

First Report on the Herpetofauna of Ataúro Island, Timor-Leste

Hinrich Kaiser^{1*}, Caitlin Sanchez¹, Scott Heacox¹, Andrew Kathriner², Agivedo Varela Ribeiro³, Zito Afranio Soares³, Luis Lemos de Araujo³, Sven Mecke⁴ and Mark O'Shea⁵

1 Department of Biology, Victor Valley College. 18422 Bear Valley Road. Victorville, California 92395, USA.

2 Department of Biology, Villanova University. 800 East Lancaster Avenue. Villanova, Pennsylvania 19085, USA.

3 Universidade Nacional Timor-Lorosa'e, Departamento da Biologia. Avenida Cidade de Lisboa, Liceu Dr. Francisco Machado. Dili, Timor-Leste.

4 Department of Animal Evolution and Systematics and Zoological Collection Marburg, Faculty of Biology, Philipps-Universität Marburg. Karl-von-Frisch-Strasse 8. 35043 Marburg, Germany.

5 School of Applied Sciences, University of Wolverhampton. Wulfruna Street. Wolverhampton, West Midlands WV1 1LY, United Kingdom; and West Midland Safari Park. Bewdley, Worcestershire DY12 1LF, United Kingdom.

* Corresponding author. E-mail: hinrich.kaiser@vvc.edu

ABSTRACT: We describe for the first time the terrestrial herpetofauna of Ataúro Island, Timor-Leste, a small mountainous island in the Inner Banda Arc of the Lesser Sunda Archipelago. The island supports a fauna of ten lizard species in three families (Gekkonidae, $n = 5$; Scincidae, $n = 4$; Varanidae, $n = 1$) and four snake species in three families (Colubridae, $n = 3$; Typhlopidae, $n = 1$; Viperidae, $n = 1$). In addition to a set of lizards (e.g., *Cryptoblepharus*, *Eutropis*, *Gehyra*, *Gekko*, *Hemidactylus*, *Lamprolepis*) and snakes (e.g., *Lycodon*, *Ramphotyphlops*, *Trimeresurus*) typical for the Lesser Sunda Islands, there appear to be undescribed endemic species of *Cyrtodactylus*, *Eremiascincus*, and *Varanus* on Ataúro. Our surveys to date have not revealed the presence of any amphibians, turtles, or crocodiles.

INTRODUCTION

Ataúro Island is a small (area = 105 km²) volcanogenic landmass with geological and geographic affinity to the Inner Banda Arc of the Lesser Sunda Archipelago. Although all neighboring islands, such as Alor to the northwest or Wetar to the northeast, are part of Indonesia, Ataúro itself is politically part of Timor-Leste, which comprises the eastern half of Timor island and is Asia's newest country. The island is inhabited by about 8000 people comprising at least three language groups, who are engaged primarily in subsistence farming and fishing.

Historically, Ataúro appears to have been quite isolated, both culturally and economically, even though it lies merely 25 km off Timor-Leste's biggest port at Dili, the country's capital. During Portuguese colonial times (ca. 1525–1975), Dili itself was described as an undesirable way station for the early ocean-faring voyages (e.g., de Freycinet 1828), and we have been unable to locate any historical accounts of life on Ataúro during that period. During the Indonesian occupation (1975–99) Ataúro was essentially left alone due to its lack of resources and amenities, and because by its remoteness it could not play a significant part in the Timorese resistance. In fact, during both Portuguese and Indonesian times, Ataúro was used as a natural prison, a place to exile those undesirable to the ruling class. Even today, Ataúro remains quite disconnected from the rest of Timor-Leste, with transportation limited to a once-weekly ferry service and many smaller boats across a very treacherous ocean passage. Largely as a consequence of this historical isolation, Ataúro has very little in the way of modern infrastructure and, recent improvements and efforts to introduce eco-friendly solutions notwithstanding, even basic needs of the population (e.g., electricity, water supply, roads) are not always addressed.

Even given the logistics-based isolation, Ataúro is in the process of becoming known as a nature tourism destination, remote yet accessible from mainland Timor-Leste, and it is becoming particularly renowned for its excellent diving sites. However, the impact of ecotourism on the island cannot be accurately assessed at this point in time since baseline surveys of neither terrestrial nor aquatic biodiversity have been conducted. The notable exception is surveys of birds (Trainor and Soares 2004; Trainor and Leitão 2007). As part of a larger survey of Timor-Leste's herpetofauna (Kaiser *et al.* 2011; O'Shea *et al.* 2012; Sanchez *et al.* 2012), we visited Ataúro on several occasions to determine the species composition of amphibians and reptiles and to investigate whether any differences existed compared to Timor, in the Outer Banda Arc. We here present the initial report of our findings.

MATERIALS AND METHODS

Localities

We surveyed for amphibians and reptiles at 11 principal localities on Ataúro (Figure 1; Table 1), focusing primarily on the island's east coast and its interior highlands for reasons of accessibility. In the species accounts (see below), the locality numbers provided correspond to those listed in Table 1.

Ataúro's main population centers (e.g., Vila, Beloi) are situated in a strip of coastal lowlands, connected by the only compacted-surface road (Figure 2A). This coastal road crosses several seasonally dry streambeds (Figure 2B) and separates the beachfront from swampy habitat (Figure 2C) and agricultural plots (Figure 2D), all of which may reach into the foothills. From Beloi a road accessible only by four-wheel drive leads steeply upwards through primarily grassy vegetation across limestone substrate (Figure 2E)



FIGURE 1. Map of Ataúro Island, Timor-Leste. Collecting localities are identified by numbers corresponding to the descriptions in Table 1. Map by Mark O'Shea.

FIGURE 2. Representative habitat types on Ataúro Island, Timor-Leste. (A) Shown is the main road, which connects the ferry dock at Beloi with Ataúro's main town, Vila. In these towns, many types of human-made habitats exist, ranging from houses and fences to gardens and plantations (Locality 7). (B) Several rocky streambeds, such as shown in this photo of the Ankarana River (Locality 4), extend in an eastward direction from the foothills towards the beach. (C) There are several swampy habitats (Locality 5) that temporarily hold rainwater runoff. These are fast-changing habitats, since in the absence of replenishment the water will drain through the porous substrate. (D) Highland areas unable to support lush forest growth due to shallow soils and a lack of nutrients are richly covered with grasses and support small, widely spaced trees (area of Locality 2). (E) A small patch of rainforest along the interior road. (F) Habitat in the transition zone between the flat lowlands and the interior slopes, characterized by many loose limestone rocks. This is the type of habitat where we located *Eremiascincus* sp. 1 (Locality 4). (G) A roadside ravine near the coast, habitat for *Cyrtodactylus* sp. 2 and *Ramphotyphlops* sp. (Locality 1). (H) Vegetation on the slopes of Mt. Manucoco (area of Locality 9). Photos by Hinrich Kaiser (D, H), Mark O'Shea (B, C, E, F), and David Taylor (A, G).



into the more verdant higher elevations of Ataúro. Along the road into the interior there are several patchily distributed forested habitats with seasonal surface water sources (e.g., Figure 2F). The road ends in the village of Anartutu (elevation ca. 500 m; Figure 1) from which paths allow access to the Mount Manucoco Protected Area (maximum elevation 996 m; Figure 2G). The steep slopes of Ataúro have resulted in considerable habitat diversity based on temperature and precipitation gradients; whereas the coastal plains of the island can remain dry for months at a time with constant temperatures above 30°C, there is nearly daily precipitation or fog-induced high humidity with temperatures in the 10–20°C range at altitude. Near the twin summits of Mt. Manucoco the vegetation is lush and moist (Figure 2H), reminiscent of cloud forest habitat normally seen at much higher elevations in Southeast Asia.

Specimen Collection

We conducted three formal surveys of Ataúro (29 Jan–1 Feb 2010, 31 Jan–2 Feb 2011, 28 Jan–3 Feb 2012). In addition, four of us (HK, LLA, AVR, ZAS) visited Ataúro on 3 Sep 2010 to ascertain the presence of monitor lizards on the island (see below). Surveys were generally restricted to areas accessible by road, with the exception of dry riverbeds in the lowlands and the Mt. Manucoco paths. We followed the methodology detailed by Kaiser et al. (2011). GPS coordinates (conforming to WGS-84) were recorded using a Garmin Oregon 400t handheld global positioning system (Garmin International Inc., garmin.com), and were later verified using Google Earth. We have carefully considered the utility of our own GPS coordinates vs. those based on the Landsat measurements and imagery used by Google Earth. Both systems deliver data with inherent, unavoidable inaccuracies. Whereas potential errors derived from our handheld GPS include a potentially low number of captured satellites due to local topography and ground cover, those in Google Earth are related to resolution. In order to standardize a protocol, we approach an area in Google Earth using our own GPS coordinates and then determine whether there is concordance between our datum and the ‘ground truth’ displayed by Google Earth, based on our familiarity with the sites. Whenever possible, we pinpoint a locality using Google Earth, and we augment these data with our own measures of elevation when necessary.

Processing

The basic methodology employed for specimen processing was described by Kaiser et al. (2011). Briefly, specimens were euthanized using intracardial injection with a 5% procaine solution according to standard methods. Tissue samples were taken from all specimens. Snout-vent length (SVL) was measured to the nearest 0.1 mm using Mitutoyo IP67 calipers. Species accounts use the accepted scientific name of each species as of 15 September 2012 (Uetz 2012). The use of the abbreviation ‘cf.’ between genus and species name flags instances where the sampled population is very similar to an existing species but where additional research is needed to confirm the identification. Scientific names are supplemented with common names in English (E) and Timor-Leste’s official language Tetun (T). English common names are those of preferred usage by professional herpetologists, whereas Tetun names with asterisks (*T) are newly coined and formed to reflect the meaning of English names. Voucher specimens (Appendix 1) have been deposited in the Division of Amphibians and Reptiles, National Museum of Natural History, Smithsonian Institution, Washington DC, USA (USNM) and the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany (ZFMK).

RESULTS

The paragraphs below contain accounts to detail the identity and natural history of the species encountered. Populations we consider to represent new species are listed with the correct genus name and an integer (e.g., *Cyrtodactylus* sp. 1) so that they can be differentiated in this and future discussions. We have not yet found two commonly reported components of the mainland Timor-Leste herpetofauna on Ataúro, namely amphibians and flying lizards (genus *Draco*). Their presence at this point appears to be unlikely, based on formal interviews with local residents using Species Identification Cards (O’Shea and Kaiser 2013) and many anecdotal reports regarding herpetofaunal records for Ataúro.

Family Gekkonidae—True Geckos

Cyrtodactylus sp. 1 (Figure 3A). (E) Manucoco Bent-toed Gecko. (*T) Teki ain-fuan kleuk Manucoco. We found a single adult male specimen of this small (SVL = 39.3 mm) species of *Cyrtodactylus* during the day, under the bark of

TABLE 1. List of localities we surveyed on Ataúro Island, Timor-Leste, during visits in 2010, 2011, and 2012. Localities listed here are numbered and correspond to the locality indicators on the map (Figure 1).

LOCALITY	DESCRIPTION	ELEVATION (m)	GPS COORDINATES ^a
1	promontory in grassy habitat	295	08°12’10” S, 125°36’00” E
2	ravine N Beloi	70	08°12’10” S, 125°37’20” E
3	cliff face N Beloi	10	08°12’42” S, 125°36’40” E
4	Barry’s Place and surrounds, Beloi	0–20	08°13’10” S, 125°36’40” E
5	Ankarana and Atipasa Rivers	20–60	08°13’30” S, 125°36’10” E
6	coastal swamp and surrounds	7–50	08°14’10” S, 125°36’20” E
7	Tua Ko’in Ecolodge and surrounds	0–8	08°15’11” S, 125°36’26” E
8	Vila town and surrounds	0–15	08°15’50” S, 125°36’20” E
9	Anartutu village and surrounds	550–600	08°15’40” S, 125°33’10” E
10	western slopes of Mt. Canilatuto	600–725	08°15’39” S, 125°33’32” E
11	western slopes of Mt. Manucoco	675–750	08°16’12” S, 125°33’30” E

^a GPS coordinates are approximate to define the surveyed area. Precise localities are not provided to protect some of the unique and fragile habitats on Ataúro Island.

a decaying log, in a limestone hollow on the western slope of Mt. Manucoco (Locality 11). The individual attempted to escape by seeking refuge under pieces of loose bark, from which we were able to retrieve it. Based on a suite of morphological characters, we have no doubts that this Mt. Manucoco population of *Cyrtodactylus* is a new species to science (Kathriner *et al.* in prep.).

Cyrtodactylus sp. 2 (Figure 3B). (E) Ataúro Bent-toed Gecko. (T) Teki ain-fuan kleuk Ataúro. Individuals of this species were encountered in several diverse habitats, including a limestone cliff face and a nearby ravine (Localities 2, 3), a coconut grove with agricultural impact (Locality 6), and in tropical dry forest and in a rock pile near Barry's Place (Locality 4). The position of individuals in their respective habitats when observed ranged from underneath solid cover (*e.g.*, rocks, logs) by day, to probable foraging on level ground, to resting on the vertical cliff face at eye height (ca. 1.75 m) above level ground. Even though this population appears to be superficially similar to *C. darmandvillei* (Weber, 1890) from Flores, a more careful morphological and genetic analysis to ascertain the taxonomic status of this population is currently underway (Kathriner *et al.* in prep.).

Gehyra mutilata (Wiegmann, 1834) (Figure 4A). (E) Mutilated Gecko, Four-clawed Gecko. (T) Teki kulit kanek. Specimens of this perianthropic species were all captured during the day, in the high elevation habitats near Anartutu village (Locality 9) and on the slopes of Mt. Canilatuto (Locality 10), and in the lowland habitats at Vila (Locality 8) and Beloi (Locality 4). The specimen from the highest

elevation (719 m) was found inside an ant colony in a rotten log. Additional specimens were observed on a rock wall along a village path and underneath rocks and logs.

Gekko gekko (Linnaeus, 1758) (Figure 4B). (E) Tokay Gecko. (T) Toke. The characteristic vocalizations of this species are widely heard in all lowland habitats of coastal eastern Ataúro. It is quite common, and we deliberately limited our sampling effort to the three voucher specimens we captured during our first Ataúro survey, with photographic vouchers collected thereafter. These large geckos are commonly seen in the rafters of human residences after nightfall, including in a restaurant in Vila, the Tua Ko'in Resort, and Barry's Place (Localities 4, 7, 8).

Tokay geckos were frequently encountered in the accommodation at both Tua Ko'in Lodge and Barry's Place, where these animals appeared to reside in the wooden



FIGURE 3. Bent-toed geckos found on Ataúro Island, Timor-Leste. (A) Male individual of *Cyrtodactylus* sp. 1 (SVL = 39.3 mm) from the slopes of Mt. Manucoco. (B) Male individual of *Cyrtodactylus* sp. 2 (SVL = 76.0 mm) from a lowland habitat north of Beloi. Photos by Mark O'Shea.

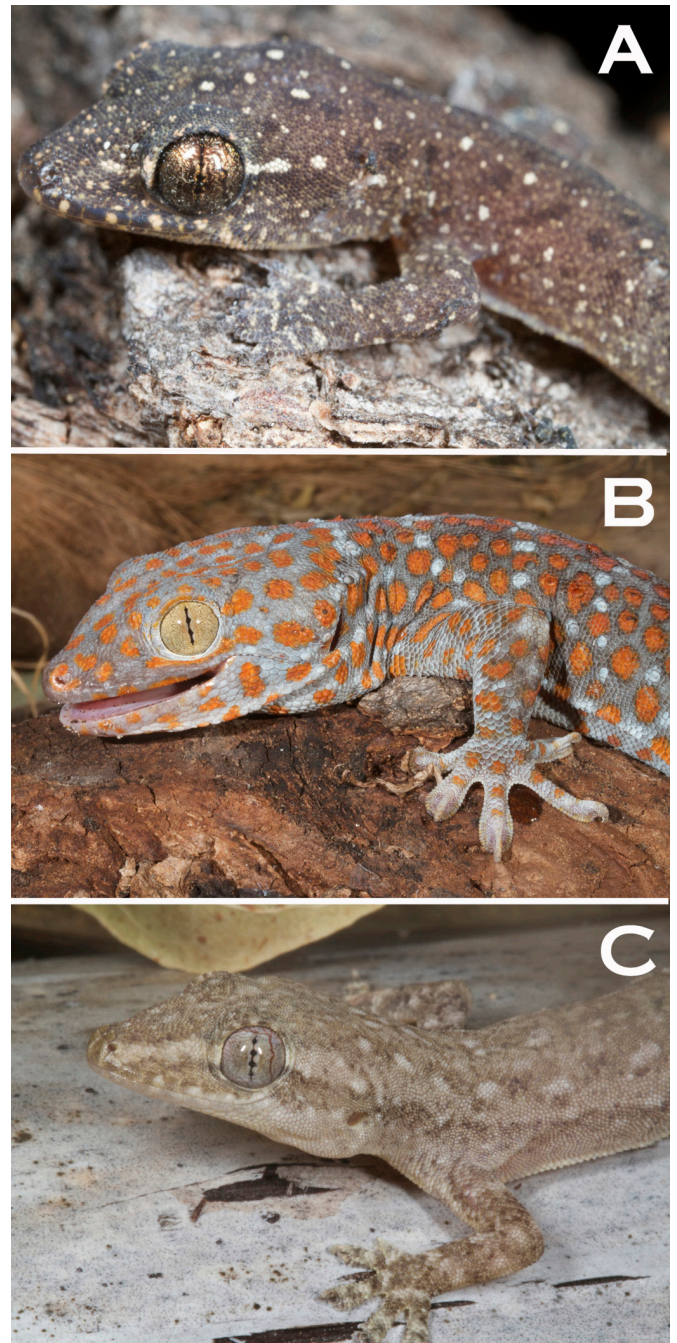


FIGURE 4. Common geckos found on Ataúro Island, Timor-Leste. (A) *Gehyra mutilata*. (B) *Gekko gekko*. (C) *Hemidactylus frenatus*. Photos by Mark O'Shea.

cabanas. They invariably display aggressively when disturbed, which includes opening the mouth widely and vocalizing threateningly. In one instance, a house gecko (*Hemidactylus*) we had captured and set on a bed in a plastic bag pending processing was dragged into the wall of the cabana by a tokay, together with the bag that held it captive. We discovered this by the rustling sounds the tokay made to break into the bag. During our attempts to retrieve the smaller gecko, the tokay held on tightly and tore the plastic bag.

Hemidactylus frenatus Schlegel, 1836 (Figure 4C). (E) Common House Gecko. (T) Teki uma baibain frenatus. Based on the frequency with which we have seen these perianthropic geckos on Ataúro, they appear to be the most common reptiles on the island. Along with *Gehyra mutilata*, they also appear to be able to tolerate the greatest breadth of habitats, ranging from the cooler, montane environments of Anartutu (Locality 9) and Mt. Canilatuto (Locality 10) to the warmer and drier habitats on the east coast of Ataúro (e.g., Barry's Place; Locality 4).

Family Scincidae—Skinks

Cryptoblepharus leschenault (Cocteau, 1832) (Figure 5A). (E) Leschenault's Snake-eyed Skink. (T) Mamór matan samea leschenault. A single individual of this normally coastal snake-eyed skink was observed high above the ground on a tree, in the transition zone from lowland swamp to hillside forest (near Locality 6). It was captured by shooting it with a blowgun.

Eremiascincus sp. 1 (Figure 5B). (E) Ataúro Glossy Night Skink. (T) Mamór kalan Ataúro. Specimens of

this population of night skinks were found during two afternoon surveys along the Akarana River and the adjacent Atipasa River (Locality 5). Glossy night skinks were encountered hiding under rocks, logs, and in leaf litter, where they exhibited an uncanny ability to merge into the loose substrate and root matter underneath. This resulted in a relatively low seen-to-capture ratio. In one instance, a juvenile skink was found alongside a wolfsnake (*Lycodon capucinus*), a possible predator of these lizards. *Eremiascincus* sp. 1 was also found in sympatry with *Eutropis* cf. *multifasciata*. We were able to collect adult as well as subadult and juvenile specimens.

Eutropis cf. *multifasciata* (Figure 5C). (E) Common Sun Skink. (T) Mamór loro. Individuals of this large skink (SVL up to 120 mm, total length up to 296 mm) were observed in both the highland and lowland localities (Mt. Manucoco: Locality 11; Beloi: Locality 4). Whereas we were unable to voucher an individual seen in a forested area on the eastern versant of Mt. Manucoco, we obtained one specimen in Anartutu village and a second one in a betel nut plantation near Beloi. We also observed individuals in a palm grove along the coastal road by night, sleeping under a palm leaf, and in the dry beach vegetation near Barry's Place and along the Akarana River during the day.

Lamprolepis cf. *smaragdina* (Figure 5D). (E) Emerald Tree Skink. (T) Mamór modok. We observed several individuals of this colorful skink, both in the montane locality (Anartutu village; Locality 9) as well as in lowland areas near Beloi (Localities 4, 6). To date, our collection consists exclusively of adult specimens displaying the green-brown coloration, punctuated with a middorsal



FIGURE 5. Skinks from Ataúro Island, Timor-Leste. (A) *Cryptoblepharus leschenault*. (B) *Eremiascincus* sp. 1. (C) *Eutropis* cf. *multifasciata*. (D) *Lamprolepis* cf. *smaragdina*. Photos by Mark O'Shea.

pepper-and-salt scale pattern; on Ataúro we have not yet seen an entirely brown adult individual, as we have encountered in mainland Timor-Leste and in the Oecusse exclave (Kaiser et al. 2011; O'Shea et al. 2012; Sanchez et al. 2012). One juvenile individual we collected displayed uniform green coloration, in a lighter green than some of the adults.

Family Varanidae—Monitor Lizards

Varanus sp. (Figure 6). (E) Ataúro Monitor. (T) Lafaek raimaran Ataúro. We initially observed two individuals of this medium-sized (total length in excess of 150 cm) monitor during our 2011 survey of Ataúro, but both escaped by running into burrows in dense undergrowth. Four of us (HK, LLA, AVR, ZSA) subsequently traveled to Ataúro in August 2011 in order to let local residents know that we were seeking information regarding the distribution of these lizards on Ataúro. During this visit we found two specimens. The first was a carcass, entangled in washed up beach debris (Figure 6A). The second individual had been held captive in a plastic drum, but had died and had begun to decay (Figure 6B). We were able to secure tail clips from both specimens for initial molecular analysis.

In September 2011, we were notified that a resident of Vila had serendipitously captured a monitor lizard (Figure 6D) and was holding it for pick-up. LLA, ZSA, and AVR, along with our colleague Venancio Lopes Carvalho, returned to Ataúro to negotiate for the release of the lizard for scientific purposes. Whereas the resident was clearly hoping to receive cash for the lizards, it was explained to him that under our collecting guidelines we could not pay for the specimen, although we would be able to recognize the effort made by providing a 25-kg bag of rice and a \$20 reimbursement for labor and expenses incurred while holding the lizard. The lizard was initially seen when it displaced a chicken from its nest using its snout. With the chicken gone, it smashed an egg with a sideways swipe of its snout and consumed the egg before the chicken's owner was able to react. He threw a piece of wood at the lizard, which moved away, and which he then pursued. The monitor attempted to escape into a burrow but could be captured because the burrow was too shallow to hold the entire lizard, and its tail remained within reach.

During our 2012 visit to Ataúro, we encountered several monitor lizards and were able to apprehend two individuals in a forested swampy area south of Beloi (Locality 6). The first of these was initially seen resting in a vertical position on a tree trunk (Figure 6C). It was captured by hand after we had surrounded the tree and it jumped from its perch. The second individual was caught in a specially modified baited funnel trap (O'Shea et al. in prep.) that had been positioned on a branch overhanging the swamp.

Family Colubridae—Typical Snakes

Coelognathus subradiatus (Schlegel, 1837) (Figure 7A). (E) Lesser Sunda Racer. (T) Samea laho. This snake was observed in the branches of a tree at the edge of agricultural land in the Mt. Canilatuto highlands above Anartutu village (Locality 10). When its human pursuer began climbing the tree, the snake initially moved to higher branches in the

tree (up to a height of ca. 6 m), then to the outer branches from where it launched itself into the air, landing on the ground several meters away from the tree. It moved very rapidly in the grassy ground cover to escape, but it was captured despite its rapid movement and aggressive defensive strikes. The very dark brown coloration of this individual is rather atypical for the species and did not permit easy identification during the hurried pursuit. Care should be taken that the potentially occurring, similarly colored, spitting cobra (*Naja* cf. *sputatrix*; see below) is not mistaken for the harmless racer.

Lycodon capucinus (Boie, 1827) (Figure 7B). (E) Common Wolfsnake. (T) Samea lobo. Just as on mainland Timor, these wolfsnakes appear to be a relatively common component of the snake fauna, and we were able to capture three individuals. Whereas two individuals were collected at the Akarana River (Locality 5), the third was observed behind equipment in the workshop at Barry's Place (Locality 4).

Family Typhlopidae—Blindsnakes

Ramphotyphlops sp. (Figure 7C). (E) Blindsnake. (T) Samea matan delek. Several specimens of blindsnake that could not readily be associated with *R. braminus* (Daudin, 1803) or *R. polygrammicus* (Schlegel, 1839), species found on neighboring islands, were found primarily in lowland habitats (Localities 2–4).

Family Viperidae—True Vipers and Pitvipers

Trimeresurus insularis Kramer, 1977 (Figure 7D). (E) Lesser Sunda Island Pitviper. (T) Samodok. We collected a single specimen from a residence in the hills below Mt. Canilatuto (Locality 10). The individual had been observed and killed earlier in the day by local residents. Its body was retrieved from the branch over which it has been draped; placing the carcass over the branch inadvertently prevented further damage to the specimen, such as from scavenging invertebrates such as ants or beetles, or its loss from being carried off by feral mammals.

Unverified Species

Naja cf. *sputatrix*. (E) Spitting Cobra. (T) Samea kaben veneno (Local residents know this snake as *samea hu-mau*, meaning “snake that blows spit.” In the interest of public safety, we here promote the name *samea kaben veneno*, the “snake that spits venom,” so that the potential danger from this animal is readily apparent). Even though we have not seen or captured a spitting cobra on Ataúro, we have had numerous anecdotal reports that the species is present in some lowland habitats, including near human habitations (e.g., Vila; Locality 8). These reports include anecdotes that we assessed for their veracity with the help of Species Identification Cards (O'Shea and Kaiser 2013) picturing the cobra. All reports agree that the snake is considered to be relatively small (fingertip-to-elbow is shown as its length in all accounts) and invariably included a description of hooding behavior and venom spitting. The reaction to a bite is described as very painful and lasting from three days to a week. Venom sprayed into the eyes caused considerable discomfort but subsides within several hours when rinsed out with water. If these descriptions are accurate, the population of spitting

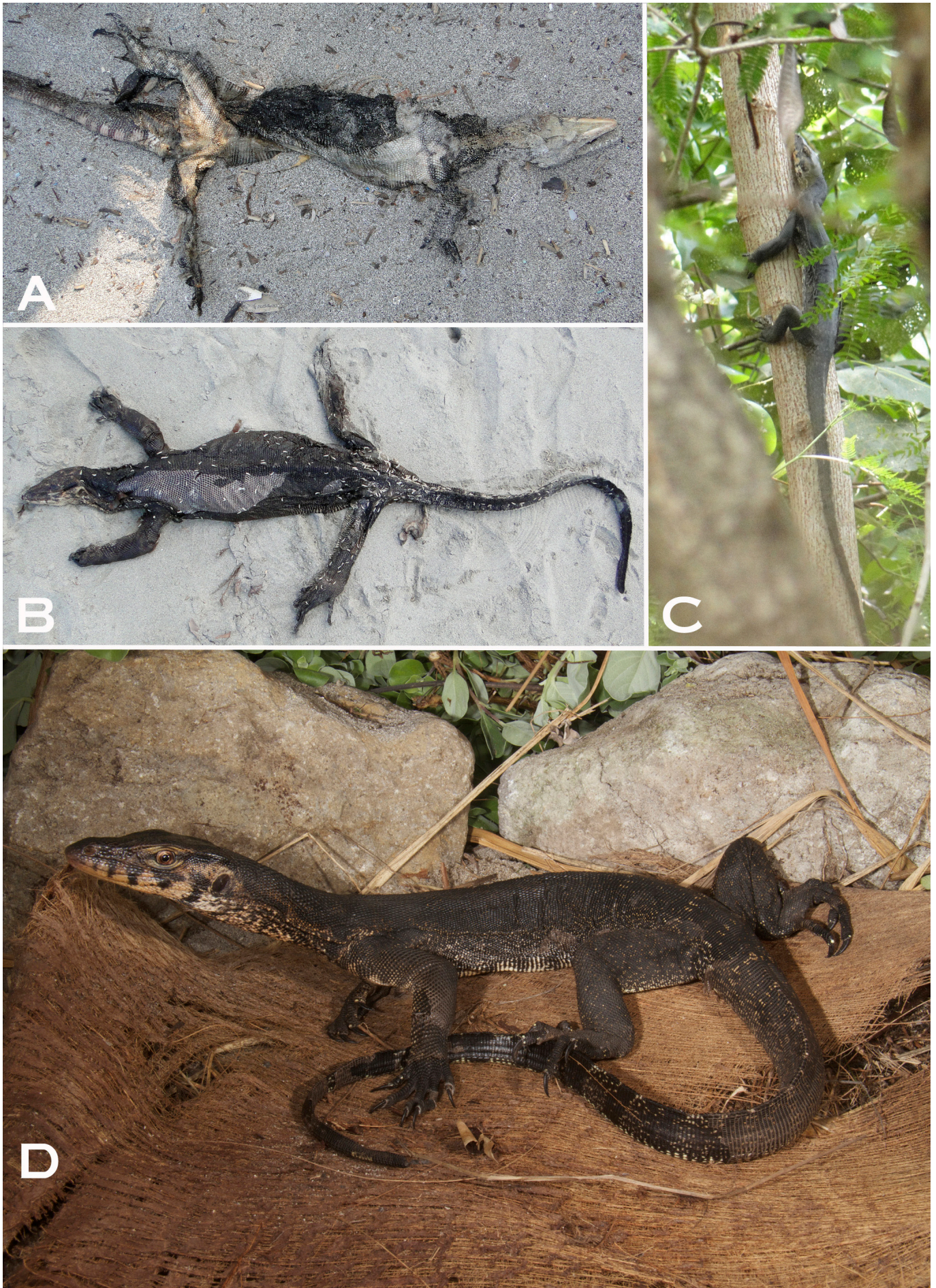


FIGURE 6. Monitor lizard (*Varanus* sp.) from Ataúro Island, Timor-Leste. (A) Carcass found on the beach. (B) Decaying specimen with insect larvae (small white patches). (C) Individual resting on a tree trunk in a swampy area. Photos by Hinrich Kaiser. (D) Individual in (C) photographed after capture. Photo by Mark O'Shea.

cobra on Ataúro appears to be a miniaturized form with somewhat lessened venom toxicity, compared with specimens known from neighboring Alor. No fatalities are known from its bite on Ataúro.

Four additional snake species may occur based on our own observations and those made by local residents: *Dendrelaphis inornatus* Boulenger, 1897; *Laticauda colubrina* (Schneider, 1799); *Liasis mackloti* Duméril and Bibron, 1844; and *Boiga hoeseli* Ramadhan et al., 2010. All four of these species are known from neighboring islands. The first three are known from Timor, with *L. mackloti* also known from Wetar. *Boiga hoeseli* is found on Alor. A fleeting glance by CS of a slender snake with a bulbous head in a tree near Barry's Place (Locality 4) may be attributable to *B. hoeseli*, whereas a chase of what was almost certainly a *D. inornatus* in grassy habitat (Locality 1) by AVR was unsuccessful.

DISCUSSION

Our findings to date indicate that the herpetofaunal diversity on Ataúro is considerably less than that of Timor, and that there are no genera recorded so far that might be considered distinctively Inner Banda Arc elements. At this time it is not possible to make a similarly comprehensive statement about comparisons with the two close larger Inner Banda Arc islands Wetar and Alor since neither of these islands has been comprehensively surveyed.

The most striking feature of Ataúro's herpetofauna is perhaps the absence of amphibians. Given the proximity of islands such as Alor, Timor, or Wetar, where populations of foam-nesting treefrogs (genus *Polypedates*), rice-paddy frogs (genus *Fejervarya*), or introduced toads (*Duttaphrynus melanostictus* [Schneider, 1799]) are known to occur, one might assume that historical or recent human economic activity, let alone natural dispersal, would have allowed a population of these taxa to become established. However, these activities may not be frequent enough and may not involve the habitat components by which human-mitigated introductions are usually made. For reasons primarily related to topography and water availability, there are no rice paddies on Ataúro, and this essentially eliminates one possible means of colonization for rice-paddy frogs. There may also not have been sufficiently frequent imports from the mainland to facilitate the arrival of treefrogs in building materials or decorative plants, and there are few locations on Ataúro where natural moisture or irrigation can provide reliable breeding opportunities for these frogs. Lastly, even though Asian toads have become well established on Timor in recent decades, transport to Ataúro is so infrequent and involves loads of such limited size that it is likely very difficult for toads to stow away and make the crossing from Dili. We expect that the expansion of tourism facilities on Ataúro will increase the opportunity for amphibian introduction, and that at least toads will colonize the island in the next decade.

Among the most interesting records identified on Ataúro are the two species of bent-toed gecko (genus *Cyrtodactylus*), the monitor lizard (genus *Varanus*), and the glossy night skink (genus *Eremiascincus*), all of which may represent new and endemic species. Whereas the overall biodiversity and distribution of *Cyrtodactylus* in Southeast Asia and into Australia is as yet unknown and appears to

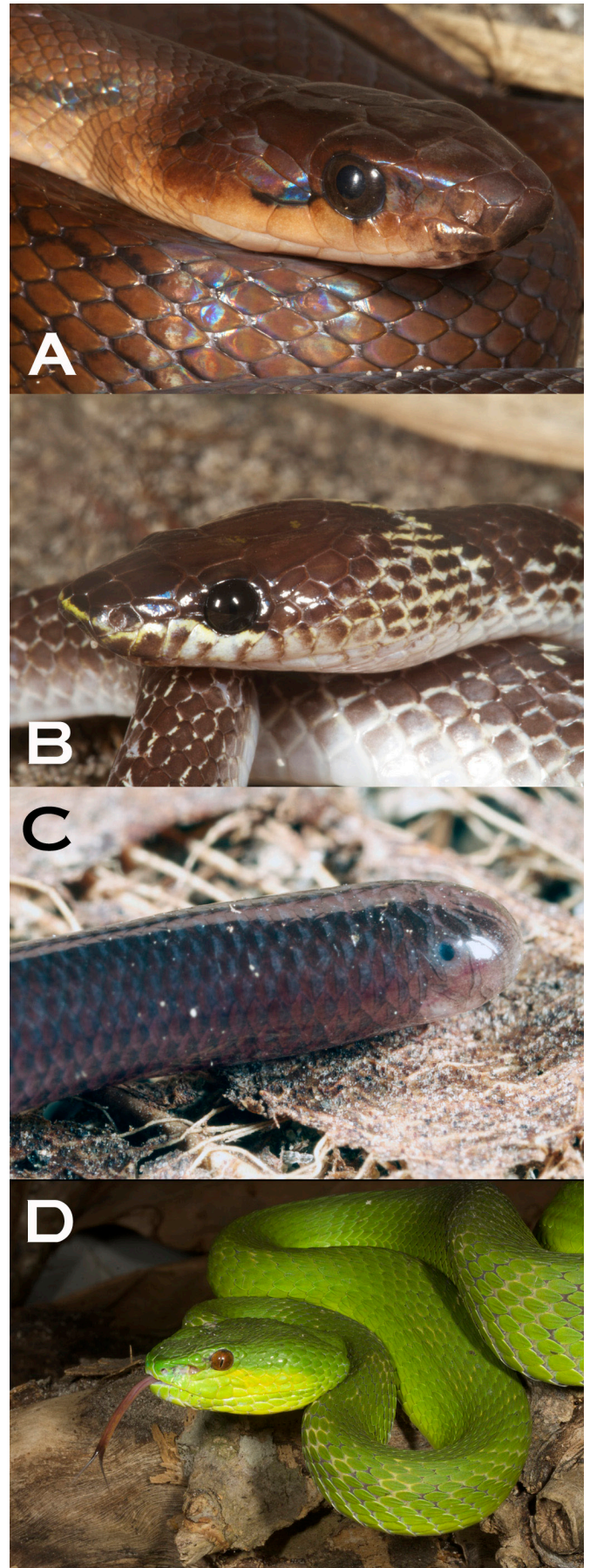


FIGURE 7. Snakes of Ataúro Island, Timor-Leste. (A) Lesser Sunda racer, *Coelognathus subradiatus*. (B) Common wolfsnake, *Lycodon capucinus*. (C) Blindsnake, genus *Ramphotyphlops*. (D) Lesser Sunda Island pitviper, *Trimeresurus insularis*. The individual shown in this image is from the mainland of Timor-Leste, given that the only known specimen from Ataúro had been killed before we were able to secure it. Photos by Mark O'Shea.

include much tightly focused regional and island endemism (e.g., Bauer and Doughty 2012; Grismer *et al.* 2012), this observation has not yet been borne out in the Lesser Sunda Archipelago. To the contrary, *C. darmandvillei* appears to have a relatively wide distribution, ranging from Lombok to Flores, and no species of the genus *Cyrtodactylus* has been described to date from Outer Banda Arc islands. We suggest that the current distribution of these geckos in the Lesser Sunda Islands is not a reflection of their true diversity but of a lack of fieldwork on these islands that is only now in the process of being rectified (Jim McGuire, pers. comm.).

In the Inner Banda Arc, monitor lizards have been identified as belonging to the *V. salvator* complex, to which the name *V. s. bivittatus* (Kuhl, 1820) has been applied (Koch 2010; Koch *et al.* 2007). An initial morphological and molecular analysis of the Ataúro monitor (Koch *et al.* in prep.) confirms that this population is probably neither conspecific with *V. salvator* nor shows any affinity with other regionally distributed monitor species, such as members of the the *V. indicus* complex sensu Ziegler *et al.* (2007) and the much smaller *V. timorensis* Gray, 1831 from the Outer Banda Arc. As a consequence of this uncertainty, we are not able to assign the Ataúro monitor population to an existing species or subspecies with confidence, beyond an assignment to the subgenus *Varanus*. As a member of the genus *Varanus*, the population is protected under CITES Appendix II. With one voucher specimen secured and accessioned and the population of indeterminate size, we will collect no further whole specimens.

Glossy night skinks (genus *Eremiascincus*) are a group of lygosomine skinks known for its underestimated diversity in Australia (e.g., Mecke *et al.* 2009 and in prep.), where some species have also invaded arid desert habitats. Our recent work on Timor (Kaiser *et al.* 2011; O'Shea *et al.* 2012) and the examination of material in the collections of several museums indicates that a higher level of diversity than originally proposed (Greer 1990) also exists in the Outer Banda Arc, where we have discovered several endemic *Eremiascincus*. The known diversity of glossy night skinks in the Inner Banda Arc has so far been limited to the widespread taxon *E. emigrans* (van Lidth de Jeude, 1895), although preliminary analyses have shown that the populations currently referred to as *E. emigrans* constitute a species complex (Mecke *et al.* in prep.). Thus, the presence of an undescribed member of this secretive and taxonomically complex genus on Ataúro is not surprising.

Whereas we have been able to establish many interesting species records during our visits to Ataúro, we are convinced that additional species are present. In addition to the spitting cobra, there are several snakes we think may be present on the island. Based on tentative visual identification of escaping animals, we anticipate the presence of a species of bronzeback (genus *Dendrelaphis*), which is known to be present on Timor, as well as the presence of a species of treesnake (*Boiga*), present on Alor. On the other hand, we do not believe that, based on the near absence of mangrove habitat, the coast of Ataúro is suitable for filesnakes (genus *Acrochordus*), homalopsid snakes (e.g., genera *Cantorina*, *Cerberus*, *Fordonia*), or for the saltwater crocodile (*Crocodylus porosus* Schneider, 1801), which exist on Timor (Kaiser *et al.* 2009) Furthermore,

we do not expect to record flying lizards (genus *Draco*) or Timor spotted monitors (*Varanus timorensis*) on Ataúro, since these are generally highly visible, well known faunal elements and easily identified by local residents when present; we have had not a single anecdotal report from Ataúro's residents.

The overall herpetofaunal diversity of Ataúro represents a subset of the herpetofauna found on larger islands, with Timor providing the best comparison because its fauna is now better known than those of Alor or Wetar, two geographically closer and geologically more similar islands. It is nevertheless intriguing that this small island appears to support endemics of relatively secretive organisms (e.g., *Cyrtodactylus*, *Eremiascincus*) as well as a hitherto unrecognized monitor lizard. These endemic forms add to the luster Ataúro is garnering as a tranquil nature isle that is off the beaten path.

ACKNOWLEDGMENTS: We are very grateful for the personal support of Timor-Leste's political leadership, particularly Their Excellencies former President José Ramos-Horta, Prime Minister Xanana Gusmão, and Minister Ágio Pereira, and acknowledge their help when called upon. Our research in Timor-Leste would not have been possible without the tireless assistance of Claudia Abate-Debat, senior advisor in the Prime Minister's Office, and the enthusiasm for science of Manuel Mendes, Director of National Parks, who facilitated issuance of our collecting permits. For their enthusiastic efforts during our fieldwork on Ataúro and elsewhere, we thank Zachary Brown, Melissa Carillo, Jester Ceballos, Joanna Flores, Stephanie Hughes, Paul Landry, Venancio Lopes Carvalho, Aaren Marsh, Eric Leatham, Gloria Morales, Kyle Olsen, Justin Rader, Dan Suzio, David Taylor, Marianna Tucci, and Mary-Jane Weil. We particularly thank David Taylor for two of the images in Figure 2. For their assistance with our many layers of logistics we thank Paulo Aniceto (Rentlô Car Rental), Gareth Turner (Air Timor), Ed Turner (Air Timor), Ian Groucott (Emirates), Barry Hinton (Barry's Place Ecological) and the management and staff at Timor Lodge Hotel. We gratefully acknowledge the help of Steve Gotte and Jeremy Jacobs (United States National Museum of Natural History, Washington, D.C., USA), Patrick Campbell (The Natural History Museum, London, United Kingdom), Annemarie Ohler and Ivan Ineich (Muséum National d'Histoire Naturelle, Paris, France), Gunther Köhler and Linda Acker (Museum und Forschungsinstitut Senckenberg, Frankfurt, Germany), Wolfgang Böhme and André Koch (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany), and Pim Arntzen and Ronald de Ruiter (Naturalis, Leiden, The Netherlands) for their help with cataloging or loaning specimens, and for accommodating our research visits. We also thank Jakob Hallermann for his review of the manuscript. Financial assistance for equipment and supplies was partially provided by a Title V Grant to Victor Valley College. Student travel was partially financed by grants from the Associated Student Body at Victor Valley College, and by donations from Pamela MacKay and Melinda Fisher. This paper is Contribution No. 12 from the Tropical Research Initiative at Victor Valley College.

LITERATURE CITED

- Bauer, A.M. and P. Doughty. 2012. A new bent-toed gecko (Squamata: Gekkonidae: *Cyrtodactylus*) from the Kimberley region, Western Australia. *Zootaxa* 3187: 32-42.
- de Freycinet, L. 1828. *Voyage Autour du Monde, Entrepris par Ordre du Roi, sous le Ministère et Conformément aux Instructions de S. Exc. M. le Vicomte du Souchage, Secrétaire d'État au Département de la Marine, Exécuté sur les Corvettes de S. M. l'Oranie et la Physicienne, Pendant les Années 1817, 1818, 1819, et 1820*. Paris: Pillot Aîné. 721 p.
- Grismer, L.L., P.L. Wood, Jr., E.S.H. Quah, S. Anuar, M.A. Muin, M. Sumontha, N. Ahmad, A.M. Bauer, S. Wangkulangkul, J.L. Grismer and O.S.G. Pauwels. 2012. A phylogeny and taxonomy of the Thai-Malay Peninsula bent-toed geckos of the *Cyrtodactylus pulchellus* complex (Squamata: Gekkonidae): combined morphological and molecular analyses with descriptions of seven new species. *Zootaxa* 3520: 1-55.
- Kaiser, H., V. Lopes Carvalho, P. Freed and M. O'Shea. 2009. Status report on *Crocodylus porosus* and its human interactions in Timor-Leste. *Crocodile Specialist Group Newsletter* 28(3): 12-14.
- Kaiser, H., V. Lopes Carvalho, J. Ceballos, P. Freed, S. Heacox, B. Lester, S.J. Richards, C.R. Trainor, C. Sanchez and M. O'Shea. 2011. The herpetofauna of Timor-Leste: a first report. *ZooKeys* 109: 19-86.
- Koch, A. 2010. Unterschätzt und ausgebeutet: Systematik, Diversität und Endemismus südostasiatischer Bindenwarane. *Koenigia* 4: 27-41.

- Koch, A., M. Auliya, A. Schmitz, U. Kuch and W. Böhme. 2007. Morphological studies on the systematics of South East Asian Water Monitors (*Varanus salvator* complex): Nominotypic populations and taxonomic overview. *Advances in Monitor Research III. Mertensiella* 16: 109-180.
- Mecke, S., P. Doughty and S.C. Donnellan, S.C. 2009. A new species of *Eremiascincus* (Reptilia: Squamata: Scincidae) from the Great Sandy Desert and Pilbara Coast, Western Australia and reassignment of eight species from *Glaphyromorphus* to *Eremiascincus*. *Zootaxa* 2246: 1-20.
- O'Shea, M. and H. Kaiser. 2013. Working with a full deck: the use of picture cards in herpetological surveys of Timor-Leste. *Herpetological Review* 44: 65-73.
- O'Shea, M., C. Sanchez, S. Heacox, A. Kathriner, V. Lopes Carvalho, A. Varela Ribeiro, Z. Afranio Soares, L. Lemos de Araujo and H. Kaiser. 2012. First update to herpetofaunal records from Timor-Leste. *Asian Herpetological Research* 3: 114-126.
- Sanchez, C., V. Lopes Carvalho, A. Kathriner, M. O'Shea and H. Kaiser. 2012. First report on the herpetofauna of the Oecusse District, an exclave of Timor-Leste. *Herpetology Notes* 5: 137-149.
- Trainor, C.R. and T. Soares. 2004. Birds of Atauro Island, Timor-Leste (East Timor). *Forktail* 20: 41-48.
- Trainor, C.R. and P.J. Leitão. 2007. Further significant bird records from Atauro Island, Timor-Leste (East Timor). *Forktail* 23: 155-158.
- Uetz, P. 2012. *The Reptile Database*. Electronic database accessible at <http://www.reptile-database.org>. Captured on 15 February 2012.
- Ziegler, T., A. Schmitz, A. Koch and W. Böhme. 2007. A review of the subgenus *Euprepiosaurus* of *Varanus* (Squamata: Varanidae): morphological and molecular phylogeny, distribution and zoogeography, with an identification key for the members of the *V. indicus* and the *V. prasinus* species groups. *Zootaxa* 1472: 1-28.

RECEIVED: October 2012

ACCEPTED: June 2013

PUBLISHED ONLINE: August 2013

EDITORIAL RESPONSIBILITY: Olivier S. G. Pauwels

Appendix 1. This list includes one voucher specimen for each verified species. In many cases, multiple specimens were captured and deposited in the USNM collection.

Lizards.—Gekkonidae: *Cyrtodactylus* sp. 1 (USNM 579046); *Cyrtodactylus* cf. *darmandvillei* (USNM 579718); *Gehyra mutilata* (USNM 579063); *Gekko gecko* (USNM 579056); *Hemidactylus frenatus* (USNM 579085). Scincidae: *Cryptoblepharus leschenault* (USNM 579748); *Eremiascincus* sp. 1 (USNM 579750); *Eutropis* cf. *multifasciata* (USNM 579785); *Lamprolepis* cf. *smaragdina* (USNM 579761). Varanidae: *Varanus* sp. (ZFMK 91937).

Snakes.—Colubridae: *Coelognathus subradiatus* (USNM 579779); *Lycodon capucinus* (USNM 579782). Typhlopidae: *Ramphotyphlops* sp. (USNM 579767). Viperidae: *Trimeresurus insularis* (USNM 579784).