

Food of *Rana tigerina* (Daud.)¹

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The Indian Bull-Frog, *Rana tigerina* (Daud.) is a widely distributed, important frog of India. A common species in fields under wet cultivation, its insectivorous habit helps in no small way, in eradicating agricultural and other pests. However, as the frog is edible, its heavy commercial exploitation has resulted in considerable depletion of its number and as such its present status is a cause for concern. This study is an effort directed not only towards collecting data on the natural diet of the frog but also towards determining the role it plays in the economy of nature.

Earlier literature on the food of *R. tigerina* includes papers, among many others, by Gostling (1895), Chibber (1911), Agharkar (1912), Mullan (1912), Davidson (1916) and Zutshi (1926) but most of these refer to observations on unusual rather than the normal food of the species. Wadekar (1963) listed the different food items of the frog while attempting to correlate the diet with their availability during different months of the year. Joshee (1968) examined the stomach contents of 100 frogs that were brought to the laboratory for dissection.

MATERIALS AND METHODS

The stomach contents of 347 frogs, collected between September 1970 to August 1971 were examined. The majority were captured during the early morning hours, from paddy fields near Bombay. The specimens were brought to the laboratory, their snout to vent length and weight were recorded and the stomachs removed and preserved in 10 per cent formalin for subsequent detailed examination of their contents. Different food items from individual stomachs were identified as far as possible and their numbers, weight and economic importance, if any, noted. The available data was then tabulated monthwise and also in relation to the size of the specimens with 20 mm gradation. Frogs

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below the size of 50 mm were not considered because the food in their stomachs, besides being scanty, was difficult to analyse.

FOOD OF *Rana tigerina*

Table 1, gives monthwise analysis of the different food items consumed by *R. tigerina*. It indicates that insects and crabs form its main diet almost throughout the year in the Bombay area. A brief account of the various food items recorded during the study is given below.

Annelids and Molluscs:

Though a few earthworms and gastropods were recovered from the stomachs of a few small sized individuals, there is no reason to believe that they form regular items of the diet.

Arthropod:

Arthropods as represented by insects and crabs form the bulk of the diet of *R. tigerina*. An insignificant number of centipedes and arachnids were also recorded from the stomachs of a few specimens.

Amongst the arthropods, insects appear to be most favoured diet of this animal. As many as forty-one species of insects belonging to ten different orders were recovered from their stomachs. There is, however, no indication to show their particular preference for any of these species. Since a number of orthopteran and coleopteran species are available during major part of the year, the representatives of these two orders naturally form the bulk of their insect diet. A number of these insects are of significant economic importance. Table 2 gives the status of the various insects fed on by the frog. Thirteen among these are important agricultural pests, four house-hold pests and four others are injurious to trees. As an indiscriminate feeder, the frog feeds on some harmless or even some of the directly or indirectly useful insects, but this does not in any way affect the important role it plays in the biological control of insect pests.

Crabs are next in importance to insects in the diet of *R. tigerina*. These crustaceans which are often seen in the paddy-fields cause considerable damage to the bunds in the fields by boring holes in them. In addition, they also damage the paddy crop during the flowering season of the paddy (McCann 1932, Jabir Ali 1955). The frog thus keeps in check the population of yet another group of animals harmful to agriculture. The occurrence of *Varuna litterata*—an estuarine crab in the stomachs of a few individuals was thought to be rather unusual. However, observations on the feeding habits of this crab revealed that it often invades the adjoining paddy fields for its food and is taken by the frog during such visits. The largest of the crabs consumed weighed 27 gm.

Vertebrates:

Representatives of all the vertebrate groups were recovered from the stomachs of a number of frogs, but they do not appear to form a part of the regular diet of the frog. However, it may be mentioned that cannibalism is quite common in *R. tigerina*. On one occasion a frog measuring 175 mm in length was seen devouring another frog of the same species measuring 110 mm. It seems that individuals of other species of anurans are also taken.

Miscellaneous:

In addition to these varied food items extraneous material like vegetable matter and gravel was often seen in the stomachs of a number of individuals. Most of the vegetable matter was, however, also seen in an undigested condition in the rectum, suggesting thereby that this material is not digested by them and as such cannot be considered as forming part of their food. The frequent occurrence of gravel in the stomachs of frogs is reported by a number of workers. During the course of the present investigation an individual was seen with as many as seven small pieces of stones weighing totally about 19 gm. It is not known whether gravel is swallowed intentionally. It seems more likely that the gravel as also the vegetable matter is taken up by the animal, accidentally, along with food.

Table 3 gives the various food items consumed by different 20 mm size groups of *R. tigerina*. It is evident that whereas insects and crabs form the main diet of all the different size groups, annelids and molluscs are consumed by small sized and vertebrates by the bigger frogs. It can, therefore, be surmised that insects and crabs constitute the main food of this frog.

The available facts thus indicate that *R. tigerina* plays a very significant role in controlling agricultural and other pests in the field and thus plays a very important role in the economy of nature.

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TABLE 1
MONTHWISE ANALYSIS OF THE STOMACH CONTENTS OF *R. tigrina* (DAUD.)

Number of the individual food items collected/number of stomachs from which collected.

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
ANNELIDA													
(Earthworms)													
<i>Pheritima</i> sp.	2/2	—	—	—	—	—	—	—	—	2/1	3/1	—	
MOLLUSCA													
<i>Ariophanta</i> sp.	1/1	—	—	1/1	1/1	—	—	—	2/2	—	—	—	Shells found in undigested condition.
<i>Planorbis</i> sp.	—	—	—	1/1	—	—	—	—	2/2	—	—	—	
<i>Pila virens</i>	—	—	—	—	—	—	—	—	2/1	—	1/1	—	
ARTHROPODA													
Class <i>Insecta</i>													
Order ODONATA	—	—	—	4/2	2/1	—	—	—	—	2/2	—	—	
(sp. not identified)													
Order ORTHOPTERA													
Family Gryllidae													
<i>Gryllotalpa africana</i>	4/2	2/2	—	—	—	—	—	—	—	1/1	2/1	—	Pest on paddy.
<i>Gryllotalpa</i> sp.	5/2	23/4	6/4	2/1	6/2	—	3/1	—	1/1	10/4	4/2	3/2	Pest on paddy.
<i>Schizodactylus monstruosus</i>	—	—	—	1/1	—	2/1	—	2/2	—	1/1	—	—	Injurious to seedlings.
<i>Brachytrypes</i> sp.	5/2	2/1	4/1	—	—	—	2/1	—	2/1	3/3	2/1	—	

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Family Tettigoniidae													Economically not important.
<i>Holochlora albida</i>	3/2	2/2	2/2	1/1	—	—	—	1/1	—	3/2	2/2	1/1	— do —
<i>Callimenelus opacus</i>	1/1	—	—	—	1/1	2/1	—	—	—	—	2/1	—	Appear in Oct.-Nov., feed on leaves of trees.
<i>Mecopoda elongata</i>	—	—	3/2	6/4	1/1	—	—	—	—	—	—	1/1	
Family Acridiidae													Very harmful to rice.
<i>Hieroglyphus banian</i>	5/2	7/3	1/1	1/1	—	—	—	—	2/1	3/2	9/2	1/1	Harmful for low growing plants.
<i>Parella</i> sp.	2/2	3/1	—	1/1	2/1	—	—	1/1	2/1	4/4	—	6/2	Harmful to crops in marshy places.
<i>Scelimena</i> sp.	3/2	7/5	3/2	4/2	2/2	6/1	—	—	4/1	2/1	—	2/2	
Order DERMAPTERA													Carnivorous, eats small insects.
Family Labiduridae													
<i>Labidura riparia</i> (Earwigs)	1/2	2/2	2/2	2/2	1/1	4/4	2/2	2/1	2/1	3/2	3/3	2/1	
Order BLATTIDAE													Household pest.
Cockroach	2/1	—	1/1	2/1	—	—	—	—	3/2	3/1	—	—	
Order ISOPTERA													Household pest. (** several)
Termites	—	15/4	—	—	—	—	—	—	—	**/5	15/1	7/2	

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Order RHYNCHOTA													
Family Corixidae													
<i>Corixa</i> sp.	8/2	6/1	—	—	—	—	—	—	—	4/1	—	4/2	Bug; plant sucker.
Family Belostomatidae													
<i>Belostoma indica</i>	3/3	1/1	2/2	—	—	1/1	—	—	—	2/2	2/2	2/1	Carnivorous water bug.
<i>Sphaerodema</i> sp.	3/2	—	1/1	3/2	—	—	—	—	—	3/3	2/1	—	Carnivorous water bug.
Family Nepidae													
<i>Laccotrephes ruber</i>	3/2	2/1	1/1	—	—	2/1	—	—	2/2	3/2	2/1	3/2	Lives in water and is predacious on other water insects and other animals.
Order LEPIDOPTERA													
Family Heterocera													
<i>Heterocera</i>	—	3/2	9/5	2/2	—	—	—	7/3	—	2/1	7/2	2/1	Larvae and adult.
Order DIPTERA													
Family Syrphidae													
<i>Eristalis</i> sp.	—	—	3/1	—	12/9	22/10	—	10/4	—	1/1	—	2/1	
Family Muscidae													
<i>Musca</i> sp. (House Fly)	—	—	1/1	—	—	—	—	—	—	15/1	—	2/1	Household pest.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Order HYMENOPTERA													
Family Eumenidae (Wasp)													
<i>Rhynchium</i> sp.	—	2/2	—	—	—	3/2	—	—	1/1	—	—	—	
Family Formicidae (Ants)													
<i>Camponotus compressus</i>	6/5	—	4/3	4/2	—	2/1	—	—	1/1	—	7/4	4/4	
<i>Solenopsis geminata</i>	16/2	—	3/1	—	—	3/1	—	—	5/1	8/2	3/1	1/1	
<i>Aphaenogaster beccarii</i>	—	—	15/1	—	3/2	—	5/2	20/2	—	—	2/1	—	
<i>Oecophylla smaragdina</i>	—	—	—	—	—	4/1	—	—	—	11/1	6/2	—	A nuisance on trees, weaving leaves together. Collects small insects.
Family Apidae	1/1	—	—	—	—	—	—	—	—	—	—	2/1	Economically useful.
<i>Apis dorsata</i>													
Order COLEOPTERA													
Family Cicindelidae													
<i>Pherosophus</i> sp.	1/1	2/1	2/2	—	—	1/1	—	—	—	—	2/2	1/1	Tiger beetles. Carnivorous adults and larvae eat insects.
Family Carabidae													
<i>Ophanus indicus</i>	—	2/2	1/1	—	—	—	1/1	—	—	4/2	—	2/1	Ground beetle. Generally a scavenger. Larvae may harm roots of plants.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
<i>Harpalus</i> sp.	—	4/1	3/1	—	2/1	—	—	—	—	5/2	12/2	3/1	Carnivorous water beetle.
Family Dytiscidae													
<i>Cybister</i> sp.	—	2/2	—	1/1	3/2	—	1/1	—	—	2/1	3/2	—	Larvae in water and carnivorous.
Family Hydrophilidae													
<i>Stethoxus</i> sp.	2/2	4/2	4/3	2/1	1/1	—	—	—	—	3/2	—	2/2	Dung roller. Larvae destroys roots of trees, adults feed on plant leaves. Harmful to agriculture.
Family Scarabaeidae													
<i>Catharsius molossus</i>	1/1	2/1	—	2/1	—	—	—	1/1	—	—	2/1	2/1	Harmful to roots in larval stages. Feeds on leaves as adult. Beetles not particularly harmful, scavengers. Generally predators.
<i>Anomala elata</i>	2/2	4/2	8/3	3/2	2/1	—	12/4	—	2/1	13/9	—	16/6	
<i>Anomala bengalensis</i>	3/2	1/1	2/2	—	1/1	3/2	5/4	1/1	2/2	—	2/2	4/2	Harmful to roots in larval stages. Feeds on leaves as adult. Beetles not particularly harmful, scavengers. Generally predators.
<i>Onitis</i> sp.	1/1	2/1	—	—	—	—	—	—	1/1	—	1/1	—	
Family Elateridae Unidentified	2/1	4/2	1/1	—	2/1	—	—	4/1	—	2/1	3/2	4/1	

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Family Tenebrionidae <i>Pseudoblaps</i> sp.	1/1	2/2	—	4/2	—	—	—	2/1	—	2/2	—	2/1	Beetles not of economic importance.
Family Cerambycidae <i>Prietyranthus mordax</i>	3/1	1/1	2/2	—	—	—	—	3/2	2/1	—	4/1	2/1	Lives in forest areas feeding on dead material.
<i>Batocera</i> sp.	2/1	3/2	4/2	6/2	5/2	—	—	2/1	8/3	4/1	2/1	6/2	Harmful borer.
Family Chrysomelidae	2/1	12/2	—	13/2	—	4/1	—	—	1/1	7/5	16/1	8/4	Harmful to leaves of plants. Found in large numbers.
Unidentified													
Class ARACHNIDAE	1/1	2/1	—	—	3/2	—	—	1/1	4/2	*66/1	—	—	* All specimens (except one) were young spiders.
Spiders (<i>Araneae</i>)													
Centipedes	—	1/1	—	—	—	—	—	—	—	—	1/1	—	
Scorpions	—	—	1/1	—	—	—	1/1	—	—	—	1/1	—	
Class CRUSTACEA													
<i>Paratelpusa guerini</i>	6/6	7/5	5/4	3/3	4/2	4/4	3/2	—	—	6/3	7/5	9/7	Common in paddy fields and pest of crops.

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
<i>Paratelphusa jacquemontii</i>	4/3	3/2	2/2	3/1	2/2	—	—	1/1	—	3/3	2/1	3/2	Noticed more in the monsoon season when it comes out of the burrows. This is also their breeding season. This damages bunds by burrowing. An esturine crab.
<i>Gecarcinus jacquemontii</i>	2/1	1/1	—	1/1	2/2	—	—	1/1	1/1	2/1	1/1	2/2	
<i>Varuna litterata</i>	2/2	3/2	1/1	—	2/2	—	—	3/3	—	2/1	1/1	—	
VERTEBRATE													
Class PISCES													
<i>Heteropneustes fossilis</i>	1/1	—	1/1	—	—	—	—	—	—	—	1/1	—	84-85 mm in length.
<i>Rasbora daniconius</i>	—	1/1	—	—	—	—	—	—	—	1/1	—	1/1	50 mm in length.
<i>Gobius giurus</i>	—	—	—	—	—	—	—	—	—	—	1/1	1/1	70 mm in length.
<i>Puntius</i> sp.	1/1	1/1	—	—	—	—	—	—	—	—	1/1	—	145 to 161 mm in length.
Class AMPHIBIA													
Family Bufonidae													
<i>Bufo melanostictus</i>	—	—	—	—	—	—	—	—	—	—	6/1	—	Tadpoles.
Family Ranidae													
<i>Rana tigerina</i>	1/1	—	—	1/1	—	—	1/1	—	—	2/1	—	—	
<i>Rana limnocharis</i>	—	1/1	—	—	—	—	—	—	—	1/1	2/1	—	

TABLE 1 (Continued)

Classified food items	Months												Remarks
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	
Class REPTILIA													
Family Scincidae													
<i>Mabuya carinata</i>	—	1/1	—	—	—	—	—	—	—	—	—	—	
Order OPHIDIA													
Family Colubridae													
<i>Xenochrophis piscator</i>	1/1	—	—	—	—	—	—	—	—	—	1/1	—	Non-poisonous.
<i>Amphiesma stolata</i>	—	—	—	—	—	—	—	2/2	—	—	—	—	Half digested (non-poisonous).
<i>Lycodon aulicus</i>	—	—	—	—	—	1/1	—	—	—	—	—	—	A part only.
Class MAMMALIA													
<i>Rattus rattus</i>	1/1	1/1	—	—	—	—	—	1/1	1/1	1/1	—	1/1	Pest of crops.
<i>Suncus murinus</i>	1/1	—	—	—	1/1	—	—	1/1	—	—	1/1	—	
Vegetable matter	ve/4	ve/8	—	—	ve/2	—	—	ve/3	—	—	ve/4	—	ve = Vegetable.
Gravel	gr/10	gr/5	gr/15	gr/12	gr/9	gr/20	gr/12	gr/14	gr/10	gr/14	gr/11	gr/8	gr = Gravel.

TABLE 2

INSECTS CONSUMED BY *R. tigerina* (DAUD.) GROUPED ACCORDING TO THEIR ECONOMIC IMPORTANCE

Species	Number of insects	Number of Frogs examined
<i>Insect pests of crops</i>		
1. <i>Gryllotalpa africana</i>	9	6
2. <i>Gryllotalpa</i> sp.	63	23
3. <i>Brachytrypes</i> sp.	19	10
4. <i>Hieroglyphus banian</i>	29	13
5. <i>Parella</i> sp.	21	13
6. <i>Scelimena</i> sp.	33	18
7. <i>Corixa</i> sp.	22	6
8. <i>Eristalis</i> sp.	50	26
9. <i>Ophanus indicus</i>	10	7
10. <i>Anomala elata</i>	62	30
11. <i>Anomala bengalensis</i>	24	19
12. <i>Batocera</i> sp.	38	17
13. Chrysomelid	66	17
Total	446	205
<i>Insects injurious to trees</i>		
1. <i>Mecopoda elongata</i>	11	8
2. <i>Solenopsis geminata</i>	39	9
3. <i>Oecophylla smaragdina</i>	21	4
4. <i>Onitis</i> sp.	5	4
Total	76	25
<i>Household pests</i>		
1. Cockroach	11	6
2. Termites	37	12
3. <i>Musca</i> sp.	18	3
4. <i>Prietyrannus mordax</i>	17	9
Total	83	30

TABLE 2 (continued)

Species	Number of specimens	Number of Frogs examined
<i>Carnivorous</i>		
1. <i>Holochlora albida</i>	15	13
2. <i>Callimenelus opacus</i>	6	4
3. <i>Labidura riparia</i>	26	23
4. <i>Belostoma indica</i>	13	12
5. <i>Sphaerodema</i> sp.	12	9
6. <i>Laccotrephes ruber</i>	18	12
7. <i>Rhynchium</i> sp.	6	5
8. <i>Pherosophus</i> sp.	9	8
9. <i>Cybister</i> sp.	12	9
10. <i>Stethoxus</i> sp.	18	13
11. <i>Catharsius molossus</i>	10	6
12. Elaterid	22	10
Total	167	124
<i>Indeterminate</i>		
1. <i>Camponotus compressus</i>	28	20
2. Odonata	8	4
3. <i>Pseudoblaps</i> sp.	13	9
Total	49	33
1. <i>Harpalus</i> sp.	29	8
2. <i>Schizodactylus monstrosus</i>	6	5
3. Heterocera	45	7
4. <i>Aphaenogaster beccarii</i>	45	7
Total	125	27
<i>Useful insect</i>		
1. <i>Apis dorsata</i>	3	3

TABLE 3
FOOD ITEMS BY THEIR NUMBER AND WEIGHT AS CONSUMED BY
DIFFERENT 20 MM SIZE GROUPS OF *Rana tigrina* (DAUD.)

Size	Annelida No./wt. gm.	Molluscs No./wt. gm.	Insects No./wt. gm.	Crabs No./wt. gm.	Arachnids No./wt. gm.	Pisces No./wt. gm.	Amphibians No./wt. gm.	Reptiles No./wt. gm.	Birds No./wt. gm.	Mammals No./wt. gm.
50-69	3/0.7	4/1.5	97/13.5	4/14.5	*66/3.5	—	—	—	—	—
70-89	2/0.5	2/0.7	103/12.2	7/25.0	1/5.2	—	**6/2.2	—	—	—
90-109	2/0.5	3/0.4	109/16.9	9/31.2	2/4.5	1/7.5	1/45.5	1/13.5	—	1/11.5
110-129	—	2/0.7	146/18.2	12/43.4	2/6.4	2/16.2	3/35.3	1/43.8	—	2/26.4
130-149	—	—	177/26.8	15/51.7	3/5.3	2/12.5	3/32.4	1/53.9	—	2/42.8
150-169	—	—	147/16.4	20/69.2	4/3.2	3/16.5	2/27.2	1/51.2	1/13.5	2/31.2
170-	—	—	143/15.3	37/127.5	3/6.5	3/14.2	2/64.3	2/69.3	—	3/57.5

* Small spiders

** Tadpoles

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