PREY DIVERSITY OF *HOPLOBATRACHUS TIGERINUS* (DAUDIN, 1802) (AMBPHIBIA: ANURA: RANIDAE) AND ITS ECOLOGICAL ROLE IN AN AGRO-ECOSYSTEM IN POKHARA VALLEY, WEST NEPAL

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The food items of *Hoplobatrachus tigerinus* included diversified prey species like Arthropoda, Annelida, Mollusca and Chordata (Amphibia and Reptilia). Primarily, it relied on insects as 76.9 percent of the total number of food items were insects. Its non-insect food included snails, crabs, earthworms and myriapods. Small frogs were also found in the stomach, which shows its cannibaliastic feeding habit. The consumed prey items consisted of 64.3 percent harmful pests and 22.2 percent non-specific insect pests. The study indcicates *H. tigerinus* is an important natural control agent of destructive pests in an agro-ecosystem.

Key Words: *Hoplobatrachus tigerinus*, prey items, insect pests, agro-ecosystem, natural control.

INTRODUCTION

Fifty three species of amphibians has been reported from Nepal (Shah and Tiwari, 2004). Indian bullfrog *Hoplobatrachus tigerinus* is an important frog listed in the Red Data Book and Appendix II of CITES. It is found in and around standing water bodies, agricultural lands of tropical and subtropical zones below 1600 masl in Nepal. It has many traditional, medicinal and food values (Shah, 1997). Meat of *H. tigerinus* is fed to children suffering from rickets and marasmus (dry malnutrition) (Shah and Tiwari, 2004). In addition, it is the main laboratory species used for practical work in biological sciences. A huge number of specimens have been used by students for anatomical studies at different level of schools and colleges in Nepal. The demand is proportionate with the increasing number of students every year as the establishment of additional institutions, which is definitely an alarming threat to this species. To supply the demand constantly there is an urgent need for the conservation management and its sustainable harvesting in the country. The diet analysis of *H. tigerinus* will support for its conservation strategies and initiating potential farming in Nepal.

Most of the amphibians play a significant role in an agro-ecosystem by controlling pest population. In this regard *H. tigerinus* is also identified as an important species to control insect and other pests in an agro-ecosystem (Abdulali 1985, Issac and Rage 1975). This study discusses on the prey diversity of Indian bullfrog *H. tigerinus* and its ecological role in an agro-ecosystem in order to recommend conservation and sustainable harvesting of the species.

MATERIALS AND METHODS

The study area is located between Lahachock and Dhorbesi in the west bank of Seti River Pokhara valley. The sampling was done from July 2003 to September 2003. The anuran was searched in the paddy fields, lakesides (Phewa and Begnas) and

irrigation channels. They were picked up by hand and also by using nets during dusk and before dawn.

All the collected specimens were anesthetized by chloroform immediately after the collection and preserved in five percent formalin. They were dissected and their stomachs were sorted out in the laboratory for further investigation. Each stomach was exposed to pickup the food contents and the food items were preserved in 70 percent alcohol. The food items of each sampled anuran were separated into different taxonomic groups like: phylum, class and order and kept in separate vials. Then, each group was further identified in their respective family, genera and species level by using standard literature.

RESULTS

Altogether 126 food items were recorded from stomach of thirty sample specimens of *Hoplobatrachus tigerinus*. The food items belonged to specimens of Arthropoda, Mollusca, Annelida and Chordata (Amphibia and Reptilia). Insect and non-insect food items constituted 76.9 percent and 23.1 percent respectively.

Insect Prey Items

H. tigerinus consumed the insects of Orthoptera, Isoptera, Hemiptera, Hymenoptera, Coleoptera, Diptera and Lepidoptera orders. Isoptera, Termitidae comprised the highest number of total food items (41.2%), however, termites were found in the stomach of a single individual. The second preferred insect is Hymenoptera represented by a single family Formicidae, which is 23.7 percent of total insect food items consumed. The Orthoptera food items formed 15.5 percent that included three known families: Acrididae, Gryllacrididae and Tetrigidae. The Hemiptera comprised five families: Cicadellidae, Aphididae, Anthocoridae, Lygaeidae and Pentatomodae. Coleoptera formed 4.1 percent of total food item and included two large families Carabidae and Scarbaeidae. Regaridng Diptera and Lepidoptera mostly larval stages were found, taken as a diet (Table 1).

Table 1: Insect prey items consumed by *H. tigerinus*

Prey items	**Total no. of recorded insects**	**Percent**
Orthoptera	**15**	**15.5**
Acrididae (*Oedipoda* sp.)	11	
Gryllacrididae	1	
Tetigridae	2	
Unknown	1	
Isoptera: Termitidae	**40**	**41.2**
Hemiptera	**10**	**10.3**
Cicadellidae	4	
Aphididae (*Aphis glossypii)*	3	
Anthocoridae	1	
Lygaeidae	1	
Pentatomidae	1	
Hymenoptera: Formicidae	**23**	**23.7**
Coleoptera	**4**	**4.1**
Carabidae	2	
Scarabaeidae	2	
Diptera	**3**	**3.1**
Culicidae	1	
Creamy white maggots	2	
Lepidoptera: Noctuid larvae	2	2.1
Total	97	

Non-insect prey items

The frog consumed significant proportion of non-insect Arachnida, Crustacea, Myriapoda, Mollusca, Amphibia and Reptilia food items. In total, snails formed the major portion of the diet, constituting 38 percent of the consumed non insect food items. The Myriapoda family Polydesmidae consisted 27.6 of the total food consumed. Likewise, Arachnids represented two families; Lycosidae and Barychelidae formed 13.85 percent of total food items. A crab and an earthworm were also reported. Among vertebrates, Limnonectes sp. (a small frog species) was found in three stomachs. Surprisingly, frog had also engulfed a juvenile Calotes versicolor (Table 2).

Ecological role in agro-ecosystem

This frog species is highly effective in controlling many agricultural pest species. It consumed 64.3 percent of harmful insects following 22.2 percent of nonspecific animals, which also include either minor pest or non-useful animals and only 13.5 percent of useful animals. Some of the common harmful insect pests consumed by the species were aphids, crabs, grasshoppers, hoppers and termites etc. Some of the serious pests namely: *Dorylus*, *Monolepta* and *Aphis* of potato and other crops were also reported in its diet. The males were found more active feeder than females.

Table 2: Non-insect prey items consumed by *H. tigerinus*

Prey items	Total no. of recorded non-insects food items	Percent
Arachnida	**4**	**13.8**
Lycosidae	1	
Lycosa sp.	1	
Pirata sp.	2	
Barychelidae (*Sasoon* sp.)		
Crustacea (Decapoda)	**1**	**3.4**
Canceridae (*Cancer* sp.)		
Mollusca (Gastropoda)	**11**	**37.9**
Planorbidae (*Gyraulus* sp.)	1	
Viviparidae (*Bellamya* sp.)	6	
Thiaridae (*Melanoides* sp.)	2	
Unknown	2	
Myriapoda (Chilognatha) Polydesmidae (*Polydesmus* sp.)	8	27.6
Annelida (Opisthophora common earthworm)	1	3.4
Amphibia	3	10.3
Ranidae (*Limnonectes* sp.)	2	
unknown	1	
Reptilia (Agamidae) *Calotes versicolor*	1	3.4
Total	126	100

DISCUSSIONS

The study reveals that *H. tigerinus* is one of the diverse predators preying upon food items. Although insects formed the main diet (76.9%), non-insect food items (23.1%) also found in significant number. Issac and Rage (1975) also found insects as the major diet of Indian bullfrog. Termites alone made 41.2 percent of the entire insect food items. Noble (1931) described ants and termites as the major diet by both biomass and number in slow moving anurans,

Presence of largest number of termites in a single stomach indicates that the frog mostly preys upon termites when it encounters a termite colony. It is easy to prey upon large number of termites waiting them at the same location. Thus, termites cannot be predicted as preferred food items. On the basis of frequency of occurrence in the diet large sized food items like orthoptera, hymenoptera and mollusca were found preferred food items of the species. Interestingly, the species was also found preying on frog and lizard. Three individuals of *Limnonectes* sp. and a juvenile *Calotes versicolor* were found in the stomach of sampled frogs. Joshee (1968) also recorded large number of amphibians including many incredible food items like snakes and fishes in its diet.

CONCLUSIONS

The Indian bullfrog *H. tigerinus* feed upon diverse prey items. Primarily, it is insectivorous in feeding habit. It is found as an important predator that plays a remarkable role in maintaining agro-ecosystem, the species helps us not only to protect the yield but also to supplement the effort of birds in controlling pests at night and to balance the nature as well. Thus, conservation of these frogs plays a vital role in maintaining agro-ecosystem and natural control of agricultural pests.

ACKNOWLEDGEMENTS

We thank Prof. V.K. Thapa for helping identification of the dipterans food items. We also appreciate Mr. H. Acharya, R. Poudel and N.B. Ranabhat for their help during the field work. Likewise we are indebted to Prof. K.B. Shah for his generous advice.

REFERENCES

Abdulali, H. 1985. Food Habit of Indian Bullfrog *Hoplobatrachus tigerinus*. J. *Bombay Nat. Hist.* Soc. 82 (2): 347-375.

Cott, H.B. 1936. The Effectiveness of Projective Adaptations in the Hive-bees, illustrated by Experiments on the Feeding Reactions, Habit Formation and

George, S. and M. I. Andrew. 1994. Food and Feeding Habits of *Rana hexadactyla,* Lesson in Kuttland, Kerela. J. Bombay Nat. Hist. Soc. 92: 220-224.

Issac, S. and M. S. Rage. 1975. Food of *Rana tigerina. J. Bombay Nat. Hist, Soc.*, 72 (1): 143-157.

Jensen, T.A. and W. D. Klimstra. 1966. Food Habits of the Green Frog *Rana clamitans* in Southern Illinois. *Amer. Mild, Nat* 76: 169-182.

Joshee, A.K. 1968. Food Habit of the Indian Bullfrog, *Rana tigrina. J. Bombay Nat. Hist. Soc.* 65 (2): 498-500.

Karamek, W.C. 1972. Food of the Frog Rana Septentrionalis in New York. Copeia, 1972 (2): 390-392.

Memory of Common Toad (*Bufo bufo bufo*). 1936. *Proc. Zool. Soc. Lond.* 111-133.

Pack, H.L. 1922. Toads in Regulation of Insect Outbreak. *Copiea* 972. (2) 46-47.

Rangaswamy, H.R. and G. P. Channabasavana. 1972. Food and Feeding habit of the Toad *Bufo melanostictus* (Ambhibia: Bufonidae): *J Bombay Nat Hist Soc* 70: 558-468.

Shah, K.B. 1997. Ambhibians and Reptiles used as Food and Medicine in Nepal. A Project Reports Submitted to Tribhuvan University, Natural 'History Museum Swaymbhu, Kathmandu, Nepal 31 pp.

Shah, K.B. and S. Tiwari. 2004. Herpetofauna of Nepal: A Conservation Companion, IUCN-The World Conservation Union, Nepal. VII+237 pp.