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Range of animal food types recorded for the tegu lizard (*Salvator merianae*) at an urban park in South-eastern Brazil

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The tegu lizard *Salvator merianae* Duméril et Bibron (Teiidae) is renowned for its catholic diet. In South-eastern Brazil this large lizard is reported to prey on invertebrates and vertebrates, and to feed on carrion, fruits, and fungi (Kiefer and Sazima, 2002; Marques and Sazima 2004; Toledo, Prado and Andrade 2004; Maffei et al., 2009). Like other teiids, it forages mostly guided by chemical cues, but it also uses vision to pursue prey (Cruz-Neto and Andrade, 1993; Pianka and Vitt, 2003; Sazima and Haddad, 1992). The tegu is a powerful hunter that outruns smaller lizards, swims well, and is able to attack relatively large mammals, such as juvenile armadillos (Sazima and Haddad, 1992; Martuscelli and Olmos, 1996; Cicchi, 2006). Herein, we report on the variety of animal food consumed by *S. merianae* living at a pond-centred urban park in South-eastern Brazil.

This study was carried out at the Parque Ecológico Prof. Hermógenes de Freitas Leitão Filho (22°48'42"S, 47°04'21"W), Campinas, São Paulo, South-eastern Brazil. This park has a total area of 13.4 ha, of which about 75 % is occupied by a pond surrounded by trees, bushes and grass patches. There is a trail surrounding the park, used by people for sports and leisure. The park harbours about 30 species of water birds, some of which breed there (Corbo et al. 2013). We recorded the animal food consumed by tegus during studies on the natural history of vertebrates in the park. We made no distinction between juvenile and adult tegus for the purpose of this study, since we recorded both categories to use the same food types. We observed the foraging tegus and their food with naked eye and through a zoom lens from a distance of 1-20 m. Throughout the observational sessions we used "sequence sampling" (Lehner 1998), which is adequate for opportunistic records. Voucher digital photographs of the tegus and their animal food are housed on file at the Museu de Zoologia da Universidade Estadual de Campinas (ZUEC).

We recorded 53 feeding events for *Salvator merianae* at the study site from December 2007 to January 2013. The food types consumed by tegus can be grouped into five categories: 1) rotting vertebrates; 2) live invertebrates; 3) bird eggs; 4) turtle eggs; and 5) small live vertebrates. Small to medium-sized rotting vertebrates were the most commonly recorded food (N= 18, of which 17 were fish, 1 opossum). Live invertebrates were also a common prey (N= 15, of which 10 were insects, 3 spiders, 2 millipedes). Eggs of ground-nesting birds and those that breed in nests anchored on aquatic or bank vegetation were commonly recorded as prey (N= 13, of which 9 were ducks, 2 teals, 1 plover, 1 gallinule), whereas terrapin eggs were recorded occasionally (N= 4). Rats were recorded rarely as prey (N= 2), and the same applies to recently hatched tegus (N= 1).

We selected five observations to briefly describe the foraging, hunting, and feeding behaviours of the tegus we recorded at the park (all of these in sunny or half-cloudy days, temperature range 27-32º C). On 27 November 2010 at midmorning, an adult female was found feeding on a large carcass of the redbreast tilapia (*Tilapia rendalli*) near the pond bank. The lizard grasped a portion of the rotting fish with its mouth (Fig. 1a), and thrashed the carcass on the ground and in the air with quick and strong lateral shakes of its head. This behaviour set apart the grasped pieces, which were then ingested. On 28 November 2012 at midmorning, a large juvenile was moving back and forth in front of a rocky wall on the pond bank, tongue-flicking continuously. After about 1-2 min an adult black rat (*Rattus rattus*)

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Figure 1. Foraging tegu lizards (*Salvator merianae*) at an urban park in South-eastern Brazil: (a) an adult female grabs a decaying fish (*Tilapia rendalli*), and thrashes the carcass to tear off a piece; (b) a juvenile holds a black rat (*Rattus rattus*) by the tail, after thrashing the prey to death against the rocky ground; (c) upon digging out an egg of Orbignyi slider (*Trachemys dorbignyi*), a female ingest the contents and discards the empty shell; (d) a piece of paper wasp nest (Polistinae) in its mouth, a juvenile seeks a sheltered place to chew the nest and ingest the brood; (e) a juvenile carries a muscovy duck (*Cairina moschata*) egg to a shelter to break the shell and lap the contents; (f) a smallish male runs, evading the chase and attacks of a brood-guarding common gallinule (*Gallinula galeata*).

jumped into the water, immediately followed by the lizard, which grabbed the rat by the back and dragged it to the land. Once there, the tegu grabbed the rat by the tail and thrashed it to death against the rocky ground. Afterwards, the lizard retreated to a shelter, dragging its prey by the tail (Fig. 1 b). On 03 January 2013 at early afternoon, a small female was found digging vigorously at an elevated point of the pond bank. The lizard dug with its forefeet, tongue-flicking from time to time. After digging a hole about 5 cm wide and 10 cm deep, the lizard extracted an elongated egg of Orbignyi terrapin (*Trachemys dorbignyi*). Manoeuvring the egg with its tongue, the tegu held the egg within the mouth with the aid of its teeth, cracked the shell and slowly closed the mandibles to ingest the egg contents. Afterwards, it discarded the empty shell (Fig. 1c). The

whole process, from the beginning of the excavation to the emptying of the eighth shell dug out, lasted about 25 min. On 21 December 2007 at early afternoon, we found a juvenile carrying a piece of paper wasp (Polistinae) nest protruding from its mouth (Fig. 1d). The lizard moved to a sheltered place and began to chew off the piece, ingesting the brood and discarding some of the nest material with its tongue. On 07 November 2011 at midmorning, we saw a juvenile tegu along the pond bank holding a duck egg (Fig. 1e). It carried the egg to a sheltered place, anchored it on the ground, and after a series of bites cracked the shell at the top. Afterwards, it licked out the egg contents. The duck eggs were from the muscovy duck (*Cairina moschata*), of which there are several domestic couples breeding in the park. Two eggs were of the Brazilian teal (*Amazonetta brasiliensis*), both recorded in December 2007 and none in the next six years.

The tegu was recognised as a potential predator by both the southern lapwing (*Vanellus chilensis*) and the common gallinule (*Gallinula galeata*), which chased it whenever the lizard was near their nests or chicks. A selected event illustrates this behaviour: on 08 January 2011 at midmorning a smallish tegu male was sunning on the pond bank, when a family group of the common gallinule (a couple plus four grown chicks) approached and spotted the lizard. The gallinules began to preen, but as soon as one of the chicks approached the lizard, the couple rushed at the potential predator, pecking and kicking at its tail until the tegu evaded the birds (Fig. 1f).

Decaying fishes were the most common food recorded for *S. merianae* at the study area. This is not surprising, given the large pond in which fish, mostly redbreast tilapias (*Tilapia rendalli*) breed and thrive. Dead tilapias were often found on the pond bank or floating nearby. The rotting opossum fits into the foraging habits of this lizard, since it is recorded feeding on an armadillo carcass (Kiefer and Sazima, 2002). Necrophagy is often mentioned as a common feeding habit of this tegu species, formerly treated as *Tupinambis teguixin* (e.g. Vanzolini, Ramos-Costa and Vitt, 1980; Sazima and Haddad, 1992). Feeding on carrion involves a relatively low foraging cost when compared to the cost of chasing and subduing live prey (Kiefer and Sazima, 2002).

Arthropods are the prevalent prey of juvenile tegus and smaller teiids in general (Kiefer and Sazima, 2002; Pianka and Vitt, 2003), although adults prey on them as well. Predation on terrapin eggs by *S. merianae* seems to be novel information, and may be compared to predation on turtle and crocodile eggs by the varanid lizards *Varanus salvator* and *V. niloticus* (Losos and Greene, 1988; Doody et al., 2007), since both the tegu and the monitors track the nests using chemical cues and dig with their forelegs to reach the buried eggs (ARKive, 2013; present study).

The number of bird eggs preyed on by tegus at our study site seems surprisingly high, although they have been reported as a diet item for this lizard (Vanzolini, Ramos-Costa and Vitt, 1980; Sazima and Haddad, 1992; Marques and Sazima 2004). Breeding of the teal *Amazonetta brasiliensis* was not recorded at the study site since December 2007, a likely cause being nest predation by tegus, since teal couples were a common sight at the park throughout the whole study period. Muscovy ducks still breed at the park, although their broods are becoming increasingly rare and small. Since the tegu in South-eastern Brazil is active from August to April (Andrade et al., 2004), a period that coincides with the breeding season of most water birds that dwell in the park (pers. obs.), this lizard has the potential to hamper the breeding of birds that nest on the ground or anchor their nests on aquatic vegetation or on branches near the pond bank. It is worth noting that only one egg of the plover *Vanellus chilensis* and one of the gallinule *Gallinula galeata* were recorded as prey of the tegu, as both these birds are commonly seen at the park year round (Corbo et al., 2013). Gallinule broods are still common in the park, whereas the plover's breeding seems hindered by decrease of open, grassy spaces to nest (pers. obs.). The small egg number of these two waterbirds recorded as prey of the tegu may be related to the birds' ability to recognise this lizard as a potential predator and their apparently effective brood defence.

The urban park offers a great range of animal food types, both alive and dead, which allow the opportunistic tegu to thrive even in this restricted area. Since it customarily preys on eggs of ground-nesting water birds at our study site, the tegu may hamper or even prevent entirely the breeding of some of these bird species at similar urban enclaves that harbour a sizable population of this lizard.

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Note added in proof. On 24 August 2013 at late afternoon, we found an adult female tegu feeding on a carcass of the cattle egret (*Bubulcus ibis*). This record adds to the variety of vertebrate carcasses consumed by the tegu at our study site: mostly fish, but mammal and bird as well.

Figure 2. An adult female tegu lizard makes a short pause to scan its surroundings while feeding on the carcass of a cattle egret (*Bubulcus ibis*).

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