30318; it was deposited at GIE, but we could not find it in 2004. LZC saw a roadkill in September 1995, but the specimen was too mangled to save. 体色紫蓝色，杂以黑白各半的鳞片彼此缀连成短横斑；前额鳞入眶；颊鳞不入眶；背鳞通身15行，平滑无棱；腹鳞152-160枚；尾下鳞39-44对。卵生。捕食陆栖软体动物及小鱼。在鼎湖山林近年已少见。

58. **Mock Viper** 紫沙蛇 (*Psammodynastes pulverulentus*). This is a common species of forest, shrubland, and even tree plantations. It climbs well and feeds on frogs and lizards. Zhou et al. (1962a, 1981) listed it. We have four records, all in May, from 1984 to 1986 (Lazell and Liao 1986). One of these was a heavily gravid female (MCZ 170512) captured at 0500 h at an elevation of ~30 m in woodland. The species was not recorded again until 16–19 July 2006, when we found three individuals, two released females (31.5 and 54.0 cm total length) and a newborn roadkill (with yolk sac scar) of 19.5 cm (CIB 083791). This latter specimen accords well with available life history data for the Hong Kong region, where these snakes bear young in July and August (Lazell 2002). It also closely fits a newborn series of five

individuals from Nan Ao Island, eastern Guangdong (SCNU F4080–4), collected 25 July 2004, which measured 18.4–19.8 cm total length (average 19.2 cm). Two juveniles measured and released on 8 September 2006 were 21.6 and 24.1 cm total length, indicating post-natal growth. A juvenile collected 16 July 2009 (SCNU 26066) was, however, 28.1 cm total length; possibly a yearling? 微毒。头三角形；吻尖钝，吻棱显著；头顶和头侧有对称的褐色纵条纹数条；体背紫褐色，有多个不规则镶黑边的土黄色横斑；背鳞17-17-15行。卵胎生。主要捕食蛙及蜥蜴类。栖息于鼎湖山人工林、灌丛及自然林，能爬树。

59. **Indo-Chinese Rat Snake** 灰鼠蛇 (*Ptyas korros*). Endangered, locally vanished. Formerly a common snake in most habitats from farmland to forest, this species is highly sought for human food and has been reduced to rarity in much of South China today. In appearance and behavior this species resembles the American racers in the genera *Coluber* and *Masticophis*. Zhou et al. (1962a, c; 1981) listed it, and two specimens are at GIE (J011–2) from Dinghushan. The generic status of this and the following species was discussed by Lazell (2002), Nagy et al. (2004), and Burbrink and Lawson (2007) without any consensus. 头长，眼大，尾长。颊部内陷；背鳞灰褐色，每一鳞片中央黑褐色，前后缀连成黑纵纹。在广东5-6月产卵。主要捕食蛙、鼠。栖息于鼎湖山平原耕作区、人工林、灌丛和自然林中，近年已极为少见。

60. **Common Rat Snake** 滑鼠蛇 (*Ptyas mucosus*). Endangered, locally vanished. Like its close relative, *P. korros* (above), this is a species of most terrestrial habitats, so highly sought for human food as to be rare over much of South China today. It feeds on a broad spectrum of vertebrates, from toads to birds, and even on carrion. It looks and acts like a larger version of the American racers, but, like its relative above, no relationship to them has been demonstrated. Oviposition is typically in May or June and hatchlings in the Hong Kong region appear in August (Karsen et al. 1998, Lazell 2002). Zhou et al. (1962a, c; 1981) listed this species and an untagged Dinghushan specimen is at GIE (dated 20 December 1963). 头背黑褐色，体背灰棕色，腹面黄白色；体后有不规则的黑色横斑，横斑至尾部形成网纹；腹鳞后缘黑色；颊鳞一般3枚；背鳞19-17-14行。在广东5-6月产卵。嗜食鼠。在鼎湖山的平原耕作区、人工林、灌丛的沟溪边昼夜活动，行动迅速。灰鼠蛇和滑鼠蛇历来都是人们捕食的重要对象，近年已极为少见。

61. **Red-necked Keelback** 红脖颈槽蛇 (*Rhabdophis subminiatus*). This common species occupies a wide range of habitats from agricultural areas to primary forest, often associated with water. This snake is highly reminiscent in habitus and behavior of an American Garter Snake (*Thamnophis*) or a European Grass Snake (*Natrix*). Records at Dinghushan go back to Mell (1922), and we have five dated records from 8 May 1983 through 20 July 1995. Two of these, from primary forest and pine plantation, are MCZ 166902 and 174898. Several were observed on 8 July 1997, 6 May 1998, and in July of 2006 and 2009. Oviposition in the Hong Kong region is from May through July; the diet is largely frogs and toads (Karsen et al. 1998). A juvenile measured and released on 8 September 2006 was 24.6 cm SVL (32.5 cm total length), another on the same date was larger (25.1 cm SVL), but had a stumped tail. A released hatchling with yolk sac scar measured 13.4 cm SVL on 16 July 2009. 颈部及躯体前部呈红色，无横斑；颈背的颈槽明显；背鳞中段19行。在广东5月产卵。主要捕食蛙类也捕食昆虫。分布在鼎湖山的平原耕作区、林区及灌丛。

62. **Chinese Mountain Snake** 黑头剑蛇 (*Sibynophis chinensis*). Status uncertain. This is nowhere known to be a common species. It inhabits upland habitats including forest, shrubland, and even open grassland at high elevations. Karsen et al. (1998) reported this to be a docile, diurnal species that feeds on skinks and Grass Lizards. We have not seen this species at Dinghushan and include it here solely on the testimony of Michael Lau (Lau 1996, Fellowes et al. 2002), who examined and released a specimen in the core primary forest on 26 September 1995 at an elevation of ~220 m. 头背黑色，体背棕褐色；颈背有1黑色宽横斑与体背中央黑褐色脊线相连；上唇鳞9枚；前颞鳞2枚。在广东7-8月产卵。捕食蛙类及蜥蜴等。分布在鼎湖山林区。

63. **Diamond-back Water Snake** 环纹华游蛇 (*Sinonatrix aequifasciata*). Regularly encountered, this is a species of streams in forest, usually in uplands but sometimes at low elevations. The diet of fish and frogs necessitates considerable flow and pools. This snake climbs well and typically perches in vegetation over water. The resemblance in habitus, activity, and behavior of this species to the southeastern American Diamondback Water Snake (*Nerodia rhombifer*) is striking. First recorded at Dinghushan by Mell (1922), we have three records from 2 April 1984 through 25 May 1986. The first of these was the individual that killed a Giant Spiny Frog (see species 15) through apparent envenomation — and escaped. Two more were collected in May 1986 (MCZ 174887 and one deposited at GIE bearing field tag Z-30311). Of the former, JDL noted "caused local swelling at tooth punctures" when it bit its captor. 头、颈可区分；躯体棕褐色，其上的环纹在体侧形成"X"形斑；背鳞19-19-17行，起棱。在广东5-6月产卵。以鱼、蛙为食。栖息于鼎湖山自然林区山溪中。

64. **Mountain Water Snake** 乌华游蛇 (*Sinonatrix percarinata*). Regularly encountered, like its relative *S. aequifasciata* (above), this is a species of upland streams with cascades and pools; it too eats frogs and fish, but is not so regular a climber in vegetation. This species looks and acts very much like the common water snakes (*Nerodia*) of eastern North America. That no previous records exist of this species at Dinghushan is surprising because the habitat is ideal and JDL and his TCA team recorded six between 11 May 1983 and 18 May 1986, beginning with a roadkill (MCZ 166906; a second voucher is MCZ 175808). Twice these snakes were found in the original guesthouse cistern at an elevation of ~32 m. 头略呈三角形；体背灰褐色，体侧具黑色横斑（特别是幼蛇）；鼻间鳞前端窄；通常有2枚上鼻鳞入眶；背鳞中段19行。在广东6-8月产卵。捕食蛙类和鱼类。栖息于鼎湖山林区山溪，多白天活动。

65. **Checkered Keelback** 渔游蛇 (*Xenochrophis piscator*). Common; this is a species of marshes, rice paddies, and pond edges in the lowlands. Because of habitat decrease, this species is not as easily found as in earlier years. It feeds on fishes, frogs, and toads. In the Hong Kong region, it oviposits in March and April (Karsen et al. 1998). The species was listed by Zhou et al. (1962a, c; 1981); also, three untagged specimens in a bottle labeled "*Dinghu*" are at GIE. An apparent juvenile was collected in July 2006 by XZ and deposited at CIB (field tagged Z-39446), but its identity is


XIAO ZHI (DINGHUSHAN MARKET)

66. Banded Krait 金环蛇 (*Bungarus fasciatus*)


WU YI (GUANGDONG)

67. Many-banded Krait 银环蛇 (*Bungarus multicinctus*)


LI ZHEN-CHANG (GUANGDONG)

68. Chinese Coral Snake 丽纹蛇 (*Sinomicrurus macclellandi*)

69. Chinese Cobra 舟山眼镜蛇 (*Naja atra*)

70. White-lipped Bamboo Viper 白唇竹叶青 (*Trimeresurus albolabris*)

71. Stejneger's Bamboo Viper 福建竹叶青 (*Trimeresurus stejnegeri*)

in question. 鼻孔位于头背侧面；眼下方一般都有2条向后的黑纹；体背、体侧有网纹斑和较大的黑色斑；体腹面有排列整齐的黑白相间的横纹。以鱼、蛙为食。栖息于鼎湖山低山林区的池沼、湿地或溪边，半水栖。

66. **Banded Krait** 金环蛇 (*Bungarus fasciatus*). Endangered, locally vanished. This highly venomous species was formerly fairly common in lowland agricultural areas. It is ophiophagous — a snake eater. Karsen et al. (1998) noted how these snakes, so often docile and inoffensive by day, become vicious and aggressive with nightfall. One clutch can have as many as 16 eggs (Zhou et al. 1962a). Because it is so highly desired for human food and traditional medicine, it has been widely reduced to rarity. Our only evidence for its occurrence at Dinghushan are listings by Pope (1935) and Zhou et al. (1962a, 1981). 剧毒，具前沟牙。头、颈区分不明显，吻圆钝；体背有黑黄相间的横纹；背脊棱起呈嵴，脊鳞扩大；尾短，端部钝圆。在广东5-6月产卵。捕食鱼、蛙、蜥蜴、鼠和蛇。夜间见于鼎湖山的人工林、灌丛或自然林区内。由于大量滥捕，已极为少见。

67. **Many-banded Krait** 银环蛇 (*Bungarus multicinctus*). Vulnerable. Highly venomous; like its close relative *B. fasciatus* (above), this species inhabits a wide spectrum of lowland habitats, from farmland to forest, usually closely associated with water. In addition to snakes, it may eat lizards, rodents, frogs, and fish. Not docile even by day, this is an aggressive snake; it is the species that killed the prominent herpetologist Joe Slowinski in Myanmar in 2001 (James 2008). It mates in September and oviposits the next June; eggs hatch in one month (Zhou et al. 1962a). Zhou et al. (1981) listed it. On 30 June 1996, LZC captured and released a specimen about 2 km up the west valley trail. A photograph of it by Peter Lynch (GATP) is accessioned as MCZ K-955, our only voucher. 剧毒，具前沟牙。头、颈区分不明显，无颊鳞；脊鳞扩大；背鳞通身15行；尾短，尾下鳞单行；体背黑白相间，黑横纹远宽于白横纹。在广东4月出蛰，6月产卵，11月进入冬眠。捕食鱼、蛙蛇等。夜间见于鼎湖山的人工林、灌丛或自然林区内。

68. **Chinese Coral Snake** 丽纹蛇 (*Sinomicrurus macclellandi*). Locally rare. This highly venomous species is secretive and usually not aggressive. It resembles a drabber version of the American coral snakes (*Micrurus* and *Micruroides*) and is similarly ophiophagous. Semifossorial and nocturnal, it inhabits woodland and forest, but rarely open areas. However, on 12 May 1983, JDL and his TCA team found a flat and dried roadkill in the agricultural area at Dinghu. This one was not salvaged, but a second roadkill (MCZ 174897) was found within the reserve, near *Cha Chang* (Tea Garden) at an elevation of ~240 m on 26 May 1986. 有毒，上颌前沟牙后有2枚小牙。体色棕红色，头背黑色，有1醒目的暗白横斑，横斑不呈“∧”形；背鳞平滑，通身13行。在广东8月产卵。捕食蛇类及蜥蜴类幼体。多夜间见于鼎湖山林区的山路。

69. **Chinese Cobra** 舟山眼镜蛇 (*Naja atra*). Vulnerable; status uncertain, vanished. Formerly common, this species occurs in a broad spectrum of habitats from farmland to forest. It is rare today because of its popularity as human food. Cobras eat almost any sort of vertebrate animal they can kill with their highly potent venom. These cobras are famous for their defensive posture of rearing the anterior third of their bodies and spreading their iconic hoods. Although related to cobras that spit venom, such behavior has rarely been observed. They seem to assume that their posture and hood will warn humans and seem reluctant to actually bite unless captured. They do not rear or spread hoods when striking prey. In the Hong Kong region, hatchlings appear in August and September (Lazell 2002). We have seen no voucher specimen, but a catalog entry for a specimen from Dinghushan is at GIE (dated 22 December 1963). Pope (1935) and Zhou et al. (1981) also recorded it here. 剧毒，具前沟牙。头椭圆形；颈部能膨扁，颈部有眼镜状斑纹，无颊鳞；上唇鳞第2、3枚入眶；下唇鳞的第4、5枚之间有小鳞。在广东5月前出蛰，5-6月交配，7-8月产卵，11月进入冬眠。食性广，鱼、蛙、蛇、鼠、鸟都捕食。在鼎湖山活动范围较广。由于大量捕猎，近年已极为少见。

70. **White-lipped Bamboo Viper** 白唇竹叶青 (*Trimeresurus albolabris*). Status uncertain, vanished. This highly venomous snake is usually common in farmland, shrubland, and forest edges. Habitat in the Dinghushan lowlands appears optimal, but the only record is Mell (1922). Mell clearly separated this species from the following, and listed "*Dingwu*" as a locality. In the Hong Kong region, these viviparous snakes produce young throughout the warm season, spring to autumn, and eat amphibians, reptiles, mammals, birds, and even insects (Lazell 2002). They are typically nocturnal and climb in vegetation to some extent. The species name and the Chinese name both translate as "white-lipped," but in life the lips are bright yellow to pale green, only fading to whitish in preservative. 剧毒，具管牙。头大，呈三角形；头、颈区分明显，具颊窝；鼻鳞一般与第1枚上唇鳞愈合或有短鳞沟；鼻间鳞大，彼此一般不相接；通身绿色，体侧有1白色纵线纹；尾部焦红色。卵胎生，在广东5月交配，6-7月产仔。捕食鼠类，也捕食蛙类、蜥蜴及鸟等。喜在鼎湖山较湿的溪边、灌草丛活动或树栖。

71. **Stejneger's Bamboo Viper** 福建竹叶青 (*Trimeresurus stejnegeri*). Locally scarce. This recent addition to the herpetofauna of Dinghushan seems rare. This species is ecologically and behaviorally similar to its close relative, *T. albolabris* (above), but ranges more inland, upland, and farther north. It is viviparous, and young have been recorded in July and August. Two specimens at SCNU were collected by LZC, both along forest edge roadsides within the reserve, on 29 June 1996 and 8 July 1998. Another collected 1 July 1997 by LZC is CIB 085045. 剧毒，具管牙。头大，呈三角形；颈细与头区分明显；全头被小鳞，具颊窝；体绿色，外侧背鳞中央白色，自颈后形成1条白色纵线纹，在白色纵线纹下方还伴有1条红色侧线；鼻鳞与第1枚上唇鳞之间有完整鳞沟。卵胎生，在广东7-8月产仔。捕食蛙类、蜥蜴类、鸟类、鼠类。在鼎湖山林区溪旁或林缘灌丛活动，有时缠绕在树上。

Discussion and Conclusions

According to Zhao and Adler (1993) and Wang and Zhao (1998), these 71 species are distributed mainly in the Oriental Zone, which often is divided into three regions as Southwestern China, Central China, and South China. Of the 23 amphibians, about 79% (18 species) are spread across both the Central and South China

regions, and 17% (4 species) occur only in the South China region: Yellow-striped Caecilian (*Ichthyophis bannanicus*), Three-striped Grass Frog (*Hylarana macrodactyla*), Spotted Narrow-mouthed Frog (*Kalophrynus interlineatus*), and Asiatic Painted Frog (*Kaloula pulchra*). Only one species (4%), Schmacker's Stinking Frog (*Odorrana schmackeri*), was previously reported as occurring only in the Central China region. Of the 48 reptiles, most are strictly in the Oriental Zone. Only two species are widely distributed across both the Palearctic and Oriental zones, the Chinese Soft-shelled Turtle (*Pelodiscus sinensis*) and the Black-browed Satin Snake (*Orthriophis taeniurus*). Of the others, 77% (37 species) are spread across both the Central and South China regions, 23% (11 species) occur only in the South China region: Black-necked Terrapin (*Chinemys nigricans*), Three-banded Box Terrapin (*Cuora trifasciata*), Bowring's Gecko (*Hemidactylus bowringi*), House Gecko (*Hemidactylus frenatus*), Changeable Lizard (*Calotes versicolor*), Four-lined Blue-tailed Skink (*Plestiodon quadrilineatus*), Reeves' Smooth Skink (*Scincella reevesi*), the undetermined skink (*Scincella* cf. *rupicola*), Chinese Waterside Skink (*Tropidophorus sinicus*), Banded Stream Snake (*Opisthotropis balteata*), and White-spotted Slug Snake (*Pareas margaritophorus*). Thus, the new Dinghushan records have documented the range of only one species southward from the Central China region to the South China region in the Oriental zone.

Of the 71 recorded species, at least 21 (nearly 30%) seem to have vanished. Among these, 11 species (>50%) are highly desired for human consumption, and this alone may account for their disappearance. This includes all four turtles, the python, both species of *Ptyas,* both species of *Enhydris,* and two large elapids, the Banded Krait and the cobra. Some of these also may suffer from the demise of local agriculture, notably the two water snakes.

Of the remaining vanished species, four (nearly 20%) may be closely enough tied to agricultural areas to have declined recently, or simply to survive now only in areas we have not searched: Chaochiao Wood Frog (*Rana chaochiaoensis*), Three-striped Grass Frog (*Hylarana macrodactyla*), Rough-skinned Floating Frog (*Occidozyga lima*), and White-lipped Bamboo Viper (*Trimeresurus albolabris*). The viper may be an unlikely candidate for this group, because it is abundant in shrubland and second-growth forest, even on very small islands in Hong Kong (Karsen et al. 1998, Lazell 2002).

The remaining six vanished species defy ready explanations. The Cascade Frog (*Amolops ricketti*) is very tenuously recorded; one might argue its paper trace is a mistake, but we opine it should be present. Alone among this group of six, it might also be a victim of global warming, because it is an upland and generally more northern species. The House Gecko (*Hemidactylus frenatus*) may have been an edificarian introduction that simply did not persist. The Five-lined Skink (*Plestiodon elegans*) is also an upland and largely more northern species, but is locally common south in the tropics and even at sea level (Lazell 2004). The Waterside Skink (*Tropidophorus sinicus*), as mentioned in the species accounts, seems truly bizarre. Well within its range, Dinghushan seems perfect for the skink and is the species' type locality. Why have we not found it since 1886? Our failure to find recent specimens of the Common Blind Snake (*Ramphotyphlops braminus*) must have been simple oversight. It should be abundant around the buildings and nursery. Lastly, the Stream Snake (*Opisthotropis balteata*) is generally rare in South China; failing to find it recently could just be bad luck — but Hong Kong has it and three more species of *Opisthotropis*. Dinghushan seems ideal habitat for this genus with plenty of cascading streams. The absence of all these species seems mysterious.

Nine (13%) of the Dinghushan's species are among those we think of as closely associated with forest. Eight of them have been recorded only since 1984. Only one, the Jade Vine Snake (*Ahaetulla prasina*), was previously collected in 1961. The possibility is heartening that these may be species that are recovering since the termination of woody fuel gathering has allowed regrowth of the forest understory and deposition of more ground cover, processes that began in the mid 1980s. Six of these species, the caecilian (*Ichthyophis bannanicus*), Heymons' Pigmy Frog (*Microhyla heymonsi*), Chinese Forest Skink (*Ateuchosaurus chinensis*), Thigh-shield Skink (*Sphenomorphus incognitus*), Brown Forest Skink (*S. indicus*), and Mock Viper (*Psammodynastes pulverulentus*), are vouchered and well-documented. We still need better documentation and we still lack voucher specimens for the remaining two, Schmacker's Stinking Frog (*Odorrana schmackeri*) and the Chinese Mountain Snake (*Sibynophis chinensis*).

At first glance, two pairs of congeneric species are suggestive of replacement turnover. In the last decade or a little longer, the Lesser Spiny Frog (*Paa exilispinosa*) has been found and the Giant Spiny Frog (*P. spinosa*) has not. The very common White-lipped Bamboo Viper (*Trimeresurus albolabris*), only recorded at Dinghushan by Mell in 1922, has not been collected for nearly a century, whereas the northern and upland Stejneger's Bamboo Viper (*T. stejnegeri*) has been collected three times since 1996. These possible examples of turnover seem quite unlikely to have involved the invasion and displacement model or, for that matter, the extinction followed by colonization model. We can envision no source areas for the newly recorded species. Each would have had to cross deforested, largely agricultural lands to invade Dinghushan, and neither seems likely to survive in such habitats. If these are real examples of species replacement, the replacing species must, we believe, have been there all along; they must have been invisibly rare and must have undergone very recent dramatic population growth. This scenario would require that the replacing species are now driving, or have driven, their congeners to local extinction. Can cessation of forest fuel collection and succeeding understory regrowth have enabled this? The first test of this hypothesis will be to see if the apparent replacements are even true. Have the two species really vanished and been replaced by remarkably similar congeners? We doubt it. Renewed collecting efforts probably will rediscover both of these species at Dinghushan.

A striking feature of Nearctic biogeography is the strong resemblance and potentially close relationship of species between East Asia (especially South China) and eastern North America (especially the Southeast). Long hailed as the "alligators and magnolia" pattern, this is known as *Grayian Distribution*, named for the nineteenth century Harvard botanist, Asa Gray (Lazell and Lu 2000, 2003). Some 24 of Dinghushan's 71 species — more than one third — require molecular biological tests of affinity to eastern North American species and, if pertinent, calculations of separation times. These species include *Bufo melanostictus, Hyla simplex,* at least three ranid "brown" frogs (under study by Kiley Briggs, University of Vermont), all three *Microhyla,* the turtles *Platysternon megacephalum* and *Cuora trifasciata,* all skinks in the genus *Plestiodon* (currently under study by Matt Brandley, Peabody Museum of Yale University), skinks in the genus *Scincella* (currently under study

Table 1. Herpetofauna of Dinghushan with the earliest reference for each species. Specimens are at South China Normal University (SCN), Chengdu Institute of Biology (CIB), Guangdong Institute of Entomology (GIE), and Museum of Comparative Zoology, Harvard (MCZ), with X, voucher specimen extant in 2004; •, specimen examined, tagged, and catalogued by us but not found in 2004; O, a catalog entry with data for a specimen not found by us in 2004; and *, a catalog entry possibly referring to a species but with no specimen found by us, and thus of questionable status. Status: V, vanished; H, consumed by humans; A, associated with agriculture; F, associated with forest; R, possibly recovering populations.

	Species	Chinese Name	English Name	Museum				Reference	Status
				SCN	CIB	GIE	MCZ		
1	*Ichthyophis bannanicus*	版纳鱼螈	Yellow-striped Caecilian				X	Qin 1985	F
2	*Bufo melanostictus*	黑眶蟾蜍	Asian Common Toad	X		X		Zhou et al. 1962c	
3	*Hyla simplex*	华南雨蛙	Chinese Green Treefrog				X	Zhou et al. 1981	
4	*Amolops ricketti*	华南湍蛙	Cascade Frog			O			V
5	*Fejervarya multistriata*	泽陆蛙	Paddy Frog	X		X	X	Zhou et al. 1962b, c	
6	*Hoplobatrachus rugulosus*	虎纹蛙	Chinese Bullfrog			X		Zhou et al. 1962c	
7	*Hylarana adenopleura*	弹琴蛙	Musical Frog					Zhou et al. 1981	
8	*Hylarana guentheri*	沼水蛙	Gunther's Frog	X		X	X	Zhou et al. 1962b, c	
9	*Hylarana macrodactyla*	长趾纤蛙	Three-striped Grass Frog			X			VA
10	*Hylarana taipehensis*	台北纤蛙	Two-striped Grass Frog	X					
11	*Occidozyga lima*	尖舌浮蛙	Rough-skinned Floating Frog			X			VA
12	*Odorrana chloronota*	大绿臭蛙	Green Cascade Frog				X	Lazell and Liao 1986	
13	*Odorrana schmackeri*	花臭蛙	Schmacker's Stinking Frog						RF
14	*Paa exilispinosa*	小棘蛙	Lesser Spiny Frog					Lau 1996	
15	*Paa spinosa*	棘胸蛙	Giant Spiny Frog				X	Zhou et al. 1981	F
16	*Rana chaochiaoensis*	昭觉林蛙	Chaochiao Wood Frog					Zhou et al. 1981	VA
17	*Rhacophorus dennysi*	大树蛙	Dennys' Treefrog					Xu 2001	RF
18	*Rhacophorus megacephalus*	斑腿树蛙	Brown Treefrog	X		X	X	Zhou et al. 1981	
19	*Kalophrynus interlineatus*	花细狭口蛙	Spotted Narrow-mouthed Frog		X			Lazell and Liao 1986	
20	*Kaloula pulchra*	花狭口蛙	Asiatic Painted Frog	X				Zhou et al. 1981	
21	*Microhyla heymonsi*	小弧斑姬蛙	Heymons' Pigmy Frog					Lau 1996	RF
22	*Microhyla ornata*	饰纹姬蛙	Ornate Pigmy Frog	X				Zhou et al. 1981	
23	*Microhyla pulchra*	花姬蛙	Marbled Pigmy Frog	X		X	X	Zhou et al. 1981	
24	*Platysternon megacephalum*	大头平胸龟	Big-headed Terrapin					Mell 1922	VH
25	*Chinemys nigricans*	黑颈拟水龟	Black-necked Terrapin					Mell 1922	VH
26	*Cuora trifasciata*	三线闭壳龟	Three-banded Box Terrapin				X	Mell 1922	VH
27	*Pelodiscus sinensis*	中华鳖	Chinese Soft-shelled Turtle					Zhou et al. 1981	VH
28	*Gekko chinensis*	中国壁虎	Chinese Gecko	X		X	X	Pope 1935	
29	*Hemidactylus bowringi*	原尾蜥虎	Bowring's Gecko	X				Zhou et al. 1981	
30	*Hemidactylus frenatus*	疣尾蜥虎	House Gecko			*		Pope 1935	V
31	*Calotes versicolor*	变色树蜥	Changeable Lizard	X		X	X	Zhou et al. 1962c	
32	*Takydromus sexlineatus*	南草蜥	Grass Lizard		X	O		Zhou et al. 1981	

by QN at SCNU), the five "ratsnakes" of controversial relationships (Nagy et al. 2004 versus Burbrink and Lawson 2007), and all of the natricine snakes currently placed in the genera *Amphiesma*, *Rhabdophis*, *Sinonatrix*, and *Xenochrophis* (Lazell and Lu 2003).

In terms of classic island biogeographic theory, Dinghushan agrees with islands in the South China Sea in having vastly more species in a given area than do most Neotropical islands (Lazell 2002). The prediction from MacArthur and Wilson (1967) for a Neotropical island herpetofauna on 1,200 ha would be about 25 species. Even if we dismiss the 21 "missing" species and allow Dinghushan only 50, that is still double the prediction of classic theory. The number of species per area for Dinghushan, with 50–71

33	*Ateuchosaurus chinensis*	光蜥	Chinese Forest Skink	X	X			Pope 1935	
34	*Plestiodon chinensis*	中华石龙子	Chinese Skink			O		Zhou et al. 1981	
35	*Plestiodon elegans*	蓝尾石龙子	Five-lined Blue-tailed Skink					Pope 1935	V
36	*Plestiodon quadrilineatus*	四线石龙子	Four-lined Blue-tailed Skink		X		X	Pope 1935	
37	*Scincella reevesi*	南滑蜥	Reeves' Smooth Skink	X				Zhou et al. 1981	
38	*Scincella* cf. *rupicola*	-	undetermined skink		X		X	Lazell and Liao 1986	
39	*Sphenomorphus incognitus*	股鳞蜓蜥	Thigh-shield Skink		X			Fellowes et al. 2002	F
40	*Sphenomorphus indicus*	铜蜓蜥	Brown Forest Skink	X			X	Fellowes et al. 2002	F
41	*Tropidophorus sinicus*	中国棱蜥	Chinese Waterside Skink					Boettger 1886	V
42	*Ramphotyphlops braminus*	钩盲蛇	Common Blind Snake			O		Zhou et al. 1962a	
43	*Python molurus*	蟒蛇	Burmese Python			X		Zhou et al. 1962a	VH
44	*Ahaetulla prasina*	绿瘦蛇	Jade Vine Snake			X	X	Zhou et al. 1962a	F
45	*Amphiesma stolata*	草腹链蛇	Buff-striped Keelback	X		X		Zhou et al. 1962a, c	
46	*Boiga multomaculata*	繁花林蛇	Large-spotted Cat Snake			O	X	Zhou et al. 1962c	
47	*Calamaria septentrionalis*	钝尾两头蛇	Northern Reed Snake			•	X	Lazell and Liao 1986	
48	*Coelognathus radiatus*	三索锦蛇	Copperhead Racer			X		Zhou et al. 1962a	VH
49	*Cyclophiops major*	翠青蛇	Greater Green Snake				X	Lazell and Liao 1986	
50	*Enhydris chinensis*	中国水蛇	Chinese Water Snake			X		Zhou et al. 1962a	VH
51	*Enhydris plumbea*	铅色水蛇	Plumbeous Water Snake			O		Zhou et al. 1962a	VH
52	*Oligodon cinereus*	紫棕小头蛇	Golden Kukri Snake			X	X		
53	*Oligodon formosanus*	台湾小头蛇	Taiwan Kukri Snake			X		Zhou et al. 1962a	
54	*Opisthotropis balteata*	横纹后棱蛇	Banded Stream Snake			*		Zhou et al. 1962a	V
55	*Oreophis porphyraceus*	紫灰锦蛇	Red Mountain Racer				X	Lazell and Liao 1986	
56	*Orthriophis taeniurus*	黑眉锦蛇	Black-browed Satin Snake			•		Lazell and Liao 1986	
57	*Pareas margaritophorus*	横纹钝头蛇	White-spotted Slug Snake			•	X	Fellowes et al. 2002	
58	*Psammodynastes pulverulentus*	紫沙蛇	Mock Viper		X		X	Zhou et al. 1962a	F
59	*Ptyas korros*	灰鼠蛇	Indo-Chinese Ratsnake			X		Zhou et al. 1962a, c	VH
60	*Ptyas mucosus*	滑鼠蛇	Common Ratsnake			X		Zhou et al. 1962a, c	VH
61	*Rhabdophis subminiatus*	红脖颈槽蛇	Red-necked Keelback	X			X	Mell 1922	
62	*Sibynophis chinensis*	黑头剑蛇	Chinese Mountain Snake					Lau 1996	RF
63	*Sinonatrix aequifasciata*	环纹华游蛇	Diamond-back Water Snake			•	X	Mell 1922	
64	*Sinonatrix percarinata*	乌华游蛇	Mountain Water Snake				X		
65	*Xenochrophis piscator*	渔游蛇	Checkered Keelback		X	X		Zhou et al. 1962a, c	
66	*Bungarus fasciatus*	金环蛇	Banded Krait					Pope 1935	VH
67	*Bungarus multicinctus*	银环蛇	Many-banded Krait				X	Zhou et al. 1981	
68	*Sinomicrurus macclellandi*	丽纹蛇	Chinese Coral Snake				X		
69	*Naja atra*	舟山眼镜蛇	Chinese Cobra			O		Pope 1935	VH
70	*Trimeresurus albolabris*	白唇竹叶青	White-lipped Bamboo Viper					Mell 1922	VA
71	*Trimeresurus stejnegeri*	福建竹叶青	Stejneger's Bamboo Viper	X	X				

species on 1,133 ha may be compared to well-studied South China Sea islands like Lantau Island (with 67 species on 14,200 ha), Hong Kong Island (with 58 species on 7,800 ha), or Shek Kwu Chau (with 24 species on a mere 127 ha) (Lazell 2002). These highly irregular numbers of species per area cause us to reject the null hypothesis that area alone determines species numbers (MacArthur and Wilson 1967) and prefer the hypothesis that diversity results from complex interactions of history, geology, and ecology peculiar to each individual island or insular region (Lazell 2005).

In conclusion, the number of 71 species of amphibians and reptiles at Dinghushan far exceeds the per area prediction of classic island biogeographic theory. Among these 71 species, nine are new records (five frogs, *Amolops ricketti*, *Hylarana macrodactyla*, *Hylarana taipehensis*, *Odorrana schmackeri*, and *Occidozyga lima*, and

LI ZHEN-CHANG (LZC) obtained his BA from South China Normal University (SCNU) in 1962 and taught biology there beginning in 1978. He is retired as Associate Professor Emeritus. Since the 1950s, he has been able to visit Dinghushan regularly, originally as a hometown naturalist and later opportunistically as an ichthyologist or mammalogist whenever demand arose, even during the turmoil of the Cultural Revolution in the 1970s. His focus on herpetology began in the 1980s. He has published over 50 papers and is currently working on a comprehensive volume on the amphibians and reptiles of Guangdong Province.

XIAO ZHI (XZ) has been a colleague of LZC since the 1990s at SCNU and is an assistant professor. He obtained his BA from Central China Agricultural University in 1985. His research interest extends from ecology to herpetological endoparasites. His experience with amphibians and reptiles at Dinghushan began in 1998. Since then he has led summer camp at Dinghushan every year for high school students from all over China.

QING NING (QN) was a student of LZC at SCNU where she obtained both BA and MS degrees with a focus on fish population genetics and physiological chemistry by 1985. She has been a colleague of LZC as an associate professor since 1996. She joined this project in 2006, when we realized that the fieldwork was a full decade out of date, and put together several field teams from SCNU to address those issues through 2009. She is the project leader on molecular work (DNA) to test relationships of pairs of amphibians and reptiles within and between North America and China. She has published over 30 papers, mainly dealing with fish population genetics and biogeography.

LU WEN-HUA (LWH) visited Dinghushan as a teenage naturalist in the 1970s. She was a student of LZC at SCNU where she obtained her BA in biology in 1982. She went on to get her MS (South China Agricultural University) in 1985 and began her professional career there on insect taxonomy and ecology. Her Ph.D. (University of Rhode Island) in 1992 focused on beetle population genetics. She and QN were classmates, and Dinghushan became a highpoint of their practical training at SCNU, but LWH's emphasis was largely on botany and entomology. In the early 1990s, she began noting the herpetofauna as a guide and instructor with the Green Across the Pacific (GATP) teams from the USA and has returned several times, most recently in 2009. She is a senior researcher for The Conservation Agency (TCA). She has published over 60 papers, mainly dealing with insects, amphibians, and reptiles.

JAMES LAZELL (JDL) began his professional career in biology a half century ago in 1957, collecting animals for the Philadelphia Zoo. He accumulated diplomas of BA (University of the South, Sewanee, Tennessee), MS (University of Illinois), MA (Harvard University), and Ph.D. (University of Rhode Island) by 1970. He first visited China in 1979, brought the first largely American team to Dinghushan from TCA in January 1982, and began surveys at the site that included seven of the next 13 years, to 1995. He returned several times in 2006 and 2009 with teams of colleagues. His research focuses on documenting speciation and geographic variation, biogeography, and conservation biology. He is the founder and president of TCA and has authored or coauthored over 300 papers and four books, the most recent in 2005, *Island: Fact and Theory in Nature* (University of California Press).

four snakes, *Oligodon cinereus*, *Sinonatrix percarinata*, *Sinomicrurus macclellandi*, and *Trimeresurus stejnegeri*). Of the 71 species, 21 have not been seen recently, but none of those is closely associated with old-growth forest. Faunal "relaxation" here seems to be the result of two artificial factors, human food or medicinal consumption and the demise of agriculture. Forest conservation in the last five decades may have contributed to the current abundance of some species. We doubt the possible cases of disappearance of some species and abundance of the other species are really "species turnover," and suspect additional fieldwork will reveal that the possibly replaced species are still present. Dinghushan's location is unique at the Tropic of Cancer and long-term monitoring of its herpetofaunal diversity may contribute to future collaborative studies on a global scale.

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Shooting a Desert Horned Lizard (*Phrynosoma platyrhinos*) from behind shows the pattern on its back, while the over-the-shoulder look adds eye contact and makes the photo more engaging.

TRAVELOGUE

Photographing Death Valley

Dan Suzio

www.DanSuzio.com
Photographs by the author.

I'm crouched on a black rock outcrop at the edge of a steep gully, my eyes fixed on a big lizard about ten feet away. Its broad head and heavy body are dark gray, almost black, while its thick, round tail is nearly white. It's a Chuckwalla (*Sauromalus ater*), the largest lizard in Death Valley and the second largest in all the southwestern deserts. The Chuckwalla turns its side toward me, showing the full bulk of its body, and lifts itself higher on its muscular legs. It performs a half-dozen pushups, then quickly scurries toward me, bobs its head a couple more times, and runs back to its starting point. I respond in kind — a few quick bobs of my head, then I extend my body forward and back again. The lizard's eyes widen. It takes a tentative step toward me. I crouch lower and retreat a little. Emboldened by my fearful reaction, the lizard moves closer, and this time it doesn't retreat. We repeat the dance, and eventually the Chuckwalla is less than three feet from the front of my lens. After a few dozen exposures, I slink away backwards and we're both winners — the lizard has proven himself the alpha male, and I've gotten some great shots. Only then do I look around and wonder if anyone has seen me making a complete fool of myself, doing a mating dance with a lizard.

Death Valley — a phrase that's become a part of our popular culture, symbolizing desolation and loneliness, a frightening and inhospitable wilderness. However, Death Valley is a real place that can mean many things to different people. To a geologist, it's a place where almost two billion years of Earth's history is laid bare, ready to be examined and understood. To a biologist, it's a won-

Chuckwallas (*Sauromalus ater*) feel more secure when they have the higher position and a better view of potential threats (top). Lizards may feel threatened in this position (bottom) — you're better off moving away and letting it get above you.

Although the common perception of Death Valley is that of a barren wasteland, that does not apply to all of the park. Spring snowmelt in the Panamint Mountains leads to wildflowers, such as this Brittlebush (*Encelia* sp.) in Hanaupah Canyon.

Looking up toward Dante's View from Badwater — the sign on the cliff indicates sea level, 282 feet above you.

derland of evolution, where plant and animal species have found ways not just to survive but thrive in what appears to us a harsh and unforgiving environment. To a hiker, it's a place to enjoy wide-open spaces, challenging off-trail hikes, and spectacular views. To a wildlife photographer, Death Valley can be all of these things and more. I'll try to show you what it means to me, and at the same time give you some tips on getting photos that you'll treasure.

The Big Three

If it's your first visit to Death Valley, you definitely shouldn't miss Badwater, Zabriskie Point, and the sand dunes. You'll see more people there than anywhere else (except maybe the shopping and dining areas at Furnace Creek Ranch), but go anyway. Badwater's main attraction is the fact that it's the lowest point in the United States, at 282 feet below sea level. It's also an easy place to walk out onto the salt flats and get a ground-level appreciation of Death Valley's size. From the salt flats, look back toward the parking area and find the "sea level" sign — you may be surprised how far up the cliff it is. Farther up the mountain is Dante's View, more than a mile above you.

An article in the travel section of the *New York Times* once called Death Valley a "monochromatic wasteland" — a phrase that always makes me laugh, especially when I'm standing at Zabriskie Point at sunrise or sunset, watching the constantly changing display of colors and shadows. The view from Zabriskie is a jumble of lakebed deposits that have been uplifted and folded by geologic forces and eroded by wind and water, resulting in a profusion of color and texture that can keep a photographer busy all day. The best colors (and the highest concentration of photographers) will be on display around sunrise and sunset. In spite of the crowds, I've found photographers here to be pretty considerate about not stepping into each other's photos.

Ask the average person to picture a desert, and chances are they'll think of sand dunes — not realizing that less than one percent of Death Valley and the surrounding deserts are covered in sand. However, sand dunes offer endless photo opportunities, so you'll want to make sure you include them when you visit. Sand dunes appear to be constantly shifting, but in many ways they're remarkably stable. Dune formation depends on just the right combination of factors, including a source of sand (such as an ancient lakebed or an eroding canyon) and a wind pattern that keeps the sand in one location, rather than scattering it all over the desert. The most easily accessible dunes in Death Valley are just off the main road a couple miles east of Stovepipe Wells; other major dunes in the park include Panamint Valley, Eureka Valley, and Ibex.

To photograph sand dunes, you'll want to be there in the early morning or late afternoon, when the sun is low in the sky. For the most dramatic photos, position yourself so the light is coming from the side (rather than from behind you) to emphasize the length of the shadows and the texture of the sand. Don't limit yourself to shooting grand landscapes with your wide-angle lens — shoot those, of course, but remember also to experiment with close-ups and telephoto shots. The detail in sand is spectacular, and, as you move in close, you'll find patterns that you might not have noticed at first. Don't forget that wind is one of the essential factors in dune formation, so you'll need to protect your equipment from blowing sand. Use a UV filter over your lens, and keep the lens cap on whenever you're not shooting. You might also want to wrap an extra tee

A Coyote (*Canis latrans*) takes a break from hunting along the road at the northern end of Death Valley.

shirt around your camera to keep the sand off. Be extremely careful when changing lenses. If it gets too windy, it might be best to put off your dune photography until another day. A friend and I once spent about four hours sitting in the car at Eureka Dunes in a howling wind, waiting for conditions that wouldn't destroy our cameras.

If you're out on the dunes very early and the wind is absent or mild, you might find some undisturbed tracks of a Sidewinder (*Crotalus cerastes*), a mostly nocturnal rattlesnake with a unique method of moving across the dunes. Photograph the tracks the way you would the dunes themselves, with the light coming from the side. If you're very lucky, you might find the sidewinder itself. You'll be tempted to move in for a close-up, but remember, it may be small and pretty, but it's still venomous. Be careful. Other wildlife you might see on or around the dunes include Desert Iguanas (*Dipsosaurus dorsalis*), Zebra-tailed Lizards (*Callisaurus draconoides*), and a variety of rodents and insects.

Dante's View and Greenwater Valley

For a view of Death Valley that seems to go on forever, head for Dante's View, a 5,475-foot overlook on the eastern side of the park. From this vantage point, you'll get a better understanding of how the valley was formed and how it continues to evolve. From here you can see that water played a major role in creating Death Valley. The valley floor looks exactly like what it is — an enormous dry lakebed, with gleaming white salt deposits and traces of narrow, winding channels where water once flowed (and still does, in wet years). You can also see how the alluvial fans, those piles of rocky debris spilling out from the canyons on both sides of the valley, could, given enough time, eventually cover the valley floor. With an average of less than two inches of rainfall per year, you can only imagine how many rainstorms — and how many years — it's taken to create these gigantic alluvial fans.

Take a warm coat to Dante's View, especially if you're planning to be there at sunrise or sunset — it can get pretty cold at that elevation, and it's almost always windy. On the way back from the overlook, if you have the time, turn off at the trailer parking area onto the dirt road that runs south through Greenwater Valley. It's about a 30-mile drive on a relatively good dirt road through typical mid-elevation creosote bush desert. The road was in good shape the last time I drove it, but always check local conditions before driving off the pavement, and be prepared to change your plans. In the spring, it's a great place to spend a leisurely morning or afternoon photographing wildflowers, driving slowly, and stopping whenever you see something you like. In a typical year, some of the flowering species you might find include Larkspur, Phacelia, Desert Gold, Chia, Evening Primrose, Tackstem, Gravel Ghost, Mojave Aster, Beavertail Cactus, and, of course, the ubiquitous Creosote Bush.

Shooting close-ups of wildflowers can be challenging, as even the slightest breeze can cause enough movement to throw your subject out of focus. Your tripod should allow you to get close to the

View of Manly Beacon from Zabriskie Point at sunrise. This is one of the most popular places to photograph in the park, offering a constantly changing display of colors and shadows.

ground; if it doesn't, you might want to buy a second, mini tripod — mine has a minimum height of about three inches. I also use a collapsible reflector (of the type made by Photoflex, Westcott, and others), which not only adds light to the shadows but can be an effective windbreak as well. Your own body can also help to block the wind — just make sure you're not blocking the light at the same time. Some flower photographers like to use a "plamp," a flexible arm with a clamp at either end; you attach one end to your tripod and clamp the other to the stem of the flower, just outside the photo. Above all, be patient. Set up your shot and then wait for the right moment to click the shutter. If it's too windy for a sharp picture, give in to Mother Nature and experiment with photographing the wind, or at least its effect on the flowers. Depending on how fast your flowers are moving, a shutter speed of between 1/30 second and one second should give you some good results.

Desert Iguanas (*Dipsosaurus dorsalis*) often climb Creosote Bushes in the spring in search of tender new leaves.

Saratoga Spring and Ibex Dunes

Near the southern border of the park is Saratoga Spring, a 15-acre oasis that attracts a great variety of migratory birds. To get there, you'll need to drive out of the park at Shoshone, head south on state highway 127, and watch for a turnoff to the west about 24 miles south of town. If you're entering the park from Baker, Saratoga Spring is a good first stop. More than 150 species of birds have been recorded here, including many spring and fall migrants stopping for a much-needed rest on their long journeys. The ponds here also are home to the Saratoga Spring Pupfish, an endemic reminder of a time when the entire valley was covered by a vast lake. Sit quietly at the edge of the pond and you can watch the brightly colored males defending their territories and trying to attract females. The Ibex Hills, overlooking the spring, offer the best view of the entire wetland — but be prepared to scramble up a steep, rocky slope.

Desert Prickly Poppy (*Argemone munita*) at the edge of Racetrack Playa in the Panamint Range.

Not far from Saratoga Spring are the Ibex Dunes, which can be reached only on foot, either by hiking from a dirt road that turns off of the Saratoga Spring road just south of the Ibex Hills, or from Highway 127 just south of the Saddle Peak Hills near the turnoff to Dumont Dunes. Ibex is one of the smallest dune systems in the park, but also one of the most beautiful. Somehow the alignment and shape of these dunes, the color of the sand, and the direction of the light have all combined in just the right way to make a photographer happy. This is also the only place in the park where you might see a Mojave Fringe-toed Lizard (*Uma scoparia*).

Side Canyons

As you study your map of Death Valley, you'll notice the 4WD roads entering several of the canyons on the western side of the valley, including Cottonwood Trail, Hanaupah, Johnson, Galena, and Warm Spring. Any of them can be an interesting place to explore for a day or several days. Camping is generally permitted in backcountry areas, as long as you're at least two miles from a paved road (check with park headquarters for other restrictions). Hanaupah Canyon is one of my favorites; it's a rough, slow drive, but worth it, especially in springtime. The upper part of the canyon carries snowmelt from Telescope Peak, ensuring a good wildflower bloom in most years.

Another favorite is Warm Spring Canyon, where you'll find an old mining camp and some abandoned equipment once used to process ore. The contrast between the delicate, colorful flowers and the stark, rusty metal can make for some interesting photos. If you're really feeling adventurous (and have a high-clearance four-wheel-drive vehicle), continue up Warm Spring Canyon to Butte Valley, a beautiful place to explore the middle of the Panamint Range.

In any of the canyons, you're likely to find Chuckwallas or Collared Lizards (*Crotaphytus bicinctores*), two of the larger and more photogenic lizards in the park. When you first see one of these lizards, it's already seen you. It might just be watching, assessing how much of a danger you pose, or it may already be heading for a crevice, or at least toward the other side of a rock. Approach too quickly and it will disappear — but, if you're patient, you can usually get close enough for a good photo. Both species have very good eyesight, and depend on having a clear view of their surroundings to avoid predators. They also seem to feel safer when perched on a high rock. With that in mind, you can position yourself against a rock where you won't block the view (you especially don't want the sky behind you) and the lizard is slightly above you. Take your time, moving only a few inches with each step, and watch the animal carefully for signs of stress. If it seems concerned, stop where you are, or back down a little. If a Chuckwalla does run into a crevice or other hiding place, make yourself comfortable. They don't generally stay hidden for long; if you can sit still for ten or twenty minutes, you'll likely see it again. Collared Lizards are a different story. In my

Creosote Bushes (*Larrea tridentate*) grows on the Ibex Dunes. Shooting late in the afternoon, when the sun is low in the sky, adds more texture and contrast to the sand while giving the dunes a warm glow.

experience, when you get too close to a Collared Lizard, it will run, and you might not get another chance at it.

When you move in for a close-up, pay careful attention to your subject's eyes — they're the key to a successful portrait, whether human or animal. The closer you are to your subject, the less depth-of-field you'll have, which means that parts of the photo will be in sharp focus while other parts will not be. Make sure the eye is sharp; when people look at a photo, they look at the eyes. Eye contact is also important. A photo will be more engaging if the subject seems to be looking back at the viewer – but you don't want to overdo it.

Desert reptiles are rarely active during the heat of the day. A Mojave Desert Sidewinder (*Crotalus cerastes cerastes,* left) seeks shelter under a Creosote Bush at midday. Sidewinders are generally active at dusk and dawn. Mojave Shovel-nosed Snakes (*Chionactis occipitalis occipitalis,* right) are mostly nocturnal, but occasionally may be seen in early morning or evening.

A Mojave Desert Sidewinder (*Crotalus cerastes cerastes*) photographed early in the morning on the Ibex Dunes; the angle and direction of the sun help to emphasize the snake's tracks.

The animal should look natural, like it just happened to look at the camera, not like it's reacting to the photographer's presence. A little reflection in the eye, whether from the sun or a fill-flash, can be the difference between a tired-looking animal and one that appears alert and full of life. Finally, whenever possible, shoot from your subject's eye level or close to it. Avoid shots where you're looking up or down at a steep angle. Instead, either get down on your belly or start climbing — whatever it takes to meet the animal at its own level and in its own world.

A Desert Iguana (*Dipsosaurus dorsalis*, left) basks on a rock near the south end of the valley. This simple portrait illustrates the importance of the subject's eyes — the eye is sharp and reflects a bit of sunlight; and the photo is shot from the lizard's eye level. The over-the-shoulder look at this Zebra-tailed Lizard (*Callisaurus draconoides*, right) on the Ibex Dunes adds eye contact and makes the photo more engaging.

A Merriam's Kangaroo Rat (*Dipodomys merriami*) at Wildrose Canyon. Kangaroo rats are fast, and generally uncooperative when it comes to photography. When you see one, you have to react quickly to get the shot.

Nevada Goldeneye (*Heliomeris multiflora nevadensis*) in Butte Valley. If the wind makes a sharp flower photo impossible, photograph the wind. Experiment with shutter speeds between 1/30 sec and 1 sec (or slower).

Ghost Towns

On your way up to Dante's View, you might have noticed a handful of long narrow buildings on the hill to your left. This is Ryan, an old mining camp that was active in the 1920s. In later years, it functioned briefly as a resort hotel and was used as the set for a few episodes of Death Valley Days. It's on private land behind a locked gate, so don't attempt to go there. Instead, if you want to photograph a ghost town, drive out of Death Valley to the northeast toward Beatty, Nevada, and turn off at Rhyolite. There you'll find the ruins of what was once the biggest city in the area. When Las Vegas was nothing more than a railroad stop and a handful of tents, Rhyolite was a rowdy boomtown served by four stagecoaches each

Looking down at the Badwater area from Dante's View; I used a 200-mm lens to isolate interesting patterns in the valley floor.

Saratoga Spring, at the south end of Death Valley, is a stopping point for migrating waterfowl, including a Canada Goose (*Branta Canadensis*) and American Coots (*Fulica americana*). The Avawatz Mountains rise in the background.

day. The downtown area had concrete sidewalks, electric lights, dozens of saloons and gambling halls, an assortment of restaurants and hotels, a couple of churches, and, of course, brothels. It's a lot quieter now than it was in 1906. Rhyolite is one of the most-photographed ghost towns in the country, but on many visits I've been able to spend half a day photographing the ruins without seeing even one other person.

Salt Creek Pupfish (*Cyprinodon salinus*) mating in Salt Creek.

Titus Canyon

On your way back to Death Valley, two miles west of Rhyolite, take a detour through Titus Canyon. It's not a short drive. The park service recommends you allow two to three hours, but, if you're a serious photographer, you might want to double that. It's a one-way road, so once you get started, you're committed to it for a while. After crossing the Amargosa Desert, the road climbs into the Grapevine Mountains for some spectacular, sweeping views in the areas of White Pass and Red Pass. This is one place where you might wish you had brought a geologist along to explain what you're seeing. A good alternative is *Geology of Death Valley* by Miller and Wright, which is for sale at the Furnace Creek Visitor Center.

About three miles beyond Red Pass is the ghost town of Leadfield. Unlike Rhyolite, this boomtown went bust almost immediately. Built on hype and exaggeration, it made a lot of money for its unscrupulous promoters, but the prospectors, merchants, and investors weren't so lucky. A post office was established here in August 1926 and closed barely six months later. What remains are mostly corrugated metal shacks, in sharp contrast to Rhyolite's multi-story concrete buildings, making this another great place to stop for photos, with lots of opportunities to experiment with shadows and textures.

A couple miles past Leadfield is a sign describing the petroglyphs in this area. When you photograph the petroglyphs, don't touch them or climb on the rocks; they're thousands of years old and

The Ibex Dunes are the only place in Death Valley where Mojave Fringe-toed Lizards (*Uma scoparia*) occur. The elongated scales on their toes provide traction for running in loose, dry sand.

can't be replaced! Just after the petroglyphs is Klare Spring, a wet spot at the side of the road that is in fact the biggest source of water in the Titus Canyon area. Look carefully in the vegetation along the spring and you might find stream orchids, the only orchid native to the California deserts. The canyon narrows dramatically about three miles beyond Klare Spring, the near vertical walls at times only about 15 feet apart. Here you'll find intricate mosaics and contrasting rock strata, all created by millions of years of folding, faulting, and erosion. Just as abruptly as it began, the narrow canyon ends when it opens onto an alluvial fan on the eastern side of Death Valley.

Wildrose Canyon at sunset, as seen from the Wildrose Peak trail. Carrying a heavy tripod on the trail may be a nuisance, but it allows you to use a telephoto lens to isolate part of the scene. This photo was taken with a 300-mm lens.

Pacific Chorus Frogs (*Pseudacris regilla*) in amplexus (left); spring snowmelt from the Panamint Mountains provides breeding habitat for these frogs in upper Hanaupah Canyon. A Mojave Collared Lizard (*Crotaphytus bicinctores*) in Wildrose Canyon (right).

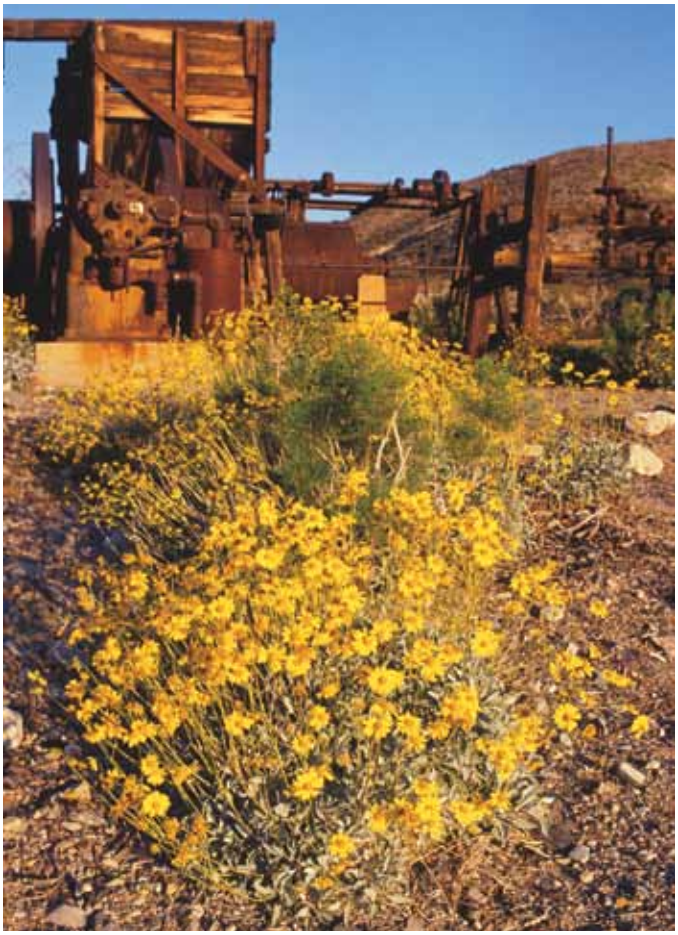
Wildrose Canyon

Wildrose Canyon, on the western side of the park, has a little of everything. It's one of my favorite locations for spring wildflowers, with more variety than I've seen in most other places in the park. The road into Wildrose starts near sea level in Panamint Valley, and ends at over 8,000 feet, passing through a variety of desert habitats along the way. If you like to photograph flowers, plan on taking a day just to drive up the canyon, stopping wherever you see something interesting. Hike up one of the side washes in the lower parts of the canyon, and you might find the rare Panamint Daisy, a bright yellow sunflower four inches across that grows on stems up to two feet tall.

Farther up the canyon, you'll find a row of enormous stone kilns that once were used to make charcoal for a silver smelting operation in the Argus Range, west of Panamint Valley. Plan on spending some time at the kilns; their shapes and shadows can make for some dramatic compositions. Near the kilns is a trailhead that will lead you to 9,064-foot Wildrose Peak, a moderately strenuous 4.2-mile hike (each way) with some great views. For a more strenuous hike and even more spectacular views, drive to the end of the dirt road and hike to Telescope Peak, at 11,049 feet the highest point in the park. On both trails, you'll be walking through forests of Piñon Pines, a very different sort of habitat than you saw in the lower parts of the park.

The Wildrose campground, at about 4,100 feet, is a pleasant place to camp — it doesn't get nearly as hot as the lower elevations and seems to be ignored by the vast majority of visitors to the park. Near the campground are a couple of springs that attract warblers, finches, orioles, and many other birds, as well as small mammals. I've had more success photographing jackrabbits, cottontails, and kangaroo rats here than anywhere else. If you're really lucky, maybe you'll have the kind of experience I had one evening.

I had arrived at Wildrose about 5 PM and, after a long day of driving, was eager to stretch my legs and have a look around. I started down the trail that leads past a small spring, thick with mesquite, at the far end of the campground. Almost immediately, I saw a bobcat on the hillside, just above my eye level and no more than ten steps in front of me. I stopped. It stopped. I took a step back; it took a step back. Neither of us knew what to do next. It was so close, and so unexpected, that it took me a few seconds to really understand what it was. I ran through a checklist in my mind: tufted ears ... short tail ... long legs ... spots ... twice as tall as a house cat ... this was definitely a bobcat.



Old mining equipment in Warm Springs Canyon makes an interesting contrast to this Bush Sunflower (*Encelia actoni*).

A wide-angle lens includes the area surrounding this building in the Rhyolite ghost town and adds drama to the sky.

A wide-angle shot of this corrugated tin building in Leadfield, a 1920s mining camp on the Titus Canyon Road, conveys the isolation that the residents must have felt.

Have I mentioned that my camera was still in the car, a hundred yards behind me?

For the next few seconds, while the cat and I stared at each other, I had two conflicting impulses. The first, of course, was to run back for my camera. The other was to stay where I was and enjoy the moment — I had never been this close to a bobcat before, and might never be again. And besides, did I really expect a bobcat to just sit and wait for me? I decided to go for the camera. All the way to the car, and all the way back, I cursed myself. How could I be so stupid as to walk away from my camera in a place like Wildrose? I knew I'd never see the cat again, at least not that close.

I guessed the cat would go up the hill, so on the way back I went up the hill myself, coming over a low ridge a few yards above where it had been. I stood for a while, scanning the hillside as well as the trail and spring below. Nothing. Then I thought I saw movement behind a sagebrush about 20 feet below me. Something was different about that bush; the ground behind it was the wrong shade of brown. I aimed my lens at the bush, trying to focus beyond the branches on whatever might be behind them. I couldn't believe what I was seeing when the cat's face popped into focus. Yes, the bobcat had sat — literally — right where I had left it, and waited for me to return with my camera. Thank you, Mother Nature!

A petroglyph near Klare Spring on the Titus Canyon Road; photographing petroglyphs can be a challenge — they blend with the rocks and are often hard to "read" in a photo. Increasing the contrast when processing the image can help.

Panamint Daisy (*Enceliopsis covillei*) and a Black-tailed Jackrabbit (*Lepus californicus*) near Wildrose Canyon. Backlighting can make the flowers (or the ears) appear more brilliant, and cause them to pop out from the background.

A Great Basin Whiptail (*Aspidoscelis tigris tigris*, left) digs for insects in Wildrose Canyon. Whiptails are fast-moving and skittish, but with enough patience you can get a good photo. A Western Fence Lizard (*Sceloporus occidentalis*, right) on the ruins of an old stone cabin in Wildrose Canyon.

Equipment Choices

Everyone's needs are different when it comes to camera equipment, depending on what subjects you like to photograph, what you plan to do with the photos, and your budget. If you want a basic outfit for shooting scenics, small wildlife, and close-ups in Death Valley, I'd recommend a digital SLR and three lenses — a medium-range telephoto zoom, a macro lens, and a wide-angle zoom. Add to that a sturdy tripod with a quick-release mount, a collapsible reflector, a pocket full of memory cards, and maybe a flash, and you should be able to handle whatever photo opportunities you find. Personally, the lens I use most for reptile photography is a 105-mm f2.8 macro lens, which allows me to fill the frame with my subject while maintaining a reasonable distance. When I need a longer lens, I like to use a 300 mm or an 80–400 mm zoom. For wide-angle shots, I use a 17–35 mm zoom or a 10.5 mm fisheye lens.

A number of "super-zoom" lenses are available. These go all the way from wide-angle to telephoto in one lens. Nikon and Canon each make an 18–200 mm zoom. Although tempting to get one of these and use it for everything, keep in mind that they're generally not as sharp as fixed focal length lenses or zooms with a smaller range. You'll have to consider the tradeoff between sharpness and convenience, which is not always an easy decision. I've missed many photos because my subject moved while I was changing lenses. In general, higher-priced lenses make sharper photos (when you're comparing lenses of the same focal length and maximum aperture), but that's not always the case. Before buying a new lens, read some reviews and see what other photographers think of it. I've found some very useful reviews at www.kenrockwell.com and www.dpreview.com.

Food and Lodging

All of the locations mentioned in this article can be found on the park map you receive when you pay your entrance fee. More detailed maps and guidebooks are available at the visitor center at Furnace Creek. Information also is available on the official Death Valley website at www.nps.gov/deva as well as a number of privately owned websites (just Google "Death Valley").

Several campgrounds are available in the park, at elevations ranging from sea level to 8,000 feet; your choice of where to camp may depend on the time of year and your tolerance for extreme temperatures. Lodging inside the park ranges from motel-like accommodations at Panamint Springs and Stovepipe Wells to the mid-range Furnace Creek Ranch and more upscale Furnace Creek Inn. Outside the park, lodging can be found at Shoshone, Death Valley Junction, Beatty, and other towns. Stores, restaurants, and gas stations are located at Panamint Springs, Stovepipe Wells, and Furnace Creek.

A Side-blotched Lizard (*Uta stansburiana*) basks on a rock at the side of the road near the campground in Wildrose Canyon.

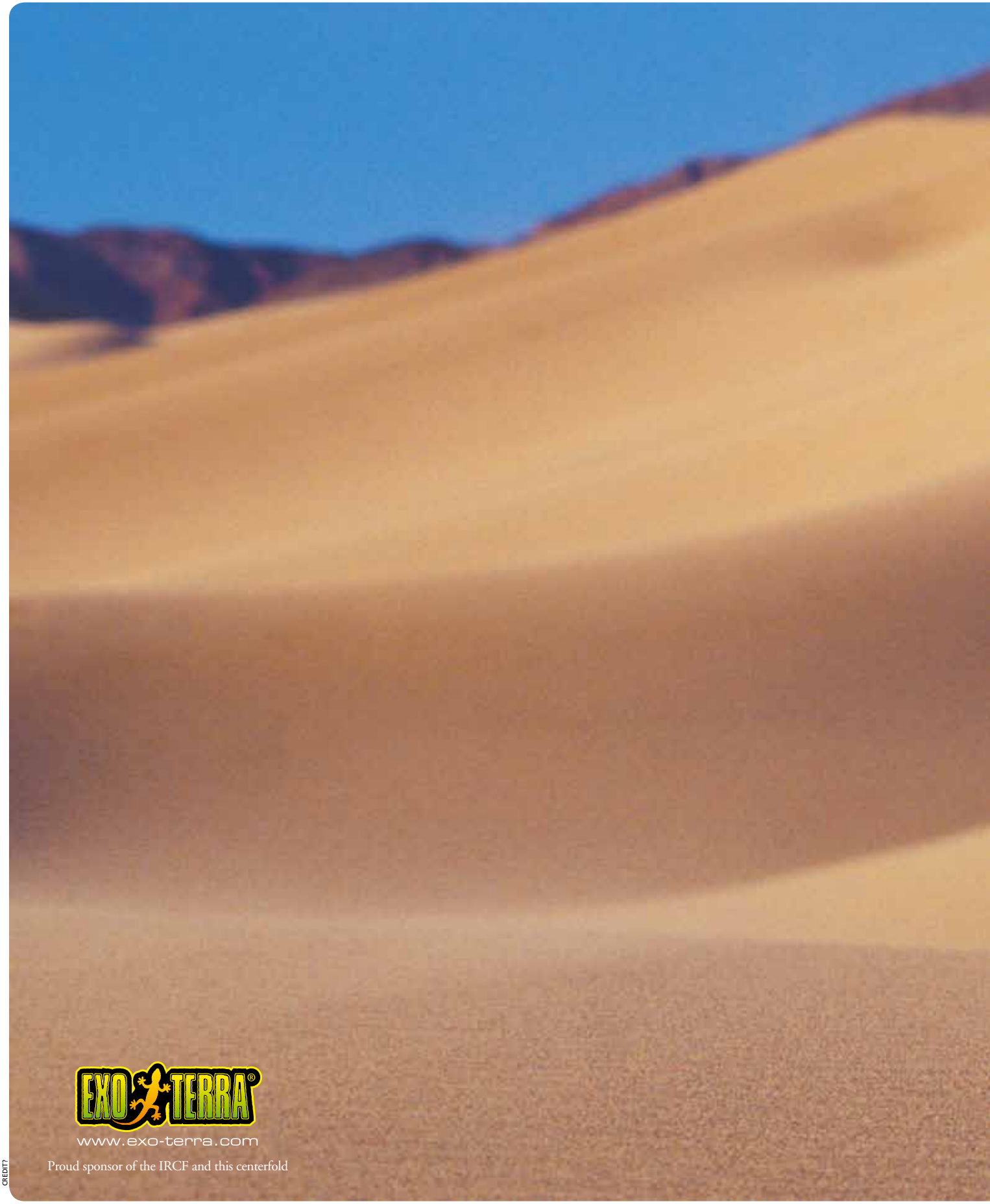
This young Mojave Desert Sidewinder (*Crotalus cerastes cerastes*) was climbing into a Desertgold Plant (*Geraea canescens*) in the Ibex Dunes. Arboreal activity is rare in Sidewinders.

Bobcats (*Lynx rufus*) can be surprisingly tolerant of photographers — but only when they're in the mood. This one gave me a couple of minutes and then it was gone.

I moved left for a better view. The cat looked at me for a moment, then walked downhill toward the spring — and lay down in the shade of another bush. A minute later, it stood up and disappeared into the mesquite. That was that. I stayed for two days and never saw the cat again. I had three photos — and one more surprise from Death Valley.

About the Author

Since 1978, Dan Suzio's photographs have appeared regularly in a wide variety of publications and museums, including *Audubon*, *Bay Nature*, and *Your Big Backyard* magazines, as well as the newly redesigned California Academy of Sciences. To see more photographs, and to order prints, cards, or other products, visit www.DanSuzio.com.



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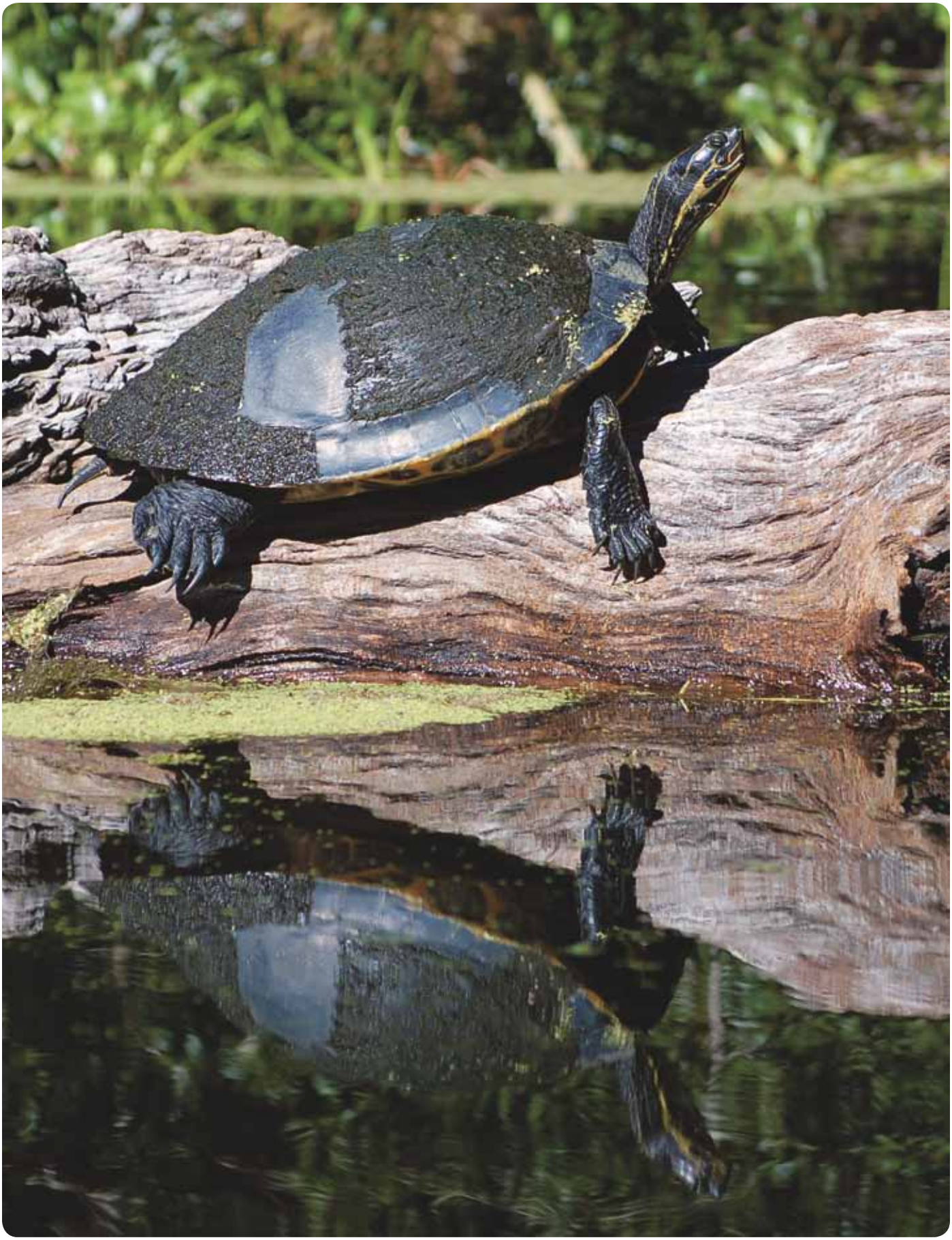
A Mojave Desert Sidewinder (*Crotalus cerast*

es cerastes) in the Ibex Dunes of Death Valley.



ANTHONY LAU

A Suwannee Cooter (*Pseudemys suwanniensis*) basking on a log should remain a familiar sight thanks to new rules limiting the take and possession of the state's freshwater turtles.

New Florida Rule Limits Take and Possession of Freshwater Turtles

Anthony Lau

Department of Wildlife Ecology and Conservation
University of Florida, Gainesville, Florida 32611, USA (alau0924@ufl.edu)

"If we allowed it, the Chinese — more than one billion Chinese — could and probably would eat every single turtle in existence in Florida in one year."

Dale Jackson
Biologist

"The … new regulations will provide the best protection for freshwater turtles in any state in the U.S. and establish Florida as a leader on this issue in North America."

IUCN Tortoise and Freshwater Turtle Specialist Group

"This decision may be one of Florida's greatest conservation stories."

Brian Yablonski, Commissioner
Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FWC) recently passed new rules regulating the take and possession of freshwater turtles to ensure the long-term persistence of these animals. The new rule, which took effect on 20 July 2009, prohibits taking or possessing any wild turtles from the state's imperiled species list, including Alligator Snapping Turtles (*Macrochelys temminckii*), Barbour's Map Turtles (*Graptemys barbouri*), and Suwannee Cooters (*Pseudemys suwanniensis*). Take of species that are similar in appearance to those that are imperiled also is prohibited. Other freshwater turtles not mentioned above can be taken throughout the year, except for Softshells (*Apalone* sp.), for which a closed season extends from May through July — but only for non-commercial use, and take is limited to one turtle per person per day for most species. The take of turtle eggs is prohibited.

ANTHONY LAU

Suwannee Cooters (*Pseudemys suwanniensis*) share a basking site with a Double-crested Cormorant (*Phalacrocorax auritus*).

SUZANNE L. COLLINS, CNAH

New rules prohibit entirely the take of state imperiled species, such as Barbour's Map Turtles (*Graptemys barbouri*; left) and Alligator Snapping Turtles (*Macrochelys temminckii*; right). Individuals who keep them as pets will be required to obtain a permit.

Florida has one of the most diverse freshwater turtle faunas (18 species) in the United States, and now it also has one of the strongest measures to protect them. Oklahoma and Texas have banned harvests from public waters or land, whereas South Carolina is restricting the harvest of certain species. Nevertheless, in certain parts of Florida, turtles still can be found on some restaurant menus. However, the real concern comes from the ever-growing numbers of turtles exported each year from the United States to Asia.

In recent years, the demand for turtles has grown dramatically in China, largely attributable to that nation's rapid economic development (Shi et al. 2007). Many turtle species native to China and surrounding countries are either threatened or facing extinction due to unsustainable harvests and ever-increasing demand for human consumption (van Dijk et al. 2000). Thousands of Florida turtles are exported each year, and conservationists are concerned that wild populations will face a fate similar to those in Asia. The conservation community reacted by promoting the new legislation, which was supported by Florida Governor Charlie Crist.

Turtles are considered to be a delicacy in many Asian countries. Some also believe that turtle meat can strengthen human immune

ANTHONY LAU

Florida Redbellied Turtles (*Pseudemys nelsoni*) take flight when disturbed at a commercial turtle farm in Florida.

SUZANNE L. COLLINS, CNAH

Softshell turtles, such as this Florida Softshell (*Apalone ferox*), may still be taken in small numbers, but a closed season for softshells extends from May through July.

systems or even cure cancer. Turtle plastra are used in traditional Chinese medicine to make a "turtle jelly" that supposedly has curative powers (van Dijk et al. 2000).

Most of the demand has been met by commercial turtle farms, but the commercial collection of wild turtles appeared to be on the rise, although the actual number taken from the wild is unknown. Wild turtles are believed to have more health benefits to humans, and turtle farmers believe wild turtles are better breeders. Although the current demand continues to grow, some conservationists believe that the rate will decline as many younger Chinese are becoming increasingly westernized and do not believe in traditional Chinese medicine and the proclaimed health benefits of eating turtles. Unfortunately, that will be too late for many turtles — at least those from Florida may not be subjected to that fate.

SUZANNE L. COLLINS, CNAH

State-endangered species, such as this Striped Mud Turtle (*Kinosternon baurii*), are afforded additional protection under new regulations recently passed by the Florida Fish and Wildlife Conservation Commission.

Although individuals who keep imperiled species as pets will now be required to possess a permit, the most dramatic impact of the new FWC rule most likely will be felt by commercial fishermen who hunt turtles for additional income and the state's roughly 28 licensed turtle farmers who rely on wild turtles to replenish captive stock. Some turtle fishermen claim that they could lose as much as $10,000 per year in extra income, but supporters of the ban say it was absolutely necessary to keep the state's turtle populations from collapsing.

More information about Florida freshwater turtles and the new rule on take and possession can be found at the FWC website: www.myfwc.com/WILDLIFEHABITATS/SpeciesInfo_FreshwaterTurtles.htm.

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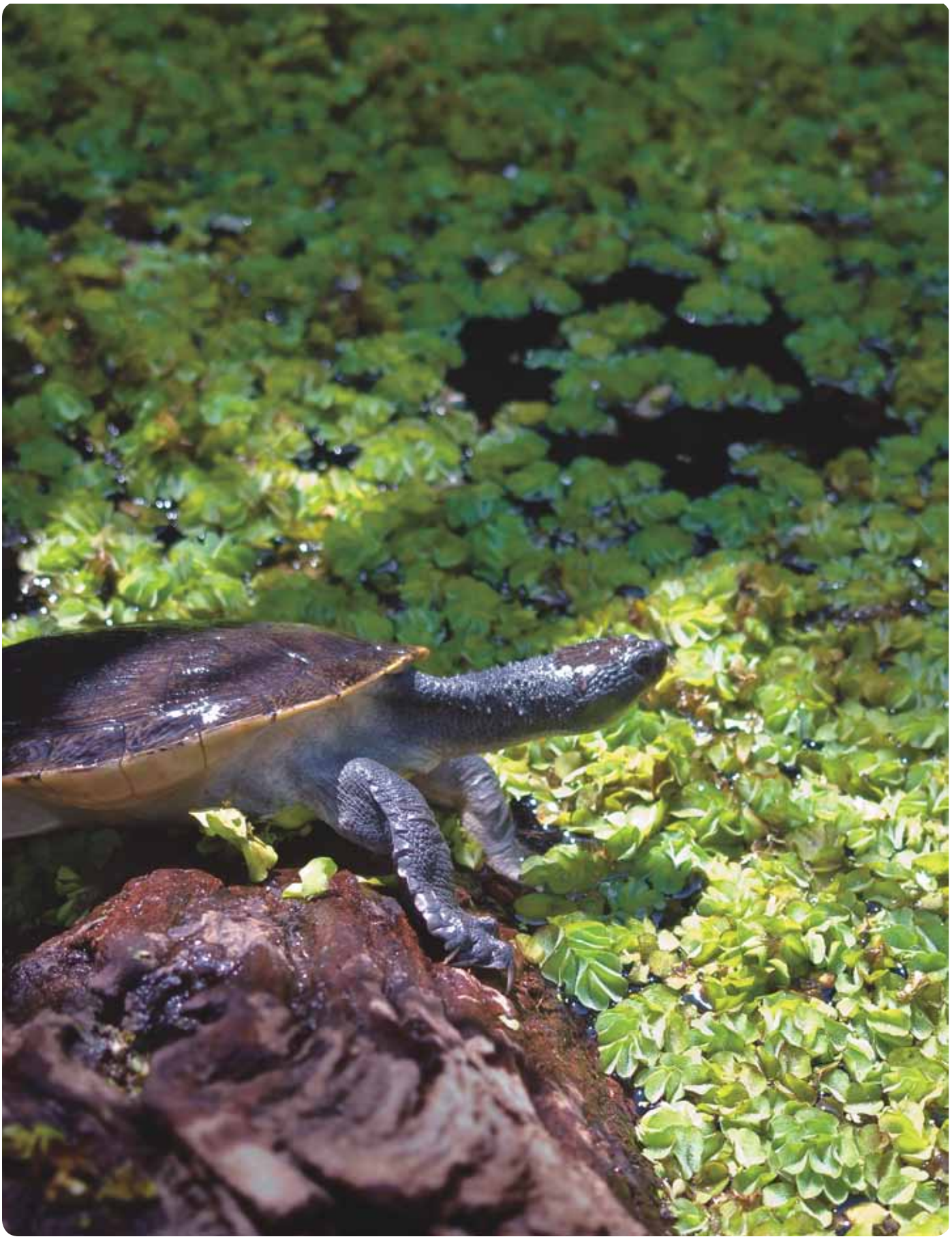


CHUCK SCHAFFER

Mary River Turtle (*Elusor macrurus*)

Frankly, Mary, I Don't Give A Dam(n)

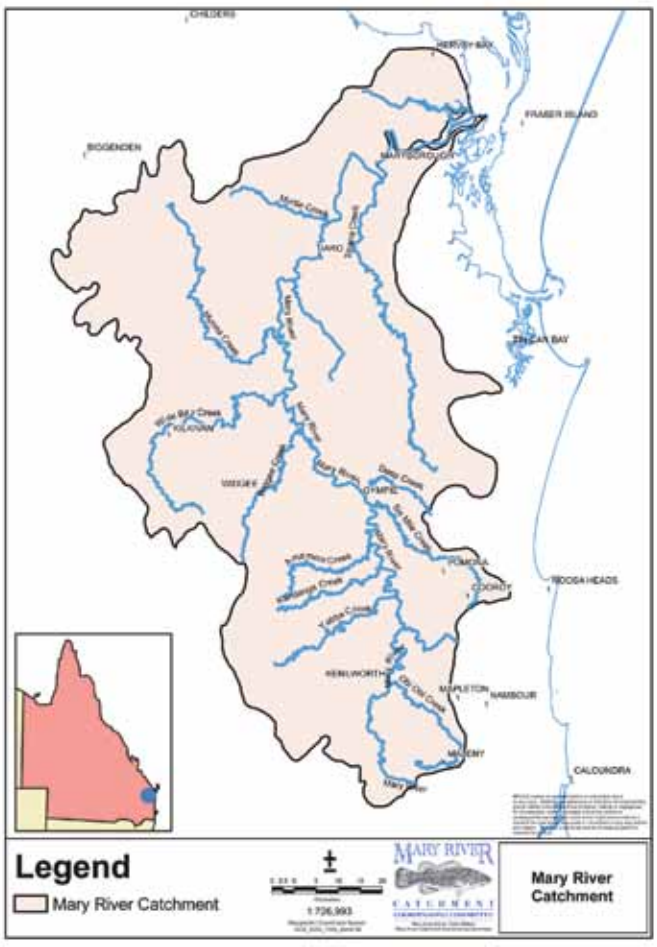
Chuck Schaffer[1] and Rick Schaffer[2]

[1]Turtle and Tortoise Newsletter, Jacksonville, Florida USA [Chelonian1@aol.com]
[2]Stanton College Preparatory School, Jacksonville, Florida USA

The story reads like a detective novel, rife with abundant mystery, intrigue, and insidious dealings. The protagonists face trials and tribulations beyond their control and likely to result in dire consequences. The current arch-villain is a dam — and, as yet, the story is without a conclusion.

We open in the communities of Kenilworth, Conondale, Jimna, and Amamoor at the headwaters of the Mary River in the Conondale Ranges near Maleny. From there, one has a wonderful view of the 26–27 million-year-old extinct volcanoes that make up the Glasshouse Mountains 70 km northeast of Brisbane. These ancient volcanoes were named by Captain James Cook in 1770 because their shape reminded him of the glasshouses or huge glass furnaces of his native Yorkshire.

Eventually, the Mary empties 307 km downstream into the Great Sandy Straits west of Fraser Island at River Heads (Tiaro Landcare Group 2008). In Cook's time, the traditional owners of the land were the Kabi Kabi (or Gubbi Gubbi), who lived in the hinterland and on the Sunshine Coast and called the Mary River the Moocooboola, and the Butchulla, who lived on Fraser Island at the mouth of the Mary River, which they called Moonaboola. The river was of great cultural importance to both, and also to other local indigenous groups.



Map of the Mary River Basin (from Flakus and Connell 2008).

CHUCK SCHAFFER

Evidence of Goanna (*Varanus varius*) predation on a turtle nest.

Andrew Petrie and his party rowed up the river in 1842 until rapids near Tiaro blocked their passage. At that point, they renamed it the Wide Bay River (Tiaro Landcare Group 2008). In 1847, the Governor of New South Wales (which included Queensland at the time), Charles Augustus FitzRoy, again changed its name, this time to Mary, after his wife, Lady Mary Lennox, who had just died in a carriage accident (Cann 1998).

For many reasons, beyond the naming (and renaming) of its river, this was a land of mysteries, not the least of them being


CHUCK SCHAFFER

Their highly developed sense of smell makes Goannas, such as this Lace Monitor (*Varanus varius*), a major problem on nesting beaches.

the Mary River Turtle (*Elusor macrurus* = the elusive long-tailed escaper), which until recently (relatively speaking) had remained unseen and unknown to the scientific community despite a long presence in pet shops.

Mary River Turtles are Australia's largest freshwater chelonian, growing from 3–4-cm-long hatchlings to animals with a carapace length of 34 cm. These turtles once were a common sight in Australian pet shops in Adelaide, Brisbane, Melbourne, and Sydney. They were sold as "penny turtles," but their origin was a mystery (Cann 1994).

The species soon attracted the attention of turtler extraordinaire, John Cann, author of the definitive treatise on Australian turtles. Although, strictly speaking, he is considered an amateur, John has a long history of working with museums and academic researchers ranging from Rod Kennett in Darwin to Arthur Georges at Applied Ecology Labs and Ross Sadlier at the Australian Museum. In all likelihood, not a single researcher, private keeper, or museum curator in Australia (and beyond) has failed to benefit from John's knowledge, which he shares quite readily and generously. The Australian Museum in Sydney holds many of his specimens, from which he described the Mary River Turtle (Sadlier 2004) — but that is getting a little ahead of our story.

John spent in excess of 30 years attempting to trace the source of the "penny turtles." He followed up lead after lead, tracking turtle dealers, suppliers, and eventually learning the name of the mysterious collector, John Greenhalgh of Maryborough, Queensland. Correspondence with Greenhalgh ultimately led Cann to nesting beaches and localities where collecting had occurred (Cann 1998). Subsequent searches were in vain, but one day a note arrived with information that an adult had been captured. The long drive from Sydney seemed pointless, as Greenhalgh presented him with an *Elseya dentata* — but, after the shock (and joke) had worn off, he was presented with another turtle, this time an adult Mary River Turtle (Flakus and Connell 2008). Subsequent trips to the river finally led him to the habitat that was home to the turtle that Peter Pritchard once jested should be named "*petshopi*" (Pritchard, pers. comm.) — Queensland's Mary River far to the north of Sydney. John ultimately published a formal description with John Legler in 1994 in *Chelonian Conservation and Biology* (Cann and Legler 1994).

The Mary River Turtle is Australia's largest short-necked turtle, and is endemic to the Mary River in southeastern Queensland, the only place in the world where a natural population occurs. Identifying features include a low streamlined shell and a very large tail. The shell (carapace) of a large male can reach 42 cm in length, and tail length can be as much as 70% of the length of the carapace. A female's shell can reach 33 cm. The shell's low profile allows these turtles to swim at astonishing speeds. Mary River Turtles often are observed with only the tips of their snouts protruding above the water's surface. These turtles also can absorb oxygen while submerged via a specialized sac-like cavity (cloacal bursa) at the base of the tail. Due to this unique physiology, they require flowing water to survive. Most of an adult turtle's diet consists of filamentous algae, other plant material, such as roots, stems, and bark of submerged and aquatic plants, and fallen fruit from trees growing along the riverbank. Adults also opportunistically feed on animal matter. Using their claws, they have an amazing ability to open and crush bivalves before swallowing the soft parts and some shell fragments.

In years gone by, the species mass-nested in the hundreds, if not thousands. During the 1960s and 1970s, it mass-nested in the hundreds. Between 1962 and 1974, as many as 15,000 eggs were collected annually. Many of these eggs were incubated and sold through the aquarium trade while it was still legal, hence the "pet shop" turtle.

However, as quickly as the turtle was located and described, it appeared that it would be lost — and it is now considered to be one of the most threatened species of freshwater turtles not just in Australia, but in the world. The turtle's restricted habitat, age at


CHUCK SCHAFFER

Mary River Turtles need sandy river banks to nest.


MARILYN CONNELL

The senior author checking a Mary River Turtle nesting site.

maturity, predation, flooding, and changes to its habitat combine to threaten its long-term survival.

Years of harvest of the majority of eggs for the pet trade, predation by introduced (e.g., foxes, dogs, and humans) and native predators, such as Goannas (Monitor Lizards in the genus *Varanus*), had taken their toll. These same factors continue to reduce the population, particularly numbers of juveniles. Females do not reach adulthood until they are 15–20 years old. In the 2004–2005 season, only 120 females were known to have laid eggs. Entire cohorts were missing; the majority of individuals were adults and no real recruitment was taking place.

The Mary River Turtle is one of two Australian turtles listed as endangered by the IUCN (IUCN/SSC TFTSG 2008), which simply means that the species has met the criteria to be considered at very high risk of extinction in the wild (IUCN 2000). The species also is included among the 25 most endangered turtles in the world (Turtle Conservation Fund 2003). Although 200 of the world's 300 or so turtles are in trouble, the Mary River Turtle is listed as one of the "Top 25 Turtles On Death Row" (Conservation International 2003).

Unfortunately, efforts to conserve an animal that should be considered a national treasure have been negligible. In the quest to meet Queensland's water needs, an absolutely beautiful landscape is to be submerged — and turtles and dams don't coexist well. Many biological and physical factors ultimately determine which turtle species occur in rivers. Changes in any of these factors can have an immense impact on species that are specialized for a particular environment. Damming indirectly damages or destroys river turtle populations by decreasing their survival rate and decimating populations well before the consequences are recognized (Moll and Moll 2004).

The Traveston Crossing Dam, if constructed, would flood 77 km^2, including several thousand hectares of rich farm and pasture land that includes 33 dairy farms, 11 of which are close to transport and population centers, and all of which contribute over $40 million dollars annually to the local economy. Not surprisingly, few locals are excited about the dam. They are, however, fiercely protective of their natural environment.

The dam project stands to displace hundreds of families, many of whom have held this land for generations. In addition to the potential loss of more than 1,000 freehold properties and all public infrastructure in the area, one must also consider the direct economic impact on the surviving local businesses in and near the proposed project. Although difficult to weigh against the need for an adequate supply of water, alternatives might exist that would avoid the either-or dichotomy facing the region today.

The water, which would normally flow to the communities downriver, would be stored behind a shallow dam. In the first stage, the "reservoir" is designed to have an average depth of 6 m. Average depth would reach 8 m in stage two, although a large portion would only be 2-m deep. At such shallow depths, the reservoir would not only be subjected to extensive evaporation, but also to very high rates of seepage, as well as contamination and known water quality problems emanating from high nutrient loads and diminished oxygen. Such a large expanse of still, shallow water with minimal flow, high temperatures, and stratification also is likely to encourage the growth of aquatic weeds and algae. The new environment will be better suited to exotic species of fish, such as Carp (*Cyprinus* sp.) and Tilapia (*Tilapia* sp.). At present, the Mary River is one of the few remaining southeastern Queensland river systems free of such large exotic fish, which proliferate quickly, out-compete native species, and feed voraciously on their young.

The downstream effects of inundating 500 ha of an endangered regional ecosystem that is currently designated as "protected" by the Queensland Vegetation Management Act further complicate the issue. The estimated 20% increase to the freshwater supply will have a negative impact on the Great Sandy Straits Marine Park and RAMSAR Treaty wetlands. Some studies have directly linked

CHUCK SCHAFFER

Local outrage is expressed in roadside signs.

decreasing fish health and productivity declines to reduced rates of flow. Commercial fisheries and tourism would also be affected adversely. The Great Sandy Strait alone contributes $100 million annually to the local economy through tourism. This downstream region also serves as an important feeding ground for migratory shorebirds and a wide range of other bird and marine life, including sea turtles.

Inevitable floods would be very difficult to control without inundating upstream areas. Structurally, the bank would be difficult to stabilize, and erosion would further increase sediment and result in even shallower water. The proposed dam site lies over deep shattered rock that would need to be sealed to eliminate seepage, further disrupting groundwater flow.

The dam project would decimate many species of animal and plant life, including a number of threatened and endangered species. In addition to the endemic endangered Mary River Turtle and other iconic species, including the endemic endangered Mary River Cod (*Maccullochella peelii mariensis*) and the endangered Queensland Lungfish (*Neoceratodus forsteri*), this ecosystem also provides habitat for populations of at least two endangered frog species, the Giant Barred Frog (*Mixophyes iteratus*) and the Cascade Tree Frog (*Litoria pearsoniana*).

Both the Mary River Cod and Mary River Turtle are listed as endangered under the EPBC Act, with the Mary River Turtle also recognized as endangered by the IUCN. The Mary is the only river where these two species can be restored and protected; it is also the best remaining option for the endangered Queensland Lungfish. Five other turtle species and many species of fishes and frogs also stand to be affected by the dam, particularly if gene flow is blocked between up- and downstream areas.

The proposed dam site contains known habitat for all of the species mentioned. They might be able to survive for a time within impounded areas, but they cannot breed there. Although the Mary River Turtle has been bred in captivity, captive breeding is not a long-term solution. The species evolved and belongs in the Mary River. It could not be restored to the river once the habitat has been degraded — and recreating this ecosystem elsewhere is impossible.

In its natural environment, the Mary River Turtle requires sandy riverbanks to lay its eggs. Very few nesting beaches are known, and the most productive of these will be flooded. The Mary River Cod relies on deep, cool, shaded pools containing large woody debris (snags) for breeding. Queensland Lungfish need shallow flowing riffles (which also support a number of macroinvertebrates eaten by all three of the endangered species) and dense beds of submerged aquatic plants on which to lay their eggs. The dam would destroy all of these. Undercut banks, riparian vegetation, and deep pools are critical habitat for the Giant Barred Frog.

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Locals fear that the Mary will suffer the same fate as the Murray River.

Some provisions have been made to address a few of the problems. Fish passages, for instance, are planned. Unfortunately, they don't work well for turtles. Studies have shown that turtles do not readily enter fish transfer devices. Photographic evidence presented at the recent Conference on the Biology & Conservation of Australasian Freshwater Turtles in Brisbane, indicated that the devices often mangle those that do.

Many Australians are concerned that this project will turn out as badly as that of the Murray River (thus the "don't Murray the Mary" signs everywhere). Dams altered that river's natural flow from the original winter-spring flood and summer-autumn dry to the present winter low level and slightly higher summer level. Although these modifications ensured the availability of irrigation water, making the Murray Valley Australia's most productive agricultural region, they have damaged the ecosystem of the river and surrounding area, leading to dry-land salinity, which is now threatening agriculture. Other problems besides damaging the natural flow of the river have included agricultural run-off, introduction of pest species, and serious environmental damage along the river. That the Murray will become unusable due to salinity is a major concern, as it not only supplies agricultural irrigation, but 40% of Adelaide's domestic water.

Enough, however, of the gloom and doom; something is being done — and it was very evident in the Mary River Valley. Much useful information for this article, although not explicitly cited, came from various websites created by people hoping to save their homes, businesses, and livelihoods. We visited the headquarters of the "Save The Mary River" group while searching for turtles. The group's campaign has grown from an initial response coordinated by Mary Valley residents fighting for the future of their river and community to a truly broad-based national and international response. The website (http://www.savethemaryriver.com/) now serves as a portal to a range of related efforts to save this river for future generations. Their goal is to communicate the big picture to the Queensland and Australian governments, which are poised on the brink of making a decision that will provide either a truly reliable and sustainable water strategy for southeastern Queensland or one that will lead inevitably to the shameful and entirely avoidable degradation of a globally significant river system and all that it sustains. The battle cry is "Save the Mary River — there are much better options for Brisbane's water!"

Other useful sources of information included four important technical reports commissioned by the Australian Government Environment Minister regarding the Traveston Crossing Dam Environmental Impact Statement: (1) A review of effects of the dam on the Mary River Turtle by Dr. Gerald Kuchling (www.environment.gov.au/epbc/notices/assessments/2006/3150/pubs/independent-expert-report-on-the-mary-river-turtle-kuchling.pdf), (2) a review of effects of the dam on matters of national environmental significance by Associate Professor Keith Walker (www.environment.gov.au/epbc/notices/assessments/2006/3150/pubs/independent-expert-report-on-matters-of-nes-walker.pdf), (3) a review of

EVA FORD

The Giant Barred Frog (*Mixophyes iteratus*) is another species that would be affected adversely by the dam.

effects of the dam on matters of national environmental significance by Professor Stuart Bunn (www.environment.gov.au/epbc/notices/assessments/2006/3150/pubs/independent-expert-report-on-matters-of-nes-bunn.pdf), and (4) a review of the hydrological model used to predict flow impacts in the EIS by Drew Bewsher (www.environment.gov.au/epbc/notices/assessments/2006/3150/pubs/independent-expert-report-on-hydrological-modelling-bewsher.pdf). However, our most valuable information came from the Tiaro and District Landcare Group, which hosted several symposium delegates after the Conference on the Biology & Conservation of Australasian Freshwater Turtles in Brisbane. This group was established in 1997 in response to a meeting of local landholders who were concerned about the health of the riverine environment. Landcare is a uniquely Australian partnership between the community, government, and business, which aims to "do something practical" about protecting and repairing their environment and promoting sustainable agriculture. They feel that the health of their district is dependent on the condition of the Mary River, her many sub-catchments, and all the plants and animals that she sustains.

One of the major concerns of Tiaro Landcare is conserving wild populations of the Mary River Turtle. Since 2001, Tiaro Landcare has been giving talks about the turtle, protecting nests to increase the survival of hatchlings, and funding a support scholarship for post-graduate students studying the turtle. A wonderful monograph, *The Mary River Turtle – Yesterday, Today, Tomorrow*, was developed and published by Tiaro Landcare. It details all known aspects of the Mary River Turtle, including its history, natural history, distribution, threats, and conservation efforts. The monograph was released in October 2008 and is available for AU$10 from Tiaro Landcare. Turtle conservation and sustainable fishing practices also are promoted through a catch-and-release fishing competition. Proceeds

Planetary 'hero' talks turtle on the banks of the Mary

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MARILYN CONNELL

Several attendees of the Conference on the Biology and Conservation of Australasian Freshwater Turtles joined the Tiaro Landcare Group to see Mary River turtle habitat and were interviewed by local media.


CHUCK SCHAFFER

Conference attendees visit a Southern Snapping Turtle nesting site on the banks of the Mary River. From left: Peter and Sibille Pritchard, Peter Paul van Dijk, Gerald Kuchling, Chuck Schaffer, and Vicki and Adrian Ross.

support conservation of both the endangered Mary River Cod and the Mary River Turtle. The Landcare group effectively keeps the Mary River Turtle in the public eye with a more whimsical approach. Many shops in Tiaro and surrounding areas sell delicious chocolate turtles, supplementing funds from other sources that, for example, protect nesting beaches. The group is in the process of developing a website (www.maryriverturtle.org.au), which will include details of past and future turtle projects and activities.

In 2008, Tiaro Landcare members noticed another species of freshwater turtle (*Elseya albigula*) nesting on their property, and so began another phase of the Tiaro Landcare turtle protection program. Eighty-eight wild hatchlings emerged as a result of nest protection.

The urgency of meeting the water needs of the Australian people is definitely understandable, but sometimes the exigency and stress of the moment point to the first and most obvious solution as the only answer. No disrespect is meant to the people or government of Queensland, but from the somewhat detached view of outsiders, we would suggest that the resolution to the water crisis must come from lucid and informed planning that considers all alternatives and their potential impact on unique species found nowhere else on Earth.

Acknowledgements

We are greatly indebted to John Cann, Helen Cann, and the entire Cann family, who facilitated plans for our trip to Australia. We also thank Marilyn Connell, Lynn Klupfel, and the members of The Tiaro Landcare Group, who facilitated the trip to the Mary River area. Vicki and Adrian Ross facilitated the trip to the Southern


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Marilyn Connell of Tiaro Landcare Group checks the electric fence that protects the major nesting beach for the Mary River Turtle.


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Grids protecting nests, like this one placed by the Tiaro Landcare Group, greatly reduce nest predation.


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Peter Pritchard admiring the obvious community support of native wildlife.


CHUCK SCHAFFER

Occasionally, however, even nest protection fails to deter Goannas.

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A Southern Snapping Turtle (*Elseya albigula*) emerges from a protected nest site on the banks of the Mary River.

Snapping Turtle (*Elseya albigula*) nesting site on the banks of the Mary River and to Frazier Island. Glenda Pickersgill and The Save The Mary River Group and Eva Ford and the Mary River Catchment Co-ordinating Committee spent hours providing background and literature on the Mary River dam project.

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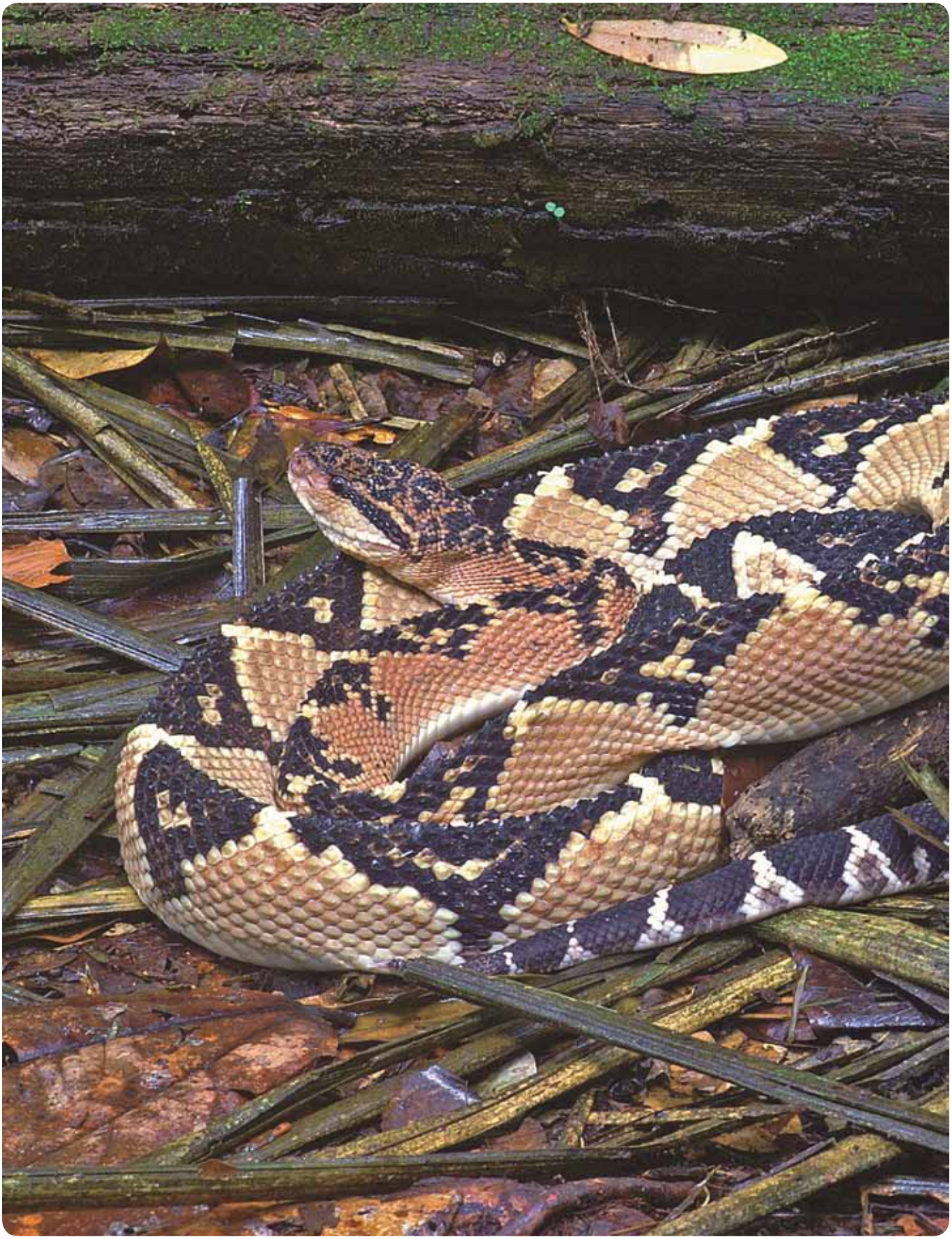


LAURIE J. VITT

Possibly the longest of all vipers, the Bushmaster (*Lachesis muta muta*) is endemic to tropical rainforests and lower montane wet forests of Central and South America.

HUSBANDRY

Propagation of the South American Bushmaster (*Lachesis muta muta*) at the Jacksonville Zoo and Gardens

Brian R. Eisele

Herpetology Keeper
Jacksonville Zoo and Gardens
Jacksonville, Florida 32218

Photographs by the author except where indicated.

"Coiled in a mound on the forest floor, its calligraphic black and tan colors blending with the surrounding debris, was the most magnificent snake I'd ever seen in nature. The snake's behavior was not exaggerated, no lunging strikes, no frenzied escape efforts, but a powerful sensation of measured readiness, like Clint Eastwood's squint in *High Plains Drifter:* 'Don't come closer'" (Greene 1997).

The Jacksonville Zoo and Gardens (JZG) acquired 1.1 South American Bushmasters (*Lachesis muta muta*) in December 2003. This pair reproduced in 2007 and 2008. This was the first breeding of Bushmasters by JZG and the techniques that were utilized to produce the two clutches are described here in detail. During the first year of breeding, the International Species Information System (ISIS.org) listed 60 *Lachesis m. muta* in numerous zoological facilities. After contacting the Association of Zoos and Aquariums (AZA) Bushmaster Studbook Keeper on the potential breeding of the pair, it was determined to be highly desirable.

Female South American Bushmaster coiled around her clutch at the Jacksonville Zoo and Gardens in 2007.

Biology

The Bushmaster is endemic to tropical rainforests and lower montane wet forests of Central and South America (Campbell and Lamar 2004). Possibly the longest of all vipers, accounts of animals reaching lengths over 3.6 m are rare, but most adults commonly exceed 2.0 m in length (Campbell and Lamar 2004). Bushmasters are like no other pit viper in the western hemisphere, in that they are the only genus that is oviparous (Savage 2002). They possess no rattle, but they will alert a perceived intruder to the danger that awaits by vigorously vibrating their tails against the substrate or the enclosure. Campbell and Lamar (1989) described this species as crepuscular and nocturnal. Mehrtens (1987) described it as secretive and given to sheltering in fallen logs or near exposed root systems. According to Greene (1997), Bushmasters feed exclusively on rodents throughout their lives. de Souza (2007) reported that wild Bushmasters do not have a regular breeding season.

Propagation in 2007 and 2008

At JZG, the Bushmasters are housed in an exhibit measuring 5.0 x 2.1 x 2.7 m. Artificial rockwork lines the interior walls and partially encompasses land areas near and around the water feature. The water basin is a 38-liter pool fed by a stream that stretches across 75% of the enclosure. The stream divides the upper and lower areas of the exhibit. A re-circulating pump submersed in the pool supplies the stream with water flow. Substrate consists of sphagnum moss in the lower front tier of the exhibit and cypress mulch covers the upper tier near the service door. Many live plants are maintained in the exhibit to provide hide areas and aesthetics. Species include Pothos (*Epipremnum* sp.), Philodendrons (*Philodendron* sp.), Rubber Plants (*Ficus elastica*), Peace Lilies (*Spathiphyllum* sp.), and bromeliads *(Neoregelia* sp.) (http://plantinfo.umn.edu/). The exhibit also is home to Blue Poison Dart Frogs (*Dendrobates azureus)* and Green and Black Poison Dart Frogs (*Dendrobates auratus*).

The photoperiod for the exhibit is maintained at a constant 12-hr daytime/12-hr nighttime. Temperatures are 24–28.5 °C and the basking spot is never above 29 °C. Exhibit temperatures are maintained by 90- and 250-watt spot lamps along with a heating ventilation and air conditioning (HVAC) duct directly over the exhibit. The latter provides fresh air in the enclosure. Each end of the habitat has a 19 x 19-cm mesh-covered vent for air exchange. Daily spraying of half the enclosure with reverse osmosis (RO) water keeps the humidity elevated. Exhibit moisture also is supplemented by a Pro Mist® misting system. Two misting heads mounted on the screen overhead project mist toward the moist side of the enclosure twice daily for ten-minute intervals. In January–March 2007, the exhibit was sprayed more frequently with the RO water hose to stimulate reproductive activity.

Possible copulation was observed in early morning on 4 March 2007. The male was chin-rubbing on the female in late March, but no other breeding attempts were reported by keeping staff. Minimal

The 2007 clutch before the last egg was added.

Table 1. Egg morphometrics.

	2007		2008	
Egg #	**Weight (g)**	**Size (mm)**	**Weight (g)**	**Size (mm)**
01	89.5	77 x 42	85.9	82 x 39
02	83.0	75 x 43	83.4	73 x 44
03	90.1	87 x 40	88.6	79 x 44
04	87.2	86 x 38	83.9	71 x 45
05	81.8	70 x 43	80.5	70 x 44
06	86.7	79 x 42	83.9	69 x 46
07	89.7	83 x 43	79.7	66 x 45
08	80.3	73 x 43	88.5	71 x 45
09	80.0	68 x 45	85.6	68 x 45
10	83.2	62 x 41	78.2	68 x 42
11	80.4	70 x 44	84.0	69 x 45
12	81.8	63 x 45	81.6	72 x 45
13	79.1	67 x 43	84.6	82 x 39
14	84.6	73 x 46	84.4	77 x 42
15			84.0	71 x 46
16			86.2	71 x 43
Mean	**84.1**	**73.8 x 42.7**	**83.9**	**72.4 x 43.7**

disturbance of the adults during the spring was maintained to avoid complications with reproduction or oviposition. The female began to refuse prey on 16 May and did not feed even though prey was offered each week. Her weight increased from 5.0 kg in January 2007 to 5.4 kg in June 2007. She was palpated during the first week of June, as her body seemed distended. During palpation, the body of the female was taut and no obvious egg bulges were visible. The herpetology staff watched for a pre-egg laying shed from the female; shedding occurred on 22 April 07 and again on 7 July 07.

On 13 June, the female was very active during the day, unusual behavior for an animal that is rarely known to move during daylight hours. A five-gallon bucket with a concrete bark design was cut in half (top to bottom) and served as a secure site for oviposition. The hide area was positioned near the exhibit service door to aid in the removal of the female and eggs. At 1600 h on 14 June, she attempted to lay a clutch of eggs inside the hide box. The next morning at 1000 h, keepers gently tubed the female and extracted a clutch of 13 eggs. Each egg was carefully separated from the clutch, weighed and measured, and labeled with a number 2 pencil. The incubation egg chamber consisted of a 12-quart Rubbermaid® storage container with a 1:1 mixture by weight of water to vermiculite.

The female was taken to the animal hospital where she was radiographed for egg retention. She was found to have withheld two eggs, one just before the cloaca and another far back in the oviduct. This brought the clutch total to 15 eggs. The dam proceeded to lay

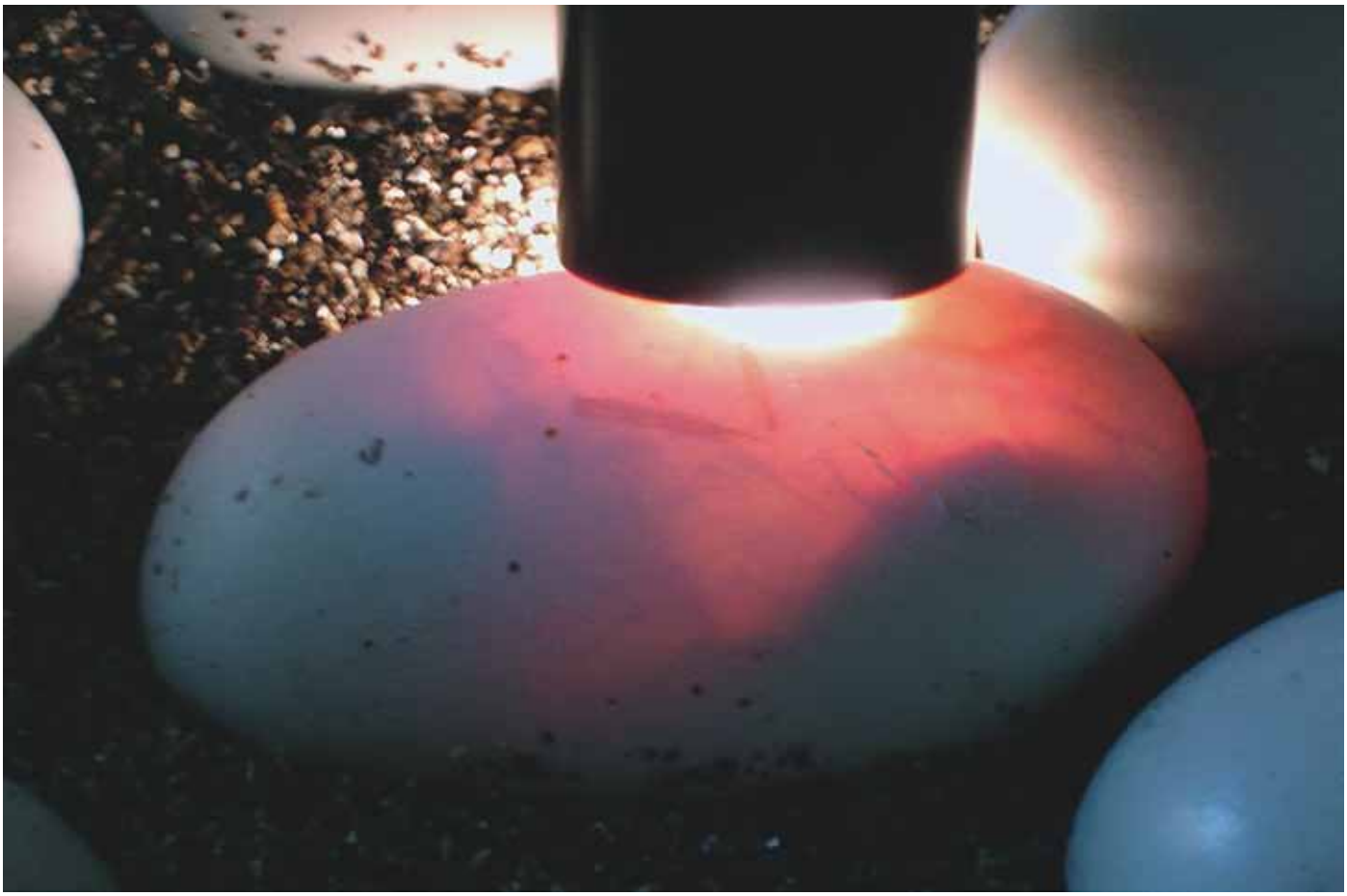
The female laid a 14th egg while being radiographed for egg retention.

the 14th egg during the hospital procedure. She was given an intramuscular injection of 0.5 ml of the hormone oxytocin to encourage deposition of the retained egg, and was placed back on exhibit. Over the course of the next two days she was administered 0.5 ml of oxytocin daily without result. A decision was made by the veterinary team to intervene surgically for the safety of the dam. The operation successfully removed the egg, but it could not be incubated. In an effort to minimize the surgical site, the egg had amniotic fluid and yolk drained; nevertheless, it appeared to be fertile with good size and color. The weight of the female was 4.4 kg after oviposition, down just over 1.0 kg from her pre-oviposition weight.

The incubator was set at 30 °C (Boyer et al., 1989) and four sealed 1.9-liter bottles of water were placed in the bottom of the incubator to keep temperatures steady in the event the incubator should fluctuate. Only three days into incubation, the HVAC system of the building that housed the incubator failed and the eggs were at 32 °C for a short time. The incubator was moved to a building with more stable temperatures to limit further unforeseen mishaps. Six days into the incubation period, a decision was made to reduce temperatures to 25.5 °C from the current incubator setting of 30 °C (Ripa 2007). Incubation temperatures were slowly reduced but could not be maintained. Temperatures fluctuated from 25.5 °C during early incubation to 27.2 °C just before hatching. Moisture was monitored by weight of the clutch, and RO water was added when the egg chamber was not equal to the box weight at the start of incubation. Candling of eggs was utilized for observation of tissue development. Eggs were not handled or removed from substrate while candling. As development progressed, more caution was taken during candling, since the eggs contained venomous neonates.

Half of the eggs began to dimple at what would be a week before hatching. After 76 days of incubation, egg #7 pipped on the afternoon of 30 August 2007. Over the next three days, the remainder of the clutch emerged, with the last neonate hatching on 2 September 2007. Each hatchling was weighed as it emerged from the egg. Neonates from eggs 4, 5, 6, 9, 11, and 14 hatched overnight, and the numbers of the eggs from which they emerged could not be determined. Neonate weights were 63.5–72.4 g. Each individual was housed separately in a 12-quart Rubbermaid® container with a 0.4-liter water dish and a 1.2-liter Gladware® storage container that had a 5.1-cm hole cut in the middle for access. This container was half filled with sphagnum moss and kept moist to offer a humidity chamber. This reduced the chance of the enclosure becoming soaked by over-misting or from a spilled water bowl. Each unit had a double row of 0.5 cm-holes either drilled or melted with a soldering iron encircling the top of the container. This provided airflow throughout the unit and kept humidity levels stable. Hatchlings moved back and forth from the humidity chamber to resting on or behind it.

The rack system housing the containers was kept locked with two aluminum poles that prevented the drawers from being opened. These were held in place by eyehooks at the top and bottom with



A small flashlight was used to candle eggs to monitor tissue development.

Table 2. Hatchling data. Neonates marked with an asterisk (*) hatched overnight, and the numbers of the eggs from which they emerged could not be determined.

Egg #	Date	Weight (g)	First Shed	Sex
07	31 AU 07	70.3	19 SE 07	0.1
13	01 SE 07	63.5	19 SE 07	1.0
01	01 SE 07	71.5	19 SE 07	0.1
08	01 SE 07	66.1	19 SE 07	1.0
12	01 SE 07	66.9	19 SE 07	1.0
10	01 SE 07	66.8	19 SE 07	0.1
02	01 SE 07	68.0	19 SE 07	1.0
04*	02 SE 07	65.3	19 SE 07	0.1
05*	02 SE 07	70.1	20 SE 07	0.1
06*	02 SE 07	67.6	20 SE 07	0.1
09*	02 SE 07	64.4	19 SE 07	0.1
11*	02 SE 07	64.6	19 SE 07	1.0
14*	02 SE 07	68.0	19 SE 07	1.0
03	02 SE 07	72.4	19 SE 07	0.1
Mean		**67.5**		**6.8**
05	29 AU 08	65.2	13 SE 08	0.1
16	29 AU 08	65.9	13 SE 08	0.1
02	29 AU 08	68.1	13 SE 08	0.1
08*	29 AU 08	64.4	13 SE 08	0.1
09*	30 AU 08	67.0	14 SE 08	0.1
11*	30 AU 08	70.4	14 SE 08	0.1
01	30 AU 08	63.8	15 SE 08	0.1
12	30 AU 08	67.1	14 SE 08	0.1
15	30 AU 08	66.1	15 SE 08	0.1
06	30 AU 08	71.6	15 SE 08	0.1
03*	31 AU 08	63.5	15 SE 08	1.0
04*	31 AU 08	71.3	15 SE 08	0.1
07*	31 AU 08	61.3	15 SE 08	1.0
10*	31 AU 08	68.6	15 SE 08	0.1
14*	31 AU 08	65.6	13 SE 08	1.0
13	02 SE 08	67.4	16 SE 08	0.1
Mean		**66.7**		**3.13**

folding hasps covering the crimped ends of the poles. Padlocks prevented removal. The unit was kept at a steady 26.6 °C with no thermal gradient. Radiant heat tape was installed in the back of the unit but was not needed as drawers reached and maintained the recommended temperatures without it. All of the juveniles completed their first shed at just under three weeks of age. We observed no difficulties in ecdysis, which we attributed largely to the style of the enclosures.

Juveniles were reluctant to accept frozen/thawed (f/t) mice as first meals, and live prey items were used to elicit a feeding response. After several live mice were consumed, almost all of the offspring were switched to f/t adult mice from forceps. Prey items were offered every 7–14 days. Some individuals fed readily at each opportunity, whereas others fed only every second feeding. Many of the juveniles would strike the prey and not let go. Very few would bite and release, leaving the prey for later consumption. The first stools of some juveniles contained shed fangs, and two pairs were found in a few instances. Surprisingly, these fangs were 0.5–0.8 cm long when passed.

Probing of the juveniles was completed at 3–5 months of age. Females were probed at 3–5 subcaudal scales and males at 7–9 subcaudals. Each animal was micro-chipped with a Trovan® PIT (passive integrated transponder) tag on the left side just above the cloaca. Over the next year, all animals were placed in AZA facilities.

The breeding of the pair was approved again in 2008. The female's viability was a concern after having an egg surgically removed. However, her overall body condition was good and her weight was 4.8 kg in early 2008. Consequently, we proceeded, anticipating another clutch. The male was observed pursuing the female in early March after he was returned to the exhibit. During mid-March, the male was extended over the female and stimulated her caudal region with his tail. Because we tried to disturb them as little as possible, we did not witness copulation, but the female began refusing prey during the second week in May.

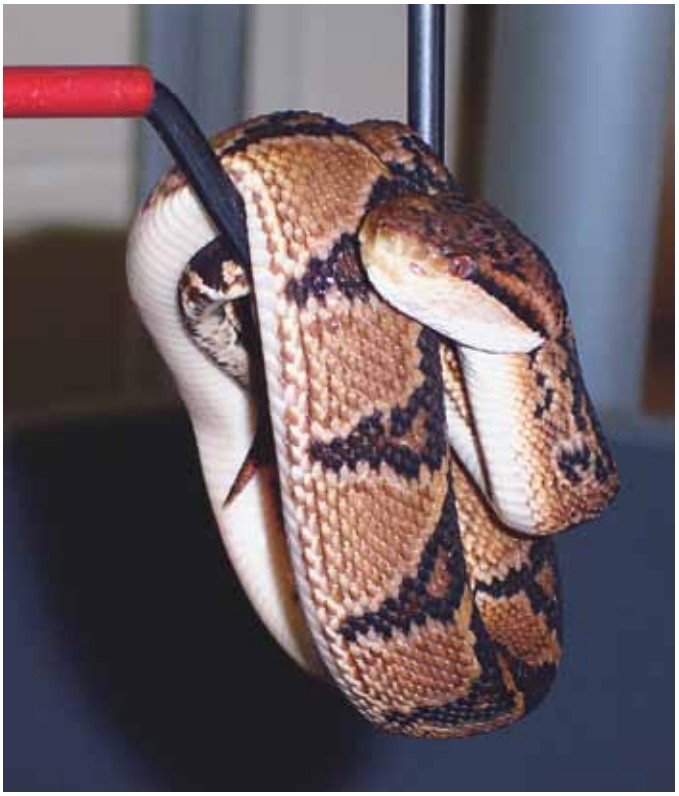
On 11 June, she was active and seemed uneasy, and the posterior half of her body was distended. The suture site from the egg removal in 2007 appeared to have abscessed, so the veterinary staff was notified. The next day she was taken to the hospital where radiographs confirmed that she was gravid with at least 15 eggs.

Each hatchling was housed separately in a 12-quart container with a 0.4-liter water dish and a 1.2-liter storage container with a 5.1-cm hole for access.

After 76 days of incubation, egg #7 pipped on the afternoon of 30 August 2007 and the hatchling emerged on 31 August.

Further examination of the abscess would not be possible until after oviposition. Her weight at that time was 5.5 kg, and she was nearing the oviposition date of the previous year. A larger hide box was constructed from half of a large plastic flowerpot covered with sphagnum moss. This was introduced to the exhibit in late May, although the female chose not to occupy the hide. On 17 June, she coiled next to the hide box and began oviposition in the late afternoon.

On the morning of 18 June, she was removed from a clutch of 16 eggs and radiographed for egg retention. All eggs had been passed, and the abscess appeared to be scar tissue protruding from the suture site. Exploratory surgery by our veterinarian found no complications. All of the eggs had good color and size. Data were collected on each egg. Again, the incubator was set at 25.5 °C but would not drop below 27 °C throughout incubation. Daily temperatures of the building rose as the heat of the summer intensified during July and August and fluctuated from 27–27.8 °C. Water was added over the course of incubation as egg box weight dropped. Six eggs were dimpled on 21 August. At 71 days of incubation, three eggs pipped in the afternoon of 28 August and hatchlings emerged the following morning. This clutch varied less than one gram in average neonate weight from that in 2007 despite the fact that the animals in the second clutch hatched and shed earlier (possibly attributable to higher incubation temperatures?). The majority of the young switched readily to f/t prey, but a few difficult feeders held out for live prey. Those that fed ravenously appeared ready to eat each time the unit was maintained.



A young Bushmaster is hooked from its enclosure for servicing.

Hatchlings were able to move in and out of a humidity chamber made from a container with moist sphagnum moss.

After two large clutches from this pair, we determined that a non-reproductive year was appropriate, especially since they are now well represented in the captive gene pool. In general, more data on captive husbandry and reproduction of Bushmasters are necessary to establish standardized guidelines for their propagation. Wild populations are increasingly threatened by habitat loss and persecution, and zoological institutions must be able to respond effectively if the species' survival comes to depend on captive populations.

A five-month-old Bushmaster feeding on a frozen and thawed prey item.

Acknowledgements

Many professionals have contributed to the success of our efforts. In particular, we thank Donal M. Boyer of San Diego Zoo for sharing his knowledge on Bushmasters. Dean Ripa was extremely gracious for answering emails and taking a phone call during the incubation of the first clutch. Dr. J. Andrew Teare lent his expertise in surgery. I also thank the staff of the Herpetology Division at The Jacksonville Zoo and Gardens: Mark Beshel, Karl H. Betz, Andy E. Price, Steve Gott, and Dino Ferri. Their tireless efforts and diligent recording of data made this paper possible.

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SUZANNE L. COLLINS, CNAH

Although this individual is a wildtype living in nature, Corn Snakes (*Pantherophis guttatus*) have been captive-bred for decades. Those snakes, with at least 30 different color and pattern morphs, certainly qualify as "domestic" reptiles.

COMMENTARY

Domestic Reptiles and Amphibians?

Al Winstel

Cincinnati, Ohio

Photographs by the author except where indicated.

Forty years ago, the idea of captive bred reptiles and amphibians was just a dream. In sharp contrast, today's herpetoculturists have a huge assortment of captive-bred herps from which to choose — Rat Snakes (*Pantherophis*), King Snakes (*Lampropeltis*), pythons (Pythoninae), boas (Boinae), Bearded Dragons (*Pogona vitticeps*), Leopard and Fat Tail geckos (*Eublepharis*), Day Geckos (*Phelsuma* sp.), chameleons (*Chameleo, Furcifer*), horned frogs (*Ceratophrys*), White's Treefrogs (*Litoria caerulea*), and on and on. Most of these are available in forms or color patterns that nature never intended. Among the King (*Lampropeltis*), Gopher (*Pituophis*), Milk (*Lampropeltis*), and Rat (*Pantherophis*) snakes, myriad hybrids also are available. This also is true for Horned Frogs (*Ceratophrys*) and probably Bearded Dragons. Furthermore, many herp enthusiasts swear that their charges are "tame."

The dictionary tells us that a "tame" animal is, "reduced from a state of native wildness, esp. so as to be tractable and useful to man." Tameness, then, is a quality of an individual animal. However, I would suggest that many herps not only have the ability to become "tame" (useful as a pet), but some actually come under the label of "domestic." Most definitions of domestic involve qualities such as having an animal's breeding controlled by humans, having a human-desired purpose for the breeding, and having changes take place in the species so that it is no longer

A captive-bred amelanistic Black Rat Snake (*Pantherophis obsoleta*) would almost certainly fall victim to a predator in nature.

A captive-bred "apricot morph" of the Pueblan Milk Snake (*Lampropeltis triangulum campbelli*).

Natural variations in patterns, such as in these wild-caught Ball Pythons (*Python regius*) provide a palette from which breeders can generate morphs never seen in nature.

exactly like the wild form. Other qualities that have been considered include hardiness, an inborn liking for man (are honeybees domestic? How about cultured pearl oysters?), comfort loving, having a flexible diet, fast growing, and with a modifiable social structure. Authorities who have tried to define domesticity include Jared P. Diamond, Pulitzer Prize winning author of *Guns, Germs, and Steel* and *Collapse: How Societies Choose to Fail or Succeed*, and Francis Galton, child prodigy, world explorer, author, British Knight, and half cousin to Charles Darwin. Some animals have been domesticated for a long time. Examples are the dog (14,000 years), cat (5,000–8,000 years), horse (5,000 years), and goldfish (1,700 years). However, some species have achieved domesticity in shorter periods. Parakeets have been around for 160 years in captivity, hamsters for 75, and guppies for 80.

What about reptiles? Consider that Crested Geckos (*Rhacodactylus ciliaris*) were being bred in captivity in fairly large numbers by 1993. Ball Pythons (*Python regius*) have been commonly captive-bred for close to 15 years, and Corn Snakes (*Pantherophis guttatus*) have been bred in captivity for more than 30 (I communicated with zoos in the early 1970s about the best way to breed Corn Snakes). Much of this breeding was done with amateur herpetoculturists in mind, making animals that fed better, bred better, were "prettier," and were more "handleable." Animals that would survive captive rearing were the ones with the simplest requirements and the most flexible habits.

One of many captive-bred Leopard Gecko (*Eublepharis macularius*) patterns; albinos, orange forms, and leucistics also are available.

Many Crested Gecko (*Rhacodactylus ciliaris*) morphs have been produced by selective captive breeding.

Tens of thousands of Bearded Dragons (*Pogona vitticeps*) are bred annually and the species has been selectively bred in captivity since the late 1980s; at least seven distinct color forms are mentioned in one popular care manual.

Captive breeding can generate hybrids that combine pattern elements of two different partental species. This is a captive-bred hybrid Corn Snake and California King Snake (*Lampropeltis getula californiae*); both parents were albinos.

Many herps have fairly long generation times for small animals, breeding at 2 or more years of age. This means that 30 years (time since Corn Snakes have been captive bred) would give us time for 15 generations to be "selected" by captive breeding. Some of the smaller lizards like Crested Geckos (*Rhacodactylus ciliaris*) can breed at one year of age, allowing more generations in less time, so quicker selection by breeders. Let's look at some of the prime herp candidates for domestic classification. Corn Snakes are my nominee for number one. They have been bred for decades and occur in at least 30 different color and pattern morphs. Tens of thousands are bred annually for the pet trade, and every pet shop that handles herps has or can get Corn Snakes. All ages tend to feed well on domestic mice. Most individuals are handleable, and skin shedding takes place with few problems. Corns can be easily raised and bred in very simple habitats with a substrate, heat source, hide box, and water dish. Several of the color phases are showy enough that they would probably be lost to predation in the wild. Hundreds of hatchling Corn Snakes may be seen at any decently sized herp expo.

Leopard Geckos are probably domestic #2. An awful lot of Bearded Dragons are bred every year, but Leopard Geckos have been around in numbers for a longer time. Many years ago, I received a call from a Texas university wondering if I had these animals available in quantity as they were trying to diversify their research colony. A look at the internet or printed price lists shows at least 30 available Leopard Gecko varieties, with an estimated 200,000 individuals bred worldwide each year. This doesn't quite compare with the 350 dog breeds, but it's still pretty amazing.

Bearded Dragons are another "domestic" breed. They seem more prevalent at some herp shows in the Midwestern United States than even Corn Snakes or Leopard Geckos. Surely thousands of these are bred annually. In the U.S., the initial breeding work was done in the late 1980s, perhaps 20 years ago. Bearded Dragons are naturally rather phlegmatic and handleable as adults. At least seven distinct color forms are mentioned in a popular care manual, and breeders are constantly creating and naming new ones. As with Leopard Geckos, commercially formulated artificial foods are available, although supplementation with insects and other vegetation often is recommended.

The next domestic herp candidate is the Crested Gecko. Described in 1866 and presumed extinct prior to the early 1990s, the Crested Gecko is certainly bred by the thousands annually in the U.S. Similar to the three above-mentioned creatures, online forums and breeders of this lizard are numerous. Formulated diets that are

Captive-bred Ornate Horned Frogs (*Ceratophrys ornata*) speak eloquently to the fact that reptiles are not the only "domesticated" herps.

A Variable King Snake (*Lampropeltis mexicana*), "*thayeri*" phase with a pink ground color.

sufficient to raise the species through several generations are commercially available. Color and pattern varieties are constantly being discovered and interbred. At least three major color groupings are available with as many as 11 described colors. At least nine different patterns have been described. Crested Geckos are available in pet shops (including chains), although in my area of the Midwest, they are not seen at swap meets in such substantial numbers as the other three domestic herps.

Although many other species might be nominated as "domestic" (see the list at the beginning of this article), the above four (Corn Snake, Leopard Gecko, Bearded Dragon, and Crested Gecko) are my favorites based on number produced, commercial availability, preponderance of information on the web in forums and dealer websites, number of publications on their care, generations of captive breeding, commercially availability of foods, and variety of morphs. California King Snakes (*Lampropeltis getula californiae*) (many, many color varieties), Ball Pythons (one popular book has 139 pages of different ball python color/pattern morph photos), and tri-colored milk snakes like the Pueblan Milk Snake (*Lampropeltis triangulum campbelli*) are herps that might give the big four a run for their money.

This mixed clutch of Corn Snakes (*Pantherophis guttatus*) provides a glimpse of the available color patterns that include normal, ghost, hypomelanistic, and anerythristic color morphs.

Not all definitions of domesticity include tameness (consider commercially raised pearl oysters, honey bee colonies, and some of the more territorial dog species). A number of types of domestic livestock are large enough to be a hazard to the unwitting human. According to the 2007 American Pet Products Manufacturer's Association's National Pet Owner's Survey, 13.4 million reptiles are kept as pets in the U.S., compared with 13.8 million horses. Based on their history, use by mankind, active captive breeding, and number kept in captivity, surely at least some herps deserve to be admitted to the ranks of the domestic!

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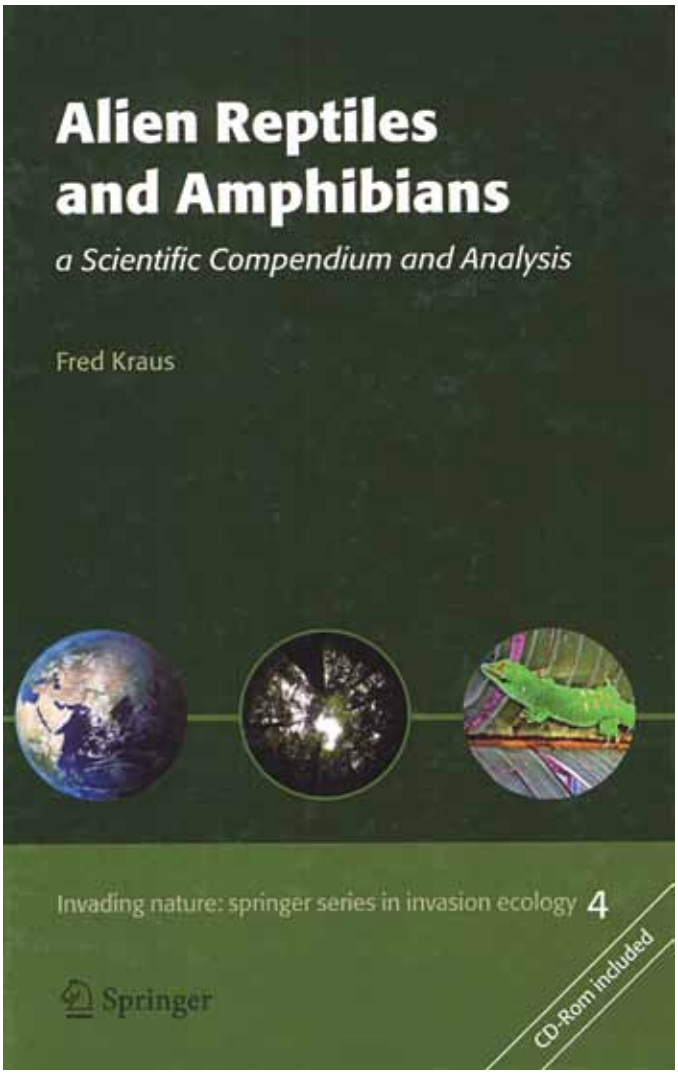
BOOK REVIEW

Alien Reptiles and Amphibians

Alien Reptiles and Amphibians: A Scientific Compendium and Analysis. 2009. Fred Kraus. Invading Nature — Springer Series in Invasion Ecology, volume 4. Springer, New York. xii + 563 pp., plus compact disk. Hardback – ISBN: 978-1-4020-8945-9. $169.00.

"Human-caused introductions of alien biota are an ecological disruption whose consequences rival those of better-known insults like chemical pollution, habitat loss, and climate change. Indeed, the irreversible nature of most alien-species introductions makes them less prone to correction than many other ecological problems."



Fred Kraus, author of this important and timely volume, goes on to say in his preface that "efforts to prevent or limit further harm are gaining wider scientific and political acceptance." However, "most research and management efforts involving terrestrial invasives have been showered on mammals, plants, and insects" (mainly because these organisms can "cause tremendous amounts of damage"). This, unfortunately leads to a "Catch-22" situation, presumptions that invasive species not featured in the media are harmless.

Despite some baby steps in the right direction, reptiles and amphibians are among the alien taxa that have received little attention from "policy makers, land managers, and researchers." The journal, *Applied Herpetology*, regularly includes a section devoted to notes detailing the spread of alien herpetofauna. In 2005, I participated in a symposium at the Joint Annual Meeting of Ichthyologists and Herpetologists in Tampa, Florida, during which a number of speakers bemoaned the inevitability of a single worldwide tropical herpetofauna composed of Cane Toads (*Rhinella marina*), Brown Anoles (*Anolis sagrei*), and Braminy Blindsnakes (*Ramphotyphlops braminus*). Nevertheless, interest in invasive reptiles and amphibians is lacking, as is funding for relevant research; most efforts, maybe understandably, are directed instead at the few remaining "natural" areas. With this volume, however, Kraus clearly shows that the neglect of invasion studies (and management) can only accelerate the rate at which natural areas disappear. He effectively addresses the issue with a thorough, authoritative treatment, in which he provides a discussion of the problems caused by introducing species to places where they do not belong and a database of documented alien species (also on a CD-Rom) supported by a bibliography of about 4,000 citations.

After the preface, which clearly identifies the problem, the book is composed of chapters providing a background to the issue of invasive reptiles and amphibians (which should be mandatory reading for every herpetologist), an overview of introduction patterns, an assessment of the impact of alien species, a summary of management responses, and a list of implications for policy and research. These chapters are followed by the 221-page database listing introduction records and a second, much shorter table that provides erroneous and uncertain introduction claims (and reasons why these claims are invalid). The impressive literature cited (a phenomenal resource in and of itself) and indices to subjects, taxonomy, and geography complete the book.

In the introductory chapter ("background"), Kraus provides a brief history of the growth in interest in invasive species by researchers (and, later in the chapter, a synopsis specifically of the study of herpetological invasions). He then provides a considerable service by clarifying the relevant terminology and clearly addressing two misconceptions that often pervade discussions of this subject. Kraus defines as "alien" any species transported and released outside their natural ranges, whether or not the move was intentional. When that movement is by humans, he calls it an "introduction." If a population becomes established outside the natural range, it may be referred to as "alien" or "naturalized" (Kraus's preferred terms), but also as "non-native," "non-indigenous," "feral," or "exotic." "Invasive" is restricted to that subset (albeit a large one) of alien species with demonstrated negative effects on native ecosystems. Such organisms also might be called "weeds" or "pests," both terms with appropriate negative connotations.

BOOK REVIEW

The problem with human-mediated dispersal is not that it differs qualitatively from dispersal by other means (i.e., attached to the fur of a mammal or the feathers of a bird or even blown off-course by a storm), but because "the temporal and spatial scales at which humans are homogenizing the world's biota" dramatically exceed any "previously seen in Earth's history." For example, the rate at which new species are becoming established in the Hawaiian Islands (where Kraus works at the Bishop Museum) is currently on the order of 20–30 species per year, a million-fold increase over rates that prevailed before humans became involved.

The misconceptions Kraus addresses are that introductions of alien species are natural phenomena and that they increase biodiversity (when the opposite is almost invariably true). To be "natural," the rate of introductions should approximate the background (pre-human) rate, which obviously is not applicable in today's world. He also addresses the mistaken idea that, because humans are a part of the natural world, what we do is therefore "natural" and not of concern. That logic falls apart rapidly if applied to other human activities most of us would not consider "natural" (Kraus's examples include genocide, torture, and slavery).

Briefly in the overview and again in much greater detail in the subsequent chapters, Kraus analyzes the invasion process. He lists the myriad means by which unintentional introductions occur and outlines many examples of how intentional introductions went awry, invariably the consequence of unanticipated effects in a natural world that is far more complex than our understanding of it. He discusses the venues by which species become established, noting that we have so little natural history data on so many species that we cannot begin to predict with any degree of accuracy which species will and which won't become permanent fixtures in their new homes or which will or won't be able to withstand the effects of introductions of aliens into their native ranges.

Furthermore, the early stages of an invasion often are difficult to assess. Because populations are initially small, those that succeed in growing and spreading differ little from those that don't or even from those that fail. Consequently, the managerial effect is that invasions are "dichotomized" into: (1) "it's not a problem," and (2) "it's too late to do anything."

This volume is the first to truly analyze the effects of herpetological invasions. Some previous studies provided abbreviated assessments and others failed to distinguish consistently between evidence and speculation. Despite a few success stories (e.g., carefully managed species, such as certain crop plants, that grow only when tended and where intended), recent research increasingly emphasizes the negative nature of invasions — and the almost inevitable unintended consequences that result. Horror stories abound. We've all heard them. Mongooses intended to control rats in sugarcane plantations instead decimated ground-nesting birds and terrestrial reptile and amphibian populations, mainly because no one took into consideration the reality that mongooses are diurnal and rats are nocturnal. Cane Toads were introduced to control insect pests in sugarcane fields, without any consideration of their predator-resistant characters and voracious appetites. The impact on native species almost everywhere these pests have become established has been catastrophic. Unfortunately, long before we realized what was happening in either instance (and many others), the damage had been done. Kraus regales the reader with myriad other examples, one more terrifying than the next — and many preventable.

So, what do we do? Kraus clearly shows that prevention (barriers to entry or ruthless elimination immediately after entry) is far cheaper and easier than eradication after an alien species has become established. However, like the U.S. healthcare industry, prevention is frequently neglected in favor of treatment after the patient is sick (or, the invasion has succeeded). Kraus provides steps that policy makers and land managers now have enough information to take. Sadly, however, I fear that the political will to take preventative action is lacking (it's hard to make a case for a problem that has yet to reach catastrophic proportions — see, for example, the "debate" on global climate change). As a result, we will continue to face the inevitable consequences: Cane Toads in Australia wreaking havoc on native species, Brown Tree Snakes on Guam decimating native birds and reptiles, and a peninsular Florida, the southern parts of which are so totally dominated by alien species that the term "natural" can be voiced only with an ironic twist.

At this point, as a reviewer, I'm expected to list the shortcomings of the book. However, they are so minor (I found only one typographical error and Kraus anticipated most of the other potentially justifiable criticisms in his comments on the structure and content of the database) in comparison with its strengths, that I see no need (although I did find the cover design somewhat uninspired).

So, have I done justice to the book in this brief review? No. The detail and phenomenally exhaustive survey of an ever-growing literature are impressive, and, as I mentioned above, should be required reading for every herpetologist. Any summary I could provide is inevitably inadequate to convey such important information. Unfortunately, I cannot in good conscience urge everyone to run to his or her local bookstore and buy a copy. The book is simply too damn expensive. For a topic this critically important, I despair at the reality that only a few diehards will acquire a copy and only a very few more dedicated persons will avail themselves of copies acquired by the small subset of libraries not suffering too much from the almost universal cutbacks in funding of academic and research facilities.

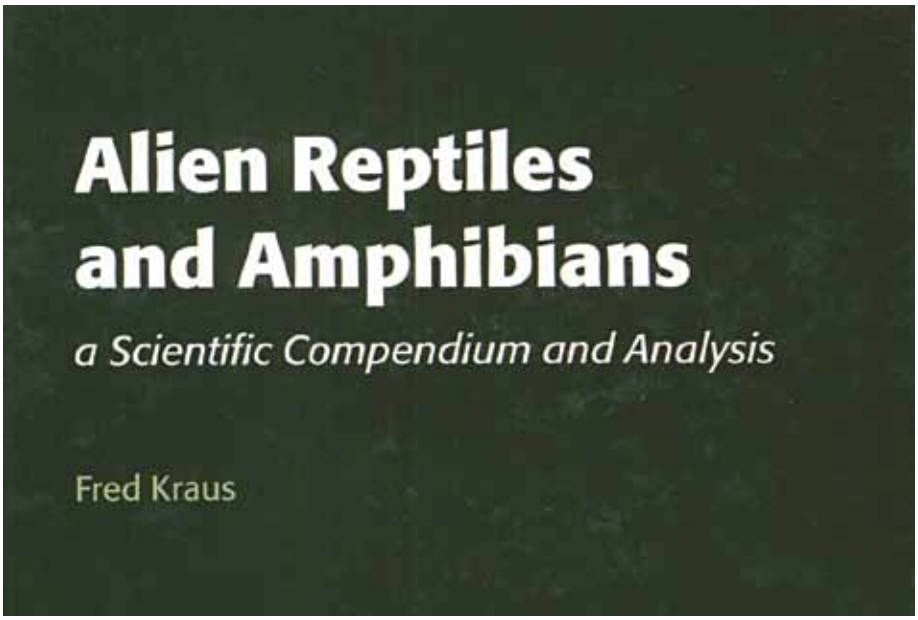
I usually like to handle a book or journal, and I frequently express dismay over the inevitable day when publications will be available only via electronic devices. However, in this case, the topic is so important that I wish the publisher could have foregone what will obviously be a relatively limited profit (hard to make much money when you sell very few books) and made the contents of the book available on the world-wide web — where the database could be updated on an ongoing basis and readily available to everyone.

Robert Powell
Avila University
Kansas City, Missouri

CONSERVATION RESEARCH REPORT

Drowning in a Sea of Development

Many reptilian species are declining, yet few studies address the current distribution and conservation status of most species, let alone how these may change with future development of natural habitats. **PIKE AND ROZNIK** (2009. *Herpetological Conservation and Biology* 4:96–105) studied the distribution, habitat associations, and conservation status of Florida Sand Skinks (*Plestiodon reynoldsi*), a fossorial sandswimming lizard endemic to Florida. They used data collected between 1912 and 2006 to map the distribution of this species and used Geographic Information System (GIS) data layers to determine the habitats in which it occurs. They determined that Florida Sand Skinks occupy many different habitat types throughout their range, including human-altered areas used for agriculture. However, Florida Sand Skinks appear to be absent from urban areas. Between 1974 and 2004, the amount of natural habitat available to support populations declined by 17.8% (5.9% per decade), and this trend is predicted to continue until at least the year 2060. Projections of future development of natural and disturbed habitats show linear increases during this same time, and will further fragment the remaining natural habitats. This makes protection of habitat for this species an immediate and real concern. Florida Sand Skinks (and other sympatric species) are rapidly losing habitat due to urbanization, and much of the remaining natural habitat outside of protected areas could be lost during the next several decades.



SUZANNE L. COLLINS, CNAH

Between 1974 and 2004, the amount of natural habitat available to support populations of Florida Sand Skinks (*Plestiodon reynoldsi*) declined by 17.8% (5.9% per decade), and this trend is predicted to continue until at least the year 2060.

NATURAL HISTORY RESEARCH REPORTS

Green Ratsnake Ecology

The Green Rat Snake (*Senticolis triaspis*) has a broad range that extends from Central America north into the Madrean region of southeastern Arizona and southwestern New Mexico, yet very little is known about its ecology. **RADKE AND MALCOM** (2009. *Herpetological Conservation and Biology* 4:9–13) used radio telemetry to examine activity patterns, thermoregulating behavior, and habitat use of rat snakes in southeastern Arizona. Telemetered snakes maintained an average temperature near 25°C throughout the active season (May through October), and preferentially used desert scrub and rocky east-facing slopes (females) or riparian areas (male). The scarcity of Green Rat Snakes dictates that ecological information, and a more complete picture of their conservation needs, will be gathered slowly.

SUZANNE L. COLLINS, CNAH

Female Green Rat Snakes (*Senticolis triaspis*) in southeastern Arizona occupy desert scrub and rocky east-facing slopes, whereas males are more likely to be in riparian areas.

Legless Frog Mystery Solved

Ballengée and Sessions (2009. *Journal of Experimental Zoology (Molecular and Developmental Evolution)* 312B: Published online at www.interscience.wiley.com. DOI: 10.1002/jez.b.21296) presented evidence that the most commonly found deformities in wild-caught amphibians, those featuring missing limbs and missing limb segments, may be the result of selective predation. Predatory dragonfly nymphs can severely injure and even fully amputate developing hind limbs of anuran tadpoles. Dragonflies apparently like to eat the hind legs because, as tadpoles mature, poison glands develop elsewhere on their bodies much earlier than in the skin of their hind legs, rendering the hind legs a far more palatable meal. Developmental responses of the injured/amputated tadpole limbs range from complete regeneration to no regeneration, with intermediate conditions represented by various idiosyncratic limb deformities, depending mainly on the developmental stage of the tadpole at the time of injury/amputation. These findings were reinforced by experimental amputations of anuran tadpole hind limbs that resulted in similar deformities. These studies suggest that selective predation by dragonfly nymphs and other aquatic predators may play a significant role in the most common kinds of limb deformities found in natural populations of amphibians.

THE MYSTERY OF DEFORMED FROGS

Stanley Sessions

Hartwick College, Oneonta, New York (sessionss@hartwick.edu)

The reason we set out to research this question is a long story, dating back more than 15 years to when I published my first paper on deformed amphibians with supernumerary limbs. We discovered that those had been caused by parasites (i.e., parasitic flatworms, or trematodes). However, since 1995, deformed (or "malformed") frogs became one of the most contentious environmental controversies of all time (at least in the United States), with the parasite researchers on one side and the "chemical company" (as I call it) on the other. A veritable media firestorm ensued, and millions of dollars of grant money were at stake, almost all of it going to research on chemical pollution.

By now, however, I am pleased to say that the evidence that frogs with extra limbs (the oddest of the deformities) are caused by parasites is widely accepted among scientists. We have had publications in both the *Journal of Experimental Zoology* (summarized previously) and *Science*, and a couple of my colleagues (Pieter Johnson of the University of Colorado and Andrew Blaustein of Oregon State University) summarized the whole thing in an article in *Scientific American* in February 2003 (www.scientificamerican.com/article.cfm?id=explaining-frog-deformiti).

However, that's not the end of the story. Frogs with extra limbs may have had the most dramatic-looking deformities (indeed, these frogs have been used by everyone as the "poster child" of the deformed frog problem), yet everyone has always realized that they are by far the least common deformities found. The most commonly found deformities occur in frogs with missing or truncated limbs and limb segments (as in the paper summarized here), and, although parasites can occasionally cause limblessness in a frog, these deformities are almost never associated with trematode infections (or at least not with the trematode species known to cause extra limbs). So, this has remained a mystery, and again the controversy has continued to brew between those who suspect chemical pollution (or even UV-B irradiation) and those who suspect (in this case) some kind of predation.

Supporters of the chemical pollution hypothesis as a cause of limbless frogs point to the range of deformities seen in these

A cleared and stained multi-legged Pacific Treefrog (*Pseudacris regilla*; left). The deformity was caused by parasites, specifically a trematode in the genus *Ribeiroia*. The Northern Leopard Frog (*Lithobates pipiens*; right) has a missing left hindlimb (the left forelimb is normal, just bent back). The spike indicates that the limb was bitten off in the course of a selective predation event.

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frogs and argue that it is unlikely that predation is involved because it is difficult to imagine a predator that would remove the hindlimbs with surgical precision and allow the tadpole to survive. This is where Brandon Ballengée comes in. Brandon (an ecoartist) and I began collaborating some years back on a "SciArt" project to make artistically beautiful and scientifically interesting images of deformed amphibians. Brandon took this one step further and went to England to do graduate work (with me as scientific adviser) focused on limbless deformed amphibians — in this case toads. Imagine my surprise when he told me that he had discovered a predator that surgically removes the developing hindlimbs of tadpoles, thus creating limbless frogs! We spent the next few months analyzing the data and writing it up for publication, knowing that at least one other laboratory had independently discovered the same thing (we offered to collaborate or cooperate in some way, but they weren't interested).

The culprits, as you know, are dragonfly nymphs, which have mouthparts adapted to grab their prey, almost like a mechanical arm with a claw on the end that they can shoot out. Once they grab a tadpole, they use their front legs to turn it around and around, searching for the tender bits, in this case the hindlimb buds, which they then snip off with their mandibles (http://blip.tv/file/1418583). Often the tadpole is released and is able to swim away to live another day. If the tadpole survives, it metamorphoses into a toad with missing or deformed hindlimbs, depending on the developmental stage of the tadpole (at early stages, the tadpoles can completely regenerate their limbs, but this ability diminishes as they grow older). We think the dragonflies select the hindlimbs because toad tadpoles have poison glands in mature skin, and the developing hindlimbs have immature glands. We call this phenomenon "selective predation." Other selective predators include stickleback fishes and even other tadpoles.

What do these results mean for the role of chemical pollution in amphibian deformities? We have purposefully focused our research over the years on specific kinds of deformities, especially those that involve the limbs (especially the hindlimbs), mainly because these are by far the most frequently observed deformities in wild-caught amphibians. I think these also have caught people's attention, because everyone remembers the horrible limb deformities caused by thalidomide, which have come to be seen as the quintessential congenital birth defects in humans. Furthermore, we all are primed for some kind of environmental catastrophe, be it ozone depletion, global warming, or some kind of toxic pollution. Amphibians are seen as "indicator species" for environmental toxins because they have a thin skin that can absorb almost anything from an aquatic (or even a merely moist) environment, and the mysterious "amphibian declines" appear to be happening in many corners of the world. So, I am not surprised at all that so many people suspect chemical pollution as the cause for deformities in frogs — and perhaps these pollutants do play a role, even if indirectly, in some kinds of deformities. Endocrine disruptors, for example, could compromise the immune system of tadpoles, making them more vulnerable to parasites (although no compelling evidence exists for this scenario at the moment). Organic pollutants (nitrogen and phosphorus) could enhance eutrophication, leading to abnormal population densities of aquatic vegetation, snails, parasites, and aquatic insects — but our research over the years has shown that the definitive cause of supernumerary limbs in wild populations of amphibians is a specific species of trematode — and now we have strong evidence that the remaining major type of limb deformity, missing or truncated limbs, is caused by selective predation by aquatic insect larvae.

These results do not completely eliminate the potential role of chemical pollutants, rather we see them as the leading current hypotheses to be excluded when confronted with deformed amphibians, at least those featuring extra limbs or missing limbs. Are parasites (i.e., the specific species of trematode) sufficient to cause extra limbs? Yes. Is selective predation sufficient to cause loss or reduction of limbs? Yes. Are chemical pollutants necessary to understand either of these phenomena? No (in fact, one could argue that the parasites and small predators would be just as, if not more — because they are smaller — vulnerable to chemical pollutants than the frogs!).

NEWSBRIEFS

Europe's Amphibians and Reptiles Under Threat

One fifth of Europe's reptiles and nearly a quarter of its amphibians are threatened, according to new studies carried out by the IUCN for the European Commission. The studies, released on International Biodiversity Day, are the first European Red Lists for amphibians and reptiles, and reveal alarming population trends. More than half of all European amphibians (59%) and 42% of reptiles are in decline, which means that amphibians and reptiles are even more at risk than European mammals and birds.

For 23% of amphibians and 21% of reptiles the situation is so severe that they are classified as threatened in the European Red List. Most of the pressure on these declining species comes from mankind's destruction of their natural habitats, combined with climate change, pollution and the presence of invasive species. "Southern Europe is particularly rich in amphibians, but climate change and other threats are placing its freshwater habitats under severe stress," says Dr. Helen Temple, co-author of the study and Program Officer for the IUCN Red List Unit. "Natural habitats across Europe are being squeezed by growing human populations, agricultural intensification, urban sprawl, and pollution. That is not good news for either amphibians or reptiles."

"On World Biodiversity Day, this is a sobering discovery," says Stavros Dimas, European Commissioner for the Environment. "Despite strong legislation protecting our habitats and most of the species concerned, almost a quarter of Europe's amphibians are now under threat. This reflects the enormous pressure we are placing on Europe's plants and animals, and underlines the need to rethink our relation to the natural world. I therefore call on citizens, politicians, and industrialists to reflect on our recent Message from Athens, and factor a concern for biodiversity into the decisions they make. These trends cannot continue."

Europe is home to 151 species of reptiles and 85 species of amphibians, many of which are found nowhere else in the world. Six reptilian species, including the Tenerife Speckled Lizard (*Gallotia intermedia*) and the Aeolian Wall Lizard (*Podarcis raffonei*), have been classified as Critically Endangered, meaning that they face an extremely high risk of extinction in the wild. Eleven more are classified as Endangered, meaning they face a very high risk of extinction in the wild, and 10 as Vulnerable, meaning they face a high risk of extinction in the wild.

Among amphibians, a group that includes frogs and toads and salamanders and newts, two species have been classified as Critically Endangered: The Karpathos Frog (*Pelophylax cerigensis*) and the Montseny Brook Newt (*Calotriton arnoldi*), Spain's only endemic newt. Five more, including the Appenine Yellow-bellied Toad (*Bombina pachypus*) are Endangered, and 11 are classified as Vulnerable.

Amphibians and reptiles are doing even worse than other species groups. Fifteen percent of mammals and 13 percent of birds are under threat. Other groups too are almost certainly in danger, but only these groups have been comprehensively assessed at the European level according to IUCN regional Red List guidelines.

CÉSAR BARRIO-AMORÓS, COURTESY OF JAVIER RIVERA

The Montseny Brook Newt (*Calotriton arnoldi*), Spain's only endemic newt, is critically endangered.

IUCN
20 May 2009

Wildlife Crisis Worse than Economic Crisis

Life on Earth is under serious threat, despite the commitment by world leaders to reverse the trend, according to a detailed analysis of the IUCN Red List of Threatened Species. The IUCN analysis, which is published every four years, comes just before the deadline governments set themselves to evaluate how successful they were in achieving the 2010 target to reduce biodiversity loss. The IUCN report, *Wildlife in a Changing World*, shows the 2010 target will not be met.

"When governments take action to reduce biodiversity loss, there are some conservation successes, but we are still a long way from reversing the trend," says Jean-Christophe Vié, Deputy Head of the IUCN's Species Program and senior editor of the publication. "It's time to recognize that nature is the largest company on Earth working for the benefit of 100% of humankind — and it's doing it for free. Governments should put as much effort, if not more, into saving nature as they do into saving economic and financial sectors."

The report analyses 44,838 species on the IUCN Red List and presents results by groups of species, geographical regions, and different habitats, such as marine, freshwater, and terrestrial. It shows 869 species are Extinct or Extinct in the Wild, and this figure rises to 1,159 if the 290 Critically Endangered species tagged as Possibly Extinct are included. Overall, a minimum of 16,928 species are threatened with extinction. Considering that only 2.7% of the 1.8 million described species have been analyzed, this number is a gross underestimate, but it does provide a useful snapshot of what is happening to all forms of life on Earth.

An increased number of freshwater species have now been assessed, giving a better picture of the dire situation they face. In Europe, for example, 38% of all fishes are threatened and 28% in eastern Africa. The high degree of connectivity in freshwater systems, allowing pollution or invasive species to spread rapidly, and the development of water resources with scant regard for the species that live in them, are behind the high level of threat.

In the oceans, the picture is similarly bleak. The report shows that a broad range of marine species are experiencing potentially irreversible losses due to over-fishing, climate change, invasive species, coastal development, and pollution. At least 17% of the 1,045 shark and ray species, 12.4% of groupers, and six of the seven marine turtle species are threatened with extinction. Most noticeably, 27% of the 845 species of reef-building corals are threatened, 20% are Near Threatened, and data are insufficient for 17% to be assessed. Marine birds are much more threatened that terrestrial species, with 27.5% in danger of extinction, compared with 11.8% of terrestrial birds.

"Think of fisheries without fishes, logging without trees, tourism without coral reefs or other wildlife, crops without pollinators," says Vié. "Imagine the damage to our economies and societies if they were lost. All the plants and animals that make up Earth's amazing wildlife have a specific role and contribute to essentials like food, medicine, oxygen, pure water, crop pollination, carbon storage, and soil fertilization. Economies are utterly dependent on species diversity. We need them all, in large numbers. We quite literally cannot afford to lose them."

The report shows nearly one third of amphibians, more than one in eight birds, and nearly a quarter of mammals are threatened with extinction. For some plant groups, such as conifers and cycads, the situation is even more serious, with 28% and 52% threatened, respectively. For all these groups, habitat destruction, through agriculture, logging, and development, is the main threat and occurs worldwide.

In the case of amphibians, the fungal disease chytridiomycosis is seriously affecting an increasing number of species, complicating conservation efforts. For birds, the highest number of threatened species is found in Brazil and Indonesia, but the highest proportion of threatened or extinct birds is found on oceanic islands. Invasive species and hunting are the main threats. For mammals, unsustainable hunting is the greatest threat after habitat loss. This is having a major impact in Asia, where deforestation is occurring at a very rapid rate.

"The report makes for depressing reading," says Craig Hilton Taylor, manager of the IUCN Red List Unit and co-editor. "It tells us that the extinction crisis is as bad or even worse than we believed. But it also shows the trends these species are follow-

TIM VICKERS (WIKI)

Nearly a third of all amphibians are threatened with extinction, and data are deficient for about 45% of those not listed in threatened categories. Populations of Mountain Chickens (*Leptodactylus fallax*) on Dominica crashed after the chytrid fungus (*Batrachochytrium dendrobatidis*) became established on the island.

ing, and is therefore an essential part of decision-making processes. In the run-up to 2010, the global community should use this report wisely to address the situation."

Climate change is not currently the main threat to wildlife, but this may soon change. After examining the biological characteristics of 17,000 species of birds, amphibians, and reef-building corals, the report found that a significant proportion of species that are currently not threatened with extinction are susceptible to climate change. This includes 30% of non-threatened birds, 51% of non-threatened corals and 41% of non-threatened amphibians, which all have traits that make them susceptible to climate change.

Red List Indices make it possible to track trends of extinction risk in groups of species. New indices have been calculated and provide some interesting results. Birds, mammals, amphibians, and corals all show a continuing deterioration, with a particularly rapid decline for corals. Red List Indices also have been calculated for amphibian, mammalian, and avian species used for food and medicine. The results show that birds and mammals used for food and medicine are much more threatened. The diminishing availability of these resources has an impact on the health and well-being of the people who depend on them directly.

"The IUCN Red List provides a window on many of the major global issues of our day, including climate change, loss of freshwater ecosystems, and over-fishing," says Simon Stuart, chair of the IUCN Species Survival Commission and co-editor. "Unless we address the fundamental causes of unsustainability on our planet, the lofty goals of governments to reduce extinction rates will count for nothing."

To read the full report, Wildlife in a Changing World — An Analysis of the 2008 IUCN Red List of Threatened Species, please go to: http://data.iucn.org/dbtw-wpd/edocs/RL-2009-001.pdf.

IUCN

Galápagos Islands World Heritage Site Stays on Danger List

The decision of the World Heritage Committee to retain the Galápagos Islands on the danger list comes two years after they were recognized as being under severe threat because of growing tourism, invasive species, and immigration. "The decision to retain the Galápagos on the List of World Heritage Sites in danger shows the clear commitment of the government of Ecuador to continue with its conservation efforts and work together with the international community to maintain the outstanding universal value of this unique place on Earth," says Pedro Rosabal, Senior Program Officer of the IUCN. "Ecuador has a history of working in line with the World Heritage Convention, which led to the removal of Sangay National Park from the danger list. The IUCN considers this as 'best practice' of using the danger list as a mechanism for enhancing the conservation and management of endangered sites. The IUCN, through its Regional Office for South America, will further support the efforts of Ecuador toward the removal of the Galapagos Islands from the Danger List."

The Galápagos Islands World Heritage Site, home to this Blue-footed Booby (*Sula nebouxii*), remains on the danger list two years after the islands were recognized as being under severe threat because of growing tourism, invasive species, and immigration.

The Galapagos Islands were among the first sites to be inscribed on the World Heritage List in 1978 and further extended in 2001.The wide variety of flora and fauna on the 19 islands contributed to Charles Darwin's theory of evolution. Due to increased tourism, immigration, and threats from invasive species brought by plane and boat by the visitors, the islands have been inscribed on the danger list, following the IUCN's recommendation in 2007.

The Galapagos Islands of Ecuador and the Manas Wildlife Sanctuary in India are the two natural sites on the danger list outside Africa. Another 11 sites in danger are all located on the African continent.

IUCN

"Python Patrol" Targets Giant Snakes of South Florida

Juan Lopez reads meters with one eye and looks for snakes with the other. Lopez is a member of the "Python Patrol," a team of utility workers, wildlife officials, park rangers, and police trying to keep Burmese Pythons (*Python molurus bivittatus*) from gaining a foothold in the Florida Keys.

Officials say the pythons — which can grow to 20 feet long and eat large animals whole — are being ditched by pet owners in the Florida Everglades, threatening the region's endangered species and its ecosystem. "Right now, we have our fingers crossed that they haven't come this far yet, but if they do, we are prepared," Lopez said.

Burmese Pythons are rarely seen in the middle Florida Keys, where Lopez works. The Nature Conservancy wants to keep it that way. The Python Patrol program was started by Alison Higgins, the Nature Conservancy's Florida Keys conservation manager. She describes it as an "early detection, rapid response" program made up of professionals who work outside.

Eight Burmese Pythons have been found in the Keys. "If we can keep them from spreading and breeding, then we're that much more ahead of the problem," Higgins said. Utility workers, wildlife officials, and police officers recently attended a three-hour class about capturing the enormously large snakes. Lt. Jeffrey L. Fobb of the Miami-Dade Fire Rescue Venom Response Unit taught the participants how to capture pythons.

"There's no immutable laws of snake catching. It's what works," Fobb said as he demonstrated catching a snake with hooks, bags, blankets, and his hands. "We're doing it in the Florida Keys because we have a lot to protect," Higgins said. "The Burmese Pythons that are coming out of the Everglades are eating a lot of our endangered species and other creatures, and we want to make sure they don't breed here."

Where the snakes are breeding is just north of the Keys in Everglades National Park. An estimated 30,000 Burmese Pythons live in the park. The Everglades, known as the "River of Grass," is a vast area with a climate perfect for these pythons to hide and breed — and breed they do: The largest clutches of eggs found in the Everglades have numbered up to 83.

The snakes grow like they're on steroids. With a life span of 30 years, these pythons can weigh as much as 200 pounds — and the larger the snake, the bigger the prey. Biologists have found endangered wood rats, birds, bobcats, and other animals in their stomachs. Two 5-foot-long alligators were found in the stomachs of Burmese Pythons that were caught and necropsied, officials say.

Officials also say Burmese Pythons can travel 1.6 miles a day by land, and they can swim to reach areas outside the Everglades.

This nonvenomous species was brought into the United States from southeastern Asia. Everglades National Park spokeswoman Linda Friar says biologists believe that well-intentioned pet owners are to blame for their introduction into the Everglades. "These pets were released by owners that do not understand the threat to the ecosystem," she said. Higgins says 99,000 of the popular pets were brought into the United States from 1996 to 2006, the most recent data available. She says they are an easy species to breed, and you can buy a hatchling for as little as $20.

The problem with these pets, Friar says, is that they get too big for their owners to handle. Making the owner aware of what to expect when the animal becomes full-grown is a priority. "The pet trade is pretty supportive in educating people," Friar said. She hopes a "Don't let it loose" message campaign makes an impact on pet owners.

Florida Sen. Bill Nelson, a supporter of restoring the Everglades, has introduced a bill that would ban importing the python species into the United States. The senator saw the need after learning about the effect these snakes were having on the park. "Finding out many endangered species are being found in the stomach of the python," Nelson spokeswoman Susie Quinn said, "we need to do a better job at protecting the resources."

In the meantime, Lopez and the Python Patrol will continue to protect the Florida Keys by capturing the snakes and turning them over to biologists to perform necropsies. The Nature Conservancy plans to expand the program to all the areas that surround the Everglades, making these predators their prey. "I would like to find them and get rid of them," Lopez said.

Predatory Snakes Become Prey in the Florida Everglades

Joe Wasilewski drives along a narrow stretch of road through Florida's Everglades. The sun is setting, night is coming on quickly, and Wasilewski is on the prowl for snakes — and one snake in particular. "The next 10 miles seem to be the hot spot for Burmese Pythons," he said.

Wasilewski is a state-sanctioned snake-hunter who regularly scours this area for the reptiles. The Everglades has the perfect space and climate for pythons to hide and breed.

They are also speedy travelers, able to move across 1.6 miles of land every day, experts say. The travel lets people like Wasilewski hunt the snakes from the driver's seat of his truck. However, it also means that the problems created in the local ecosystem by the non-venomous snakes are spreading. "It's a large predator, and they're eating basically everything in sight. That's the problem," Wasilewski said.

Volunteers like Wasilewski, happy to grasp the problem and the snakes with both hands, are not the only troops in Florida's war on the invading pythons. A "Python Patrol" was launched in the Florida Keys, south of the Everglades, by Alison Higgins of the Nature Conservancy. Her program uses utility workers, wildlife officials, park rangers, and police to keep an eye out for snakes and trains them to capture any they find. "The Burmese Pythons that are coming out of the Everglades are eating a lot of our endangered species and other creatures, and we want to make sure they don't breed here," said Higgins, the conservation manager for the Keys.

The problem probably originated when reptile-breeding facilities near the Everglades were destroyed during Hurricane Andrew. Compounding the problem is the release of these snakes by pet owners.

Twenty years ago, no Burmese Pythons were found in the Everglades, park statistics say. Now, there could be 100,000 snakes in the River of Grass, but no one knows for sure. What Wasilewski is sure of is that night is the best time for his hunting, as that is when the snakes tend to be on the move. When he finds his prey, he puts the snake in a bag, deposits it in a crate, and delivers it to biologists for the Everglades National Park, where the snake can be studied and/or destroyed.

On one recent evening, the pickings were slim, and after two hours of driving back and forth along the two-lane Tamiami Trail, Wasilewski's crate was empty. He saw a python on the road, but it was dead, and the other small snakes and a baby alligator in the area did not interest him. Finally, Wasilewski, an environmental and wildlife consultant, spotted something. "Yeah, baby! Hee ha! Look at the size of this one," he exclaimed from the front seat of his truck. He got out and picked up the brownish-green snake, which immediately coiled around his arm. "This isn't a big one," he said, but as he got a closer look, he did not deny that it was a good one: "At least 12 [feet]."

Wasilewski has a soft spot for these species, and one of the reasons he volunteers for the snake hunt is to learn more about them. He says it is not the snakes' fault that they ended up in the Everglades, but he acknowledges the problems they are causing on the Florida ecosystem and the need to do something. "One down, 100,000 to go," he said.

Kim Segal and John Zarrella
CNN

Florida wildlife officer holding the tail of a large Burmese Python (*Python molurus bivittatus*).

ADVERTISEMENTS

Editor's Remarks

In this special issue (with 80 instead of the regular 64 pages), we feature the spectacular photography of Dan Suzio (travelogue, p. 152). We also include our first (and possibly only) bilingual article (conservation alert, p. 130). The Chinese text exists to facilitate the use of this article in educational and conservation efforts at Dinghushan, China's oldest nature reserve. Finally, instead of a "Focus on Conservation" highlighting a conservation effort worthy of your support, we provide an editorial for your consideration on p. 208. That decision was triggered by the upsurge in media attention surrounding Burmese Pythons established in southern Florida (see the newsbriefs on pp. 201 and 202). Alien introductions have become all too common, and are indicative of much greater problems facing not only the state of Florida, but much of the world, as invasive species become increasingly common inhabitants of places where they simply do not belong (see the book review on p. 195). This editorial, like many of the commentaries we have published in past issues, is intended to elicit a response. Whether you support or oppose our stand on this particular issue, we invite your comments, a selection of which we promise to include in a future issue.

The Editors of *Reptiles & Amphibians*

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EDITORIAL

Big Snakes in the Everglades[1]

Amidst scary headlines and hysterical responses, a snake-hunt is on in Florida. The state has long been the poster-child for herpetological invasions. In recent years, several species of reproducing and spreading constrictors have been identified. What to do about them has been contentious. Scientists have advocated eradication of incipient populations and regulations to reduce future risks. Unfortunately, managers considered action premature — until eradication has become essentially impossible. The pet trade is likely responsible for many of the introductions, either directly or through owner carelessness, and is eliciting strong commercial and emotional opposition to any action. Many hobbyists have seen any efforts to control these snakes as an overreaction. The United States Association of Reptile Keepers still opposes any actions to limit the trade, stating: "There is absolutely no evidence to suggest that banning the import, sale, and trade of any of these animals will have any positive effect on the economy, environment, or human or animal species health" (www.usark.org/uploads/NO%20on%20HR669.doc). They oppose "ideologically based legislation designed to exploit fear and misunderstanding in order to pass [a] federal law to ban the import, purchase, sale, trade, and breeding of many, many reptiles. HR6311 & Rule Change adding Boa, Python and Eunectes to the Injurious Wildlife List of the Lacey Act" (www.usark.org/positionstatements.php).

After a pet Burmese Python killed a toddler in Florida earlier this year, concern turned to action. Florida has begun regulating ownership of pythons and some other snakes, and the U.S. Congress is considering measures. A major tool chosen for use is a bounty system. Interior Secretary Ken Salazar announced that "trained and well-supervised volunteers [will] hunt down and remove snakes." As we write this, the Florida Fish and Wildlife Conservation Commission website reports that 13 "permit holders have captured and euthanized 14 Burmese Pythons on selected FWC-managed sites." Unfortunately, the best estimates of python populations in Florida are in the tens of thousands, and the number captured to date clearly does not represent an effective response. This is in line with other such attempts; bounty programs have generally not been effective for controlling invasive reptilian species. More often than not, bounty programs generated unintended consequences, including habitat destruction, collection of non-target species, and intentional spread of the target species for future profit. **We oppose the bounty program now in place and call for measures that have more realistic goals and a better track record.** Prevention of spread of the existing populations and future colonization would be an appropriate focus for the near future.

The editors of this journal are committed to a science-based approach for the conservation of reptiles and amphibians. We advocate responsible husbandry of appropriate species, but also see the need for better regulation of problematic species. In addition, we strongly support a preventative, rather than a reactive approach to invasive species. Prevention is more effective and cheaper than trying to eradicate populations once they have become established — something that seems unlikely in the current case. Risk assessment can be a crucial part of efforts to identify potential problems in advance. We also support putting into place longer-term efforts, including the identification of pathways by which amphibian and reptilian species become established outside their native ranges, development of effective tools to prevent such events from occurring, and eradication of incipient populations.

[1] See newsbriefs on pp. 201 and 202 and the book review on p. 195.

The Editors of *Reptiles & Amphibians*

L. LEE GRISMER

Extremely venomous Banded Kraits (*Bungarus fasciatus*) once were common in lowland agricultural areas throughout southeastern Asia. They are increasingly rare today because they are avidly sought for human food and traditional medicine. See the article on p. 130.