

SEASONAL VARIATION IN THE DIET OF THE FAN-THROATED LIZARD, *SITANA PONTICERIANA* (SAURIA: AGAMIDAE)

Arttatrana Pal^{1*}, Mitali Madhusmita Swain², and Swapnananda Rath³

¹Department of Zoology, Utkal University, Bhubaneswar, Orissa 751004, India

²Department of Microbiology, Orissa, University of Agriculture and Technology, Bhubaneswar, Orissa 751001, India

³B.J.B. College, Bhubaneswar, Orissa 751001, India

*Present address: Molecular Biology Laboratory, School of Life Sciences, Jawaharlal Nehru University, New-Delhi 110067, India
e-mail: arttatrana@yahoo.com

Abstract.—We analyzed the stomach contents of 296 Fan-throated Lizards (*Sitana ponticeriana*) from their natural habitat. Insects constituted the largest portion of the total diet. Insects comprised the majority of food items during the rainy and winter seasons, when this prey was most common. During the summer dry season, plant material was the dominant food type. Gastropod intake increased during the dry months, when availability of insect prey was low. The dietary composition of the sexes did not differ. Prey size was closely associated with body size.

Key Words.—agamid; climatic factor; diet, Fan-throated Lizard; feeding behavior; *Sitana ponticeriana*; stomach content

INTRODUCTION

Seasonal weather patterns may be key regulators of food diversity and abundance and resultantly lizard dietary composition (Ballinger and Ballinger 1979; Dunham 1980; Robinson 1987; Durtsche 1995). Many agamids feed on insects and other small animals (Anibaldi et al. 1998; Pianka 1971), although some species are partly herbivorous (Pianka 1971). Information about the diet and feeding behavior of Indian lizards is fragmentary (Subba Rao 1970; Subba Rao and Rajabai 1972, 1974; Devasahayam and Devashayam 1989; Sazima and Haddad 1992). *Japalura tricarinata* and *J. polygonata* feed primarily on small arthropods such as insects (Kastle et al. 1993). Stomach contents of *Calotes versicolor* revealed a diet of mainly ants, although it also ate other small invertebrates and plants (Sura 1989; Diong et al. 1994; Kalita 2000). *Calotes versicolor* occasionally preys on juvenile *C. versicolor*, small birds and nestlings, frogs, geckos, and small snakes (Rao 1975; Dhindsa and Toor 1983; Sharma 1991a, 1991b, 1999; Diong 1994).

The Fan-throated Lizard (*Sitana ponticeriana*) is a medium-sized ground-living agamid distributed throughout open xeric patches of forests in India. It eats a diversity of food items (Daniel 1983; Shanbhag et al. 2003). Diet is a key component of an organism's natural history and essential for implementing effective conservation and management strategies (Bury 2006; McCallum and McCallum 2006). Few studies exist on the biology of *S. ponticeriana* (Shanbhag et al. 2003; Rajkumar and Shanbhag 2003), and its diet remains subject to speculation due to small sample sizes over limited periods of time (Subba Rao and Rajabai 1974). Herein, we report on the dietary composition of *S. ponticeriana* over a two year period. We hypothesize that seasonal availability in food

items will cause seasonal variation in the dietary components of this lizard.

MATERIALS AND METHODS

This study took place on the Balukhand-Konark Wildlife Sanctuary in the District of Puri, Orissa, India (Latitude 19° 48' to 19° 54', Longitude 85° 52' and 86° 14' [East]). This sanctuary is a 71.7 km² area established on a sandy tract along the coast between Puri and Konark. The canopy composition includes primarily *Casuarinas* sp., Tamarind (*Tamarindus indica*), *Anacardium* sp., Karanja (*Pongamia glabra*), Polanga (*Calophyllum inophyllum*), Neem (*Azadirachta indica*), *Eucalyptus* sp., and *Acacia* sp. The understory shrubs include *Pandanus* sp., *Adhatoda* (*Adhatoda vasica*), and various horticultural plantings. The fauna includes Striped Hyena (*Hyaena hyaena*), Jungle Cat (*Felis chaus*), Spotted Deer (*Axis axis*), Blackbuck (*Antilope cervicapra*), and several species of birds. The lizard fauna includes *Lygosoma punctatus*, *Mabuya bibroni*, *Mabuya macularia* and *Calotes versicolor*. The maximum air temperature is 40°C during May-June. Maximum surface soil temperature ranges from 40°C in the shade to in excess of 45°C in areas with full sun. Minimum winter temperature is 10°C. We defined July-October as the rainy season, November-February as winter, and March-June as summer.

We collected lizards by hand from October 2001 through September 2003. We euthanized specimens, removed the stomachs, and placed the animal and its stomach in 10% formalin. This was done immediately upon capture in the field to prevent further breakdown of the stomach contents. We categorized stomach contents by lizard size classes: juveniles (SVL = 15 mm-26 mm), immature adults (SVL =

Pal et al.— Fan-Throated Lizard, *Sitana ponticeriana*, Diets

Table 1. Stomach contents of fan throated lizard, *Sitana ponticeriana*, (N = 296) during winter (W), summer (S) and rainy (R) seasons from October 2001 to September 2003.

Food Type	<u>Mean % item ± SD</u>			<u>% Stomachs found with type of food</u>		
	W	S	R	W	S	R
Animalia						
Insecta						
Isoptera						
Termitidae	6.89 ± 2.37	5.23 ± 1.79	8.23 ± 2.46	83%	79%	86%
Hemiptera						
Pentatomidae	4.21 ± 1.79	2.47 ± 0.87	3.89 ± 0.78	49%	45%	43%
Dictyoptera						
Blattidae	3.48 ± 2.13	2.00 ± 0.47	3.12 ± 1.68	21%	20%	24%
Lepidoptera						
Lepidopteran larvae	12.38 ± 2.56	7.12 ± 1.87	13.34 ± 2.08	96%	89%	96%
Coleoptera						
Coccinellidae	2.65 ± 1.24	25.00 ± 0.57	2.53 ± 0.37	23%	18%	20%
Carabid grubs	4.87 ± 1.85	1.23 ± 1.06	1.56 ± 1.89	7%	12%	15%
Hymenoptera						
Formacidae	15.12 ± 3.43	14.34 ± 2.65	14.87 ± 3.28	99%	95%	99%
Apidae	2.76 ± 1.74	2.37 ± 0.39	2.69 ± 1.03	20%	21%	19%
Vespidae	2.1 ± 1.09	1.21 ± 0.70	2.45 ± 0.96	19%	15%	17%
Mollusca						
Gastropoda	0.0	3.79 ± 0.73	0.0	0.0	20%	0.0
Plantae						
Casuarina (Leaves)	0.0	1.12 ± 0.52	0.0	0.0	19%	0.0
Unidentified/amorphous	1.01 ± 0.89	3.67 ± 1.84	2.32 ± 0.72	10%	25%	15%

27 mm-35 mm) and mature adult (SVL ≥ 36 mm). Bony elements of each lizard were later prepared for skeletochronology.

We followed Heideman's (2002) protocol for stomach contents analysis of lizards. We identified the stomach contents of each specimen with the aid of a dissecting microscope in the laboratory. Plant material was dried in an oven prior to microscopic examination.

RESULTS

Stomach contents revealed that *S. ponticeriana* is primarily insectivorous (Table 1). Hymenoptera represented the most important food item in terms of both total numbers and the number of stomachs examined, followed by Lepidoptera and Isoptera. Lizards ate small gastropods and plant material during the summer months. We found many items that were probably incidentally ingested. These included small stones, sand particles, fragments of mollusk shell, and an unidentifiable amorphous substance. Juveniles (N = 74) consumed smaller prey items in comparison with immature and mature adults. Lepidopteran larvae, ants, and small crickets dominated their stomach contents. We found no gastropods or plant material among juvenile gut content. Immature adults (N = 113) had a diverse diet. No gastropods or plant materials appeared in the gut contents of immature adults. Most of the stomachs contained sand. Adult lizards (N = 109) fed on all types of prey. Hymenoptera, Isoptera, and Coleoptera were the dominant prey items with other arthropod orders less prevalent. There was no sexual dichotomy in stomach contents and reproductive state did not appear to alter diet composition.

There was seasonality in *S. ponticeriana* dietary composition. Arthropods were prominent components of the diet during monsoon months (July-October). There was no variation in the gut content of male, non-gravid, or gravid females in summer months. Ants (Formicidae), termites (Isoptera), and crickets (Gryllidae) were major food item in rainy season. In winter caterpillar larvae, ants, crickets and beetles represented the major dietary components. In summer, lizards fed on termites, ants and occasionally crickets, gastropods, and plants (Table 1).

DISCUSSION

Fan-throated Lizards are primarily insectivorous, although plant material is a seasonally important dietary component. Our observations coincide with previous findings on the feeding ecology of *Sitana ponticeriana* (Subba Rao and Rajabai 1974). We speculate that juvenile diets lack plants because juveniles appear at the onset of the rainy season, which stimulates widespread emergence of insects. However, the immature adults are available until the end of March in winter. This season reflects the abundance of arthropod in the environment. We hypothesize that lizards utilize gastropods and plants as food due to the scarcity of preferred insect prey. However, other ground dwelling lizards (skinks) occurring sympatrically with *Sitana ponticeriana*, do not shift to these alternative foodstuffs. Diong et al. (1994) reported the stomach content of *Calotes versicolor* and demonstrated that they consume mainly ants, larvae, adult insects and other small invertebrates.

It is essential to document dietary components in order to formulate effective conservation and management plans

(Bury 2006). Our data provide evidence that seasonal fluctuations in climate may influence food availability and therefore control dietary composition in this species. This information will be important to those implementing land management practices that could impact insect communities or plant distribution during critical times of the year, when these organisms are in low abundance. Furthermore, as a species with climate-controlled seasonal diet variation, one must question how impending climate change could influence the natural history of this species

Acknowledgements.—We are grateful to Sushil Kumar Dutta, Department of Zoology, North Orissa University, Baripada, Orissa, who has encouraged and directed this work from the beginning. I thank Bhabendra K. Patnaik (retd.), Department of Zoology, Berhampur University, Orissa, for his comments and helpful suggestions. Thanks are also due to the Department of Zoology, Utkal University for providing necessary facilities for the work.

LITERATURE CITED

- Anibaldi, C., L. Luiselli, and F.M. Nagelici. 1998. Notes on the ecology of a suburban population of Rainbow Lizards in coastal Kenya. *African Journal of Ecology* 36:199-206.
- Ballinger, R.E., and R.A. Ballinger. 1979. Food resources during periods of low and high food availability in *Sceloporus jarrovi* (Sauria: Iguanidae). *Southwest Naturalist* 24:347-363.
- Bury, R.B. 2006. Natural history, field ecology, conservation biology and wildlife management: Time to connect the dots. *Herpetological Conservation and Biology* 1:56-61.
- Daniel, J.C. 1983. Fan-throated Lizard *Sitana ponticeriana* Cuvier. Pp. 45 *In* The Book of Indian Reptiles, J.C. Daniel (Ed.). Journal of Bombay Natural History Society, Bombay, India.
- Devasahayam, S., and A. Devasahayam. 1989. A peculiar food habit of the garden lizard *Calotes versicolor* (Daudin). *Journal of Bombay Natural History Society* 86:253.
- Dhindsa, M.S., and H.S. Toor. 1983. Reciprocal predation between weaverbirds and a lizard species. *Journal of Bombay Natural History Society* 80:221-222.
- Diong, C.H. 1994. *Calotes versicolor* (Oriental Garden Lizard). Cannibalism and diet. *Herpetological Review* 25:25-26.
- Diong, C.H., L.M. Chou, and K.K.P. Lim. 1994. *Calotes versicolor*, the changeable lizard. *Nature Malaysiana* 19:46-54.
- Dunham, A.E. 1980. An experimental study of interspecific competition between the iguanid lizards *Sceloporus merriami* and *Urosaurus ornatus*. *Ecological Monographs* 50:309-330.
- Durtsche, R.D. 1995. Foraging ecology of the Fringe-toed Lizard, *Uma inornata*, during periods of high and low food abundance. *Copeia* 1995:915-926.
- Heideman, N.J.L. 2002. A comparison of the breeding and non breeding season diets of *Agama aculeata* and *Agama planiceps* (Reptilia: Agamidae) in Windhoek, Namibia. *Journal of Herpetology* 36:515-520.
- Huey, R.B., and E.R. Pianka. 1981. Ecological consequences of foraging mode. *Ecology* 62:991-999.
- Kalita, S.K. 2000. Competition for food between a Garden Lizard *Calotes versicolor* and a Magpie Robin *Copsychus saularis*. *Journal of Bombay Natural History Society* 97:431.
- Kastle, W., H.H. Schleich, and K.B. Shah. 1993. Contributions to the biology of *Japalura tricarinata* and *J. psygnata* (Sauria: Agamidae). *Journal of Bombay Natural History Society* 90:223-262.
- McCallum, M.L. and J.L. McCallum. 2006. Publication trends of natural history and field studies in herpetology. *Herpetological Conservation and Biology* 1:62-67.
- Pianka, E.R. 1971. Ecology of the agamid lizard *Amphibolurus isolepis* in Western Australia. *Copeia* 1971:527-536.
- Rajkumar, S.R., and B.A. Shanbhag. 2003. Interrelationships among reproductive traits of female lizard, *Sitana ponticeriana* (Cuvier). *Current Science* 85:89-91.
- Rao, S.M.V. 1975. Studies on the food and feeding behavior of the agamid Garden Lizards *Calotes versicolor*. *British Journal of Herpetology* 5:467-470.
- Robinson, M.D. 1987. Diet diversity and prey utilization by the omnivorous Namid Desert lizard, *Aporosaura anchietae* (Bocage), during two years of very different rainfall. *Journal of Arid Environment* 13:279-286.
- Sazima, I., and C.F.B. Haddad. 1992. Répteis da Serra do Japi: notas sobre história natural. Pp. 212-237 *In* História Natural da Serra do Japi: Ecologia e preservação de uma área florestal no sudeste do Brasil. Morellato, L. P. (Ed). Org, Campinas, Editora da Unicamp.
- Shanbhag, B.A., S.R. Rajkumar, N.P. Gramapurohit, K.V. Dheeraj, V.H. Ammanna, B.N. Pandav, and S.K. Saidapur. 2003. Demography of Fan-throated Lizard, *Sitana ponticeriana* (Cuvier) in a cotton field in Dharwad District of Karnataka, India. *Current Science* 85:1363-1366.
- Sharma, S.K. 1991a. Cannibalism by Common Garden Lizard *Calotes versicolor*. *Journal of Bombay Natural History Society* 88:290-291.
- Sharma, S.K. 1991b. Common Garden Lizard *Calotes versicolor* preying on Brook's Gecko *Hemidactylus brooki*. *Journal of Bombay Natural History Society* 88:459.
- Sharma, S.K. 1999. *Calotes versicolor* feeding on *Lycodon aulicus*. *Journal of Bombay Natural History Society* 96:146-147.



ARTTATRANA PAL earned his Ph.D. from Utkal University in 2006 and is currently a research associate in the School of Pharmacy at the University of Colorado Health Sciences Center. His research includes the natural history and biogeography of Indian lizards, and the human physiology and pathology. He is currently developing 2-chloroethyl ethyl sulfide induced skin toxicity models to generate critical pre-clinical efficacy and mechanistic data with silibinin in various cell culture and animal models.