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Notes on some dietary items of *Eutropis longicaudata* (Hallowell, 1857), *Japalura polygonata xanthostoma* Ota, 1991, *Plestiodon elegans* (Boulenger, 1887), and *Sphenomorphus indicus* (Gray, 1853) from Taiwan

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An understanding of the natural history and ecology of reptile and amphibian species is essential for successful conservation and management programs (Bury, 2006). A crucial part of the natural history of an animal is its diet, because not only does it reveal the source of the animal's energy for growth, maintenance, and/or reproduction (Dunham, Grant and Overall, 1989; Zug et al., 2001), it also indicates part of the ecological roles of the animal. Since there may be temporal and spatial variations in the diet of a species (e.g. Lahti and Beck, 2008; Rodríguez et al., 2008; Goodyear and Pianka, 2011), there is a need for dietary descriptions from different localities. For this reason, observations made on an ad hoc basis and descriptions from small collections can be instrumental in developing a better understanding of the diet of a species. Herein, we describe the dietary items of six lizards that died when they were accidentally collected in 2003 by pitfall traps that were set as part of an ecological study in Yangmingshan National Park, northern Taiwan. We also incorporate and describe the dietary items of three DOR (dead on road) specimens of the scincid, *Eutropis longicaudata*, collected on an ad hoc basis, from tarred roads in an agricultural area of Santzepu, Sheishan District, Chiayi County, south-western Taiwan.

The lizards were treated as follows; the snout-vent length (SVL) and tail length (TL) were measured to the nearest mm with a transparent plastic ruler; and the tail was scored as complete or broken. The *E. longicaudata* were weighed (body mass) to the nearest 0.1g with a digital scale, but since the specimens from northern Taiwan were partially dissected and not intact, their body masses were not recorded. All the lizards were dissected by making a mid-ventral incision, and the stomach was removed and slit longitudinally, after which the stomach content was removed. The stomach contents were spread in a petri dish and examined under a dissection microscope, and all the prey items were identified to the order level and, if possible, to family or species level.

Three *Japalura polygonata xanthostoma* (Agamidae), were examined. Two were females, and both had a SVL of 58 mm, but one had a TL of 115 mm, while that of the other was 104 mm. The sex of the third specimen was not determined. It had a SVL of 39 mm and a TL of 70 mm. On the 29th of March, 2002, we collected an *E. longicaudata* male, with a SVL of 109 mm, TL of 174 mm, and body mass of 30.2 g (the exact locality was not recorded), and on the 18th of March, 2003, we collected another male (at 23º25'47"N, 120º28'52"E; datum:

Figure 1. The yellow-mouthed tree lizard (*Japalura polygonata xanthostoma*) is an endemic sub-species, restricted to northeastern, northern and northwestern Taiwan, in areas below 1000 m (photographed by Jean-Jay Mao).

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Figure 2. The long-tailed skink (*Eutropis longicaudata*) is the largest native lizard species in Taiwan, and is often a common species in areas disturbed by anthropogenic activities (photographed by Gerrut Norval).

WGS84), with a SVL of 122 mm, TL of 179 mm, and a body mass of 49.1 g. On the 29th of September, 2002, a female was collected (at 23º25'47"N, 120º28'56"E; datum: WGS84). The lizard had a SVL of 105 mm, and body mass of 27.4 g (including the fragments of the tail that could be collected), but since the tail was mutilated no TL was recorded. One *Plestiodon elegans* (Scincidae) specimen was examined. It had a SVL of 40 mm and a TL of 73 mm. The sex was also not determined. Two *Sphenomorphus indicus* (Scincidae) specimens were examined. Both were males, and had a SVL of 68 mm, but one had a TL of 105 mm, while that of the other was 84 mm, of which 24 mm was a regenerated tail.

Fifty-nine prey items, which belonged to 14 orders from 7 classes, were recorded in this study (Table 1). The most numerous prey items were ants, followed by spiders, earthworms, lepidopteran larvae, woodlice, and flies, in that order.

Figure 3. The elegant skink (*Plestiodon elegans*) is a common species island wide in open mountainous areas and areas disturbed by anthropogenic activities below 2500 m (photographed by Gerrut Norval).

Figure 4. The Indian forest skink (*Sphenomorphus indicus*) is a common species island wide in forested areas below 1500 m (photographed by Gerrut Norval).

Most of the prey items of *J. p. xanthostoma* reported herein belong to orders that were also reported by Kuo, Lin and Lin (2007) as prey of this species. The only exceptions were flies (Diptera), mite (Acarina), and earthworms (Haplotaxida). Rather than being due to a difference in diet, this may simply be because earthworms tend to digest fairly quickly, and may be overlooked if lizards are not fixed shortly after being collected. It must also be remembered that earthworms are rarely active on the soil surface during the day, and would thus be a prey item that these lizards rarely encounter. The majority of the prey items we recorded from *E. longicaudata* belonged to orders that were also reported by Huang (2006) as prey of conspecifics from Orchid Island. However, unlike in this study, Huang (2006) did not record earthworms (Order: Haplotaxida) as prey of *E. longicaudata*. Again, rather than indicating dietary variation, this is more likely due to reasons as explained earlier for *J. p. xanthostoma*. Huang (2006) recorded *Gekko hokounensis* Zhou, 1982, and *Hemidactylus frenatus* Schlegel, 1836, as well as the eggs of *Eutropis multicarinata* (Gray, 1845) (reported as *Mabuya multicarinata*) and *Sphenomorphus incognitus* Thompson, 1912, as dietary items of *E. longicaudata* from Orchid Island, and Norval, Mao and Chu (2004) described an instance of *E. longicaudata* (reported as *Mabuya longicaudata*) predation on *Anolis sagrei* Duméril & Bibron, 1837, an exotic invasive species in Taiwan, so ovophagy and saurophagy are known for this species. Still, the remains of a lizard egg, and toe and tail fragments, as well as scales, of the embryo were found in the stomach of the first *E. longicaudata* described herein. Based on these fragments it was possible to determine that the egg was that of a *Takydromus* species. Since *T. formosanus* (Boulenger, 1894) is the only species of this genus in the area where the *E. longicaudata* was collected, we are confident that the egg was that of *T. formosanus*. Our observation is thus the first reported

Table 1. The dietary items of the *Japalura polygonata xanthostoma* (*J.p.x.*), *Eutropis longicaudata* (*E.l.*), *Plestiodon elegans* (*P.e.*), and *Sphenomorphus indicus* (*S.i.*) described herein. The number of lizards, of each species, that preyed upon each prey type is indicated in parenthesis. The prey items belonged to the following orders, Coleoptera (Cole.), Diptera (Dipt.), Hemiptera (Hemi.), Hymenoptera (Hyme.), Lepidoptera (Lepi.), Mantodea (Mant.), Orthoptera (Orth.), Scolopendromorpha (Scol.), Spirobolida (Spir.), Acarina (Acar.), Aranea (Aran.), Isopoda (Isop.), Squamata (Squa.), and Haplotaxida (Hapl.). (* indicates that it is an egg.)

			J.p.x.		*E.l.*		*P.e.*		*S.i.*	
Class	Order	Family	F	%	F	%	F	%	F	%
Insecta	Cole.	Unknown	1 (1)	3.45	1 (1)	7.14	-		-	
		Scarabaeidae	-		1 (1)	7.14	-		-	
	Dipt.	Unknown	4 (2)	13.8	-		-		-	
	Hemi.	Unknown	-		2 (1)	14.3	-		-	
		Pentatomidae	-		1 (1)	7.14	-		-	
	Hyme.	Formicidae	12 (2)	41.4	4 (2)	28.6	-		1 (1)	12.5
	Lepi.	Noctuidae	3 (3)	10.3	2 (1)	14.3	-		1 (1)	12.5
	Mant.	Unknown	-		1 (1)	7.14	-			
	Orth.	Gryllidae	-		-		1 (1)	12.5	2 (2)	25
Chilopoda	Scol.	Unknown	1 (1)	3.45	-		-		-	
Diplopoda	Spir.	Unknown	1 (1)	3.45	-		-		-	
Arachnida	Acar.	Acariformes	1 (1)	3.45	-		-		-	
	Aran.	Unknown	1 (1)	3.45	-		6 (1)	75	-	
Crustacea	Isop.	Pocellionidae	1 (1)	3.45	-		1 (1)	12.5	3 (2)	37.5
Reptilia	Squa.	Lacertidae*	-		1 (1)	7.14	-			
Clitellata	Hapl.	Unknown	4 (3)	13.8	1 (1)	7.14	-		1 (1)	12.5
TOTAL			**29**		**14**		**8**		**8**	

instance of predation on the eggs of *T. formosanus* by *E. longicaudata*. As for *P. elegans*, the observations described herein are the first description of dietary items of this lizard in Taiwan. All the prey items from the *S. indicus* described herein belong to some of the orders described by Shieh, Juan and Lue (1986) as prey of this species from northern Taiwan.

Based on what is known about the food intake of the four lizard species described herein, it is clear that these species are dietary generalists. However, there are some differences in their foraging modes. The type of prey consumed by lizards is often determined by the foraging mode of the lizard. Lizard foraging modes can typically be classified as a very active, cruising predator ("widely foraging"), which tend to prey more on prey types that are sedentary, unpredictably distributed, clumped, and/or are large and hidden; or as a sedentary, ambush predator ("sit-and-wait"), which tend to prey on more active prey, that is mobile, on the surface, and visually conspicuous (Huey and Pianka 1981; Pianka and Vitt 2003). The occurrence of primarily mobile and conspicuous prey (e.g. ants, flies, and lepidopteran larvae) in the

diet of *J. p. xanthostoma* suggests that this species is an opportunistic ambush foraging species. Because millipedes (Diplopoda) are known to produce toxins, and active foraging lizards can presumably detect the toxic compounds released by these prey and therefore avoid them (Vitt and Cooper, 1986), the occurrence of prey such as millipedes in the diet of *J. p. xanthostoma* is additional proof of the ambush foraging strategy of this species. As for the skinks (Scincidae), the presence of prey that is usually nocturnal (e.g. crickets), cryptic (e.g. preying mantis), inactive (e.g. fruits and seeds), and/or hidden (e.g. lizard eggs and woodlice), suggests that all three species are active foragers.

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