PRANIKEE

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THE EMBLEM

On the cover page is the emblem of "NABAGUNJARA" a chimeric animal peculiar to Orissan art and literature. Literally meaning "Nineform" it is a common motif in Orissan painting. This form has been described by poet Sarala Das in his epic Mahabharata written in Oriya. Apparently Lord Krishna appeared in "Nabagunjara" form consisting of the body of an elephant, a leg each of a horse a deer and a tiger; throat of a peacock, tail in the from of a serpent, waist of the lion, hump of the bull and the head of a cock; to fool his friend Arjuna. The chimera was holding a lotus flower in a human hand. Arjuna had never seen such a creature in his life and guessed that this cannot be a real animal and must be a form assumed by Lord Krishna and bowed down at its feet. It is said that the human hand with the lotus provided the clue. In the paintings and sculptures however, the lotus is often replaced by the "Chakra" or the "stylized discuss" of Lord Krishna.

Chimeric forms are encountered in literature and art all over the world. However, as far as I know, a chimera of nine animals, is peculiarly Orissan. Therefore, we thought that this will be an appropriate emblem for the journal of the Zoological Society of Orissa.

—P. Mohahty-Hejmadi

President

We are happy to place in the hands of our readers Volume 6 for 1985 of *Pranikee*, Journal of the Society. Various forces including paucity of funds did stand on the way of its publication resulting in delay by almost a year. It is hoped that the next Volume will appear in time.

We record our gratitude to the State Youth Welfare Board, Orissa and Utkal University for grant in aid which has helped us in bringing out this publication.

B. K. BEHURA
Editor

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Abbreviation : *Pranikee*

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SHORT COMMUNICATIONS

Pranikee, **6** : *1-7 (1985)*

A SURVEY OF THE FISHES OF SAMBALPUR, ORISSA.

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ABSTRACT

The fishes of Sambalpur are mainly caught from the river Mahanadi and the nearby Hirakud reservoir. The ichthyofauna is represented by 86 species belonging to 21 families. These fishes include mainly cyprinoids and siluroids. Hillstream fishes representing the genera of *Garra, Tor, Glyptothorax, Noemacheilus. Lapidocephalichthys* and *Barilius* are found. The cat fishes form the bulk of the riverine catch. Of the various species *Mystus seenghala* forms the major fishery followed by *Silonia silondia. Bagarius bagarius* is the largest riverine fish. *Hilsa ilisha* and *Lates calcarifer* occuring in the lower reaches of the river Mahanadi are totally absent.

Key words : fish, fauna, Orissa.

INTRODUCTION

Sambalpur (21° 28′ & 83° 58′) is the district headquarters of the Western hilly tracts of Orissa. It is a commercially important town located on the bank of river Mahanadi. The town receives its fish supply mainly from Mahanadi and the nearby Hirakud reservoir. Although there are records of commercially important species contributing to the fishery of Hirakud reservoir (Job *et al*, 1955; Verghese *et al*, 1981), there has been no survey of the species contributing to the fish population of Mahanadi at Sambalpur. The present paper deals with the various species occuring in this area.

MATERIALS AND METHODS

The study is based on the fishes brought to the local market from the nearby rivers, reservoir, nullahs and ponds. Two important fish mar-

kets, namely Gole Bazar and Fatak Bazar were selected for sampling. The samples were brought to the laboratory on every alternate days from May 1983 to April 1984 and examined. For identification upto species level, the method of Jayaram (1982) was followed.

FISH FAUNA

The fish fauna of Sambalpur is composed of the following species belonging to the class Teleostomi and Subclass Actinopterygii.

Order *CLUPEIFORMES*.

1. Family Clupeidae
   Gadusia chapra (Hamilton)

2. Family Notopteridae
   Notopterus chitale (Hamilton)
   Notopterus notopterus (Pallas)

Order *CYPRINIFORMES*.

Division (A) CYPRINI

3. Family Cyprinidae
   Chela bacaila (Hamilton)
   C. untrahi (Day)
   Salmostoma bacaila (Hamilton)
   S. clupeoides (Bloch)
   S. boopis (Day)
   Securicola gora (Hamilton)
   Barilius vagra vagra (Hamilton)
   B. bendelisis bendelisis (Hamilton)
   Esmos danricus (Hamilton)
   Rasbora daniconius (Hamilton)
   Amblyphxryngodon mola (Hamilton)
   Aspidoparia morar (Hamilton)
   Danio aquipinnatus (Mc Clelland)

D. devario (Hamilton)

D. rerio (Hamilton)

Catla catla (Hamilton)

Cirrhinus mrigala (Hamilton)

C. reba (Hamilton)

Labeo bata (Hamilton)

L. boga (Hamilton)

L. boggut (Sykes)

L. dero (Hamilton)

L. dyocheilus (Mc Clelland)

L. rohita (Hamilton)

L. calbasu (Hamilton)

L. fimbriatus (Bloch)

L. gonius (Hamilton)

Osteobrama cotio cotio (Day)

O. vigrosii (Sykes)

Oreichthys cosuatis (Hamilton)

Puntius sarana (Hamilton)

P. ticto ticto (Hamilton)

P. jerdoni (Day)

P. tetrarupuqus (Day)

P. sophore (Ham)

P. chola (Hamilton)

P. dorsalis (Jerdon)

P. gugunio (Hamilton)

Garra mullya (Sykes)

Tor mosal mahanadicus (David)

4. Family Cobitidae

Lepidocephalichthys quntea (Hamilton)

L. berdmorei (Blyth)

Noemacheilus botia (Hamilton)

N. dayi (Sykes)

Division (B) SILURI

5. Family Siluridae

Ompok bimaculatus (Bloch)

Wallago attu (Schneider)

6. Family Bagridae

Mystus aor (Hamilton)

M. seenghala (Sykes)

M. tengra (Hamilton)

M. vittatus vittatus (Bloch)

M. gulio (Hamilton)

Mystus menonda menonda (Hamilton)

Rita chrysea (Day)

7. Family Sisoridae

Hara hara (Hamilton)

Bagarius bagarius (Hamilton)

Gagata cenia (Hamilton)

Glyptothorax lonah (Sykes)

8. Family Schilbeidae

Ailia coila (Hamilton)

Clupisoma garua (Hamilton)

Eutropichthys vacha (Hamilton)

E. murius (Hamilton)

Silonia silondia (Hamilton)

9. Family Pangasidae

Pangasius pangasius (Hamilton)

10. Family — *Sacchobranchidae*

Heteropneusteusteus fossilis (Bloch)

11. Family — Clariidae

Clarius batrachus (Linnaeus)

Order *BELONIFORMES*

12. Family — Belonidae

Xenentodon carcila (Hamilton)

Order *MUGILIFORMES*

13. Family — Mugilidae

Rhinomugil corsula (Hamilton)

Order *OPHIOCEPHALIFORMES*

14. Family — Ophiocephalidae (Channidae)

Channa gachua (Hamilton)

C. striatus (Hamilton)

C. punctatus (Bloch)

C. marulius (Hamilton)

Order *SYMBRANCHIFORMES*

15. Family — *Monopterus cuchia* (Hamilton)

Order *PERCIFORMES*

16. Family — Centropomidae

Chanda nama (Hamilton)

C. ranga (Hmilton)

C. baculis (Hamilton)

17. Family — Nandidae

Nandus nandus (Hamilton)

18. Family Anabantdae
Anabas testudineus (Bloch)

19. Family Gobiidae
Glossogobius giuris (Hamilotn)
Awaous stamineus (Valenciennes)

20. Family Sciaenidae
Pama pama (Hamilton)

Order *MASTACEMBELIFORMES*

21. Family Mastacembilidae
Magrocgnathus aculeatum (Bloch)
Mastacembelus armatus (Lacepade)
M. pancalus (Hamilton)

DISCUSSION

The fishes of Sambalpur represent the ichthyofauna of the upper reaches of the river Mahanadi. Apart from sand, the river bed in this region is filled with pebbles, stones and boulders. Few hillstreams also enter into the main river in this region. Naturally the fish fauna contains a number of hill stream fishes.

During the present investigation 86 species belonging to 21 families have been recorded. The fish population is mainly represented by the cyprinoid and siluroid fishes. The clupeids, mugils and perches though comprising the major fishery in estuarine region of Mahanadi (Shetty *et al*, 1965), are represented by only a few species. *Gadusia chapra* represents the clupeids in this region. The mugils are represented by a single species *Rhinomugil corsula*. The representatives of the genus *Mugil*, *Liza* and *Valamugil* common in the tidal reaches are absent in this zone. The scianeids are represented also by a single species. Gobies which are numerous in the estuarine region are represented by two species. Belones are represented by *Xenentodon cancilla* and there is a total absence of hemirhamphids, so common in the lower reaches. Amongst catfishes, the estuarine tachysurids are altogether absent. *Lates calcorifer* and *Hilsa ilisha* forming a lucrative fishery in the lower reaches of Mahanadi are not encountered in the local fish population. There is a total absence of

brackishwater polynemids, and engraulids. On the other hand, few hill stream fishes are present, which include *Garra, Tor, Glyptothorax, Naemacheilus* and *Barilius*. It was observed that the catfishes formed the bulk of the riverine catch at Sambalpur. Of the various species *Mystus seenghala* formed the highest catch followed by *Silonia silondia*. The largest fish caught from the river is *Bagarius bagarius* which weighs nearly 50 Kg or more.

ACKNOWLEDGEMENT

The author expresses his deep gratitude to the local fishermen for their co-operation during the collection.

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Pranikee, 6 : 9-14 (1985)

STUDIES ON THE MITOTIC INDEX IN REGENERATING LIVER OF WHITE RAT, *Rattus norvegicus* AFTER PARTIAL HEPATECTOMY

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and

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Key words : *Mitotic index, partial hepatectomy, Regenerating liver.*

Organ specific mitotic rates, increased rate of cell division during regeneration and comparative growth and cessation of mitosis in mature organ, all indicate the presence of an efficient system in controlling mitosis in an organism. The complexity of this system has shown to influence cell division which has been indicated by nutritional condition (Keiler, 1954), energy rich substances (Swann, 1957), hormones (Cater et. al., 1957) and vitamins (Oides, 1958). More recently attention has been given to interaction between specific tissues and unknown chemical factors derived from these tissues as an important aspect in the regulation of cell division. The presence of mitotic inhibitors (Stich and Florian, 1958) and mitotic stimulators (Paschiks et al 1959) in different mammalian organs has been postulated and the hypothesis of autoregulation of tissue growth (Rose, 1958) and cell growth (Stich and Katiyakara, 1957) was formulated. Cell kinetics is an useful tool in attempting to understand the control mechanism by which each organ and tissue reaches and is maintained at the appropriate size in the adult animal. These control mechanisms are very finely balanced either by inhibiting cell division

beyond a certain developmental stage (in nerve and striated muscles) or by exactly balancing the cell production and the cell loss so that there is no net growth (small intestine, skin and haemopoetic system). The latter group has also the capacity to vary the cell production rate to make use of the excessive loss of cell caused by the injury. A third group of normal tissues exist that are normally quiscent (kidney, liver, lungs) but which can respond to injury by compensatory burst of proliferation followed by return to normal state. In order to study the cell proliferation pattern the experiments have been undertaken employing white rat liver as a model system.

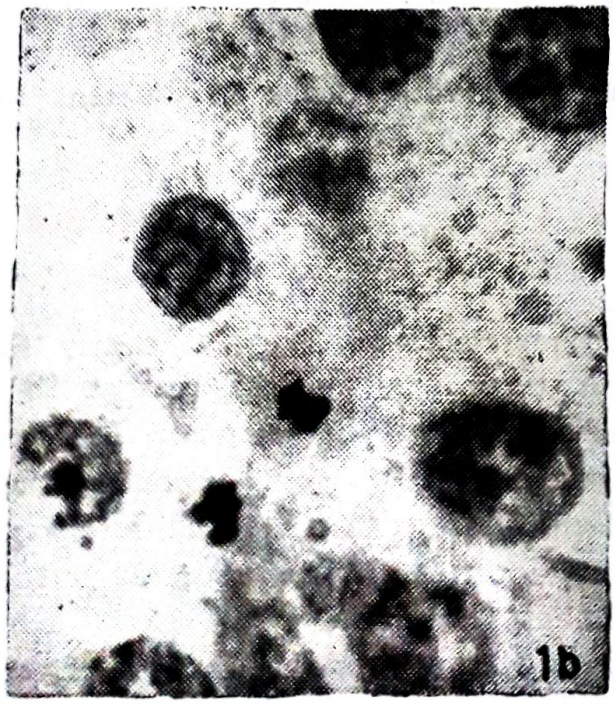
MATERIALS AND METHODS

Male adult white rats weighing 160 to 200 g were used for the experiment. Partial hepatectomy was performed according to the routine procedure (Higgins and Anderson, 1931). Partially hepatectomised rats were sacrificed at 18, 24, 28 and 48 hrs and small liver pieces were removed for cytological studies. For microscopic examination, small pieces of liver were fixed in Carnoy's solution, processed through alcohol, xylene-paraffin schedule, sectioned at 8 to 10 micra and stained by Feulgen technique (Feulgen and Rossenbeck, 1924). The slides were then counter-stained with Fast green. In control series liver from nonhepatectomised rats were processed for microscopic examination.

OBSERVATION

Approximately 500 cells were analysed from each series to know the frequency of dividing cells (Table 1). The chromosomes and nuclear parts were stained violet while the cytoplasm and other tissue elements stained green. Two dividing hepatocytes have been presented in Figs. 1a and 1b.

B. B. Parida, G. Mohapatra, D. Mohanty, & B. Mohapatra



Figs, 1a & 1b. Anaphase in hepatocytes of partially hepatectomised rat

Table 1 : Frequency of dividing (anaphase) cells in total hepatocyte population of nonhepatectomised and partially hepatectomised white rats with mitotic index.

Hrs of fixation after PH	No. of cells analysed	No. of dividing cells	Mitotic Index (MI)
Control	545	15	2.7
18 hr	509	54	10.6
24 hr	536	67	12.5
28 hr	528	102	19.3
36 hr	582	38	6.4
48 hr	567	25	4.4

$$MI = \frac{\text{Total no. of dividing cells}}{\text{Total no. of cells observed}} \times 100$$

The frequency of mitotic index in different series has been presented (Fig. 2).

DISCUSSION

The graphical representation (Fig. 2) clearly shows that the mitotic rate in liver tissue reaches the peak at 28 hrs. Within 28 to 48 hrs there is a decrease in the trend. The result emphasizes that the mitotic activity is very much vigorous during regeneration of liver tissues which persists till 28 hrs and afterwards the control mechanism operates and this activity is reflected as there is a fall in mitotic index after 28 hrs. The above findings clearly indicate that in the mammalian regenerating tissue system, as in liver, two factors are operating : 1. Mitotic stimulator at 18 hrs phase or soon after partial hepatectomy and this persists till 28 hrs, 2. Mitotic inhibitor which operates during the second phase that is after 28 hrs. This complex system

of autoregulation is clearly manifested in mamalian liver particularly in rat.

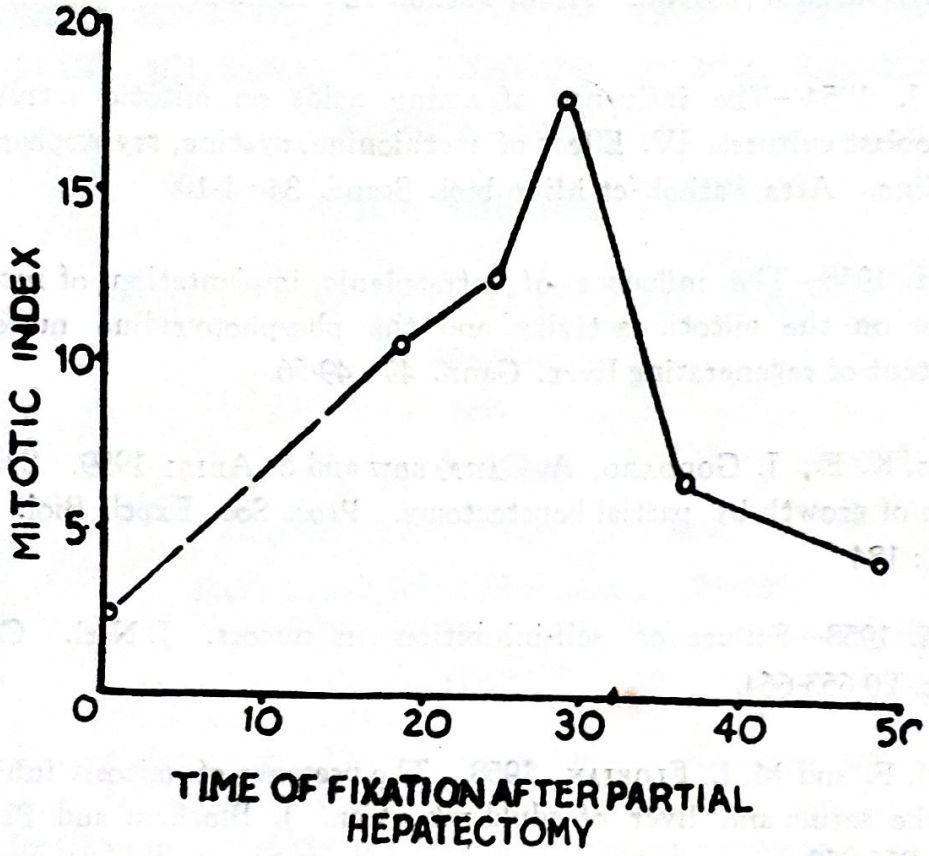


Fig. 2. Graph showing the frequency of mitotic index in hepatocytes of partially hepatectomised rats sacrificed at different time .

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We are thankful to Prof. (Mrs) P. Mohanty-Hejmadi, Head of Zoology Department, Utkal University for providing necessary laboratory facilities.

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Pranikee, 6 : 15-18 (1985)

PREVALENCE OF *PHLEBOTOMUS ARGENTIPES* ANND. and BRUN. (DIPTERA : PSYCHODIDAE) IN PURI DISTRICT OF ORISSA STATE.

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ABSTRACT

During December, 1980 an occurrence of Kala-azar was reported in the Rajsunakhala P. H. C. of the Puri District. An immediate survey in the locality indicated the presence of *Phlebotomus argentipes*. A total of 36 specimens of *P. argentipes* were collected, out of which 4 were males. All the specimens were collected from outdoor shelters within height 2–5'. The house of the patient was positive for *P. argentipes*.

Key words : *Kala-azar, Orissa.*

INTRODUCTION

Sandfly borne diseases or leishmaniasis which was known to be endemic in the coastal belt along Bay of Bengal, showed a declining trend after 1950 and virtually disappeared from the scene by 1970 (Sanyal *et al*, 1980). Therefore, the interest in sand flies diminished considerably. The disappearance of the disease was due to the launching of the National Malaria Eradication Programme in 1958 when the country came under the purview of D. D. T. spray. This was attributed to the high susceptibility of *Phlebotomus* sp. to DDT. However, with the recent resurgence of Kala-azar in Gujrat, Maharastra, Rajasthan and Bihar States (Kaul *et al*,

1976 and Wattal, 1973), information on the prevalence/distribution of sandflies in India has become important. During December, 1980, an occurrence of kala-azar was reported by the Department of Medicine, M.K.C.G. Medical College, Berhampur in the Rajsunakhala P.H.C. of the Puri district (Orissa). Therefore, an immediate investigation was made and the results are presented in this communication.

MATERIALS AND METHODS

One kala-azar case was reported from the village Lakhapada of the Rajasnakhala P.H.C. of the Puri district (Orissa). Adjacent to village Lakhapada, is situated the village Sanapadar. The population of the villages were 300 and 5000, respectively. Adult resting sand-flies were collected from these two villages with the help of aspirator tube and torch light. Searches were made during 6 to 9 A.M.; 12 to 2 P.M. and 6 to 9 P.M. in human dwellings and cattle sheds and other man-made structures. Sand flies collected from different heights of the walls were recorded. Sand flies from the aspirator tube was transferred to test tube and were brought to the laboratory for further studies. The temperature and relative humidity at the time of collection was 17°C and 75%, respectively.

RESULTS

A total of 36 sand flies were collected, all being *P. argentipes*. The species could be easily recognised at the time of collection on account of the silvery white tarsi due to reflections from the white scales. The identification was confirmed in the laboratory. No sandfly was found during the morning collection from 6 to 9 A.M. and noon collection from 12 to 2 P.M. The evening collection starting from 6 P.M, the sand flies were found from 7 P.M. onwards. All the specimens were collected from the outdoor collection of the human dwellings only and none was found indoors. The cattle sheds were negative for sand flies. The specimens collected from different heights in both the villages are presented in table 1 which shows that 23 specimens of *P. argentipes* were collected from village Lakhapada, where the Kala-azar case was reported. The house where kala-azar was detected was positive for *P. argentipes*. Thirteen specimens were collected from the village Sanapada which has no record of kala-azar. In both the villages more flies were collected within 2 to 5′ of the walls.

Out of the 36 specimens 4 were males and 32 were females. Only one male was collected from the village Sanapada, the rest were from Lakhapada.

TABLE-1

COLLECTION OF *P. ARGENTIPES* FROM VILLAGE LAKHAPADA AND SANAPADA AT DIFFERENT HEIGHTS.

Height range in feet	Number collected from village	
	Lakhapada	Sanapada
0–1	3	2
1–2	3	2
2–3	4	4
3–4	5	0
4–5	4	5
5–6	2	0
6–7	0	0
7–8	0	0
8–9	2	0
TOTAL;	23	13

DISCUSSION

The previous records of sand flies from Orissa state were made by Sinton (1924) and Kaul and his coworkers (Kaul *et al*, 1976). Sinton recorded only *P. minutus* Rondani from Puri district. According to the present taxonomical concept, *P. minutus* is not found in India and the specimens recorded as *P. minutus* may actually consist of *Sergentomyia theodory* (Parrot) and *S. dentate arpalklensis* (Perfilev).

Surveys were made by Kaul and his co-workers in seven districts of Orissa State, who collected 352 specimens of sand flies comprising 13 species mostly from out door habitats (Kaul *et al* 1976). Nine species in the order of abundance were : *Sergentomyia bailvi, S. babu, S. punjabensis, S. sirohi S. zeylanica, S. shortti, S. barraudi, P. colabaensis* and *S. soruamipleuris indica.* In addition, four species of *Sergentomyia* were also collected by them. Kaul

and Lewis (1977) described *Sergentomyia orissa* as a new species collected from ancient excavated caves of Khandagiri hills near Bhubaneswar. However, *P. argentipes* was not found in out door resting shelters in Orissa. In the present study all the specimens of *P. argentipes* were collected from out door shelters only. Similar observations have been made by Lewis (1978) who remarked that *P. argentipes* is rare or absent away from indoor houses.

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Pranikee, 6 : 19-28 (1985)

A TAXONOMIC STUDY OF COLLEMBOLA (APTERYGOTA : INSECTA) IN SOME SOILS OF EASTERN ORISSA, INDIA

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ABSTRACT

Sixteen species of Collembola were recorded from a grass land, one crop field and one forest site of eastern Orissa which are new reports from this state. The forest showed maximum species diversity. The detail descriptions of the morphological characters of all the species are given in this paper.

Key words : *taxonomy, collembola, Orissa*

INTRODUCTION

Collembola represents a significant group of soil arthropods in the pedo-ecosystem. Recent studies on Collembola suggest that they play a dominant role in soil formation and litter decomposition in most of the ecosystems of the globe. While attacking different ecological problems on Collembola and ascertaining the relative importance of a particular species of Collembola it is highly essential to study the taxonomy of this group. The taxonomy of Collembola is based on the structures of the antennae, ocelli, body segments, furca and mainly on the chaetotaxy of the body. There is no current standard monograph on Collembolan taxonomy. However, there are many individual papers published on different genera and families from various parts of the world. The notable workers on Collembolan taxonomy in the Indian subcontinent are Imms (1912), Trehan (1945), Yosii and Ashraf (1965), Yosii (1966), Salmon (1969), Mukharji and Singh (1970), Prabhoo (1971 a, b), Choudhuri and Roy (1971), Choudhury and Banerjee (1975), and Mitra *et al* (1977). Recently, Hattar and Alfred (1984) worked on the Collembolan fauna of Meghalaya; Mitra *et al* (1983) reported the Collembolan fauna of West-Bengal and Pai and Prabhoo (1981) reviewed the Collembolan

fauna of Kerala. The present report is based on the findings of a taxonomic survey of Collembolan fauna in some soils of Eastern Orissa.

STUDY SITE

The present study was carried out in the grass land and rice fields of Bhubaneswar and deciduous forest site in Kapilas reserve forest which is situated 115 kms north-west of Bhubaneswar. The forest is spread over a hill which has a height of 635 meters. It is a mixed deciduous forest with red loam soil. In all the study areas, four distinct seasons are experienced in a year i.e. March to May (Summer), June to September (Monsoon), October to November (Post-monsoon) and December to February (Winter). The average rainfall in the study sites of Bhubaneswar and Kapilas reserve forest during the period of the investigation was about 122 cm and 170 cm, respectively. The maximum and minimum temperatures recorded in the forfest site were 38.9° C and 20.8° C, respectively. The soil temperature ranged from 23.8° C to 37.1° C in the grass land site and 23.7° C to 37.2° C in the paddy field site. The percentage of soil moisture ranked from 7.5 to 20 in the forest; 12 16 to 20.46 in the grass land and 12.04 to 21.31 in the crop field site. The soil pH of the forest study site varied from 7.3 to 8.1 and the soil pH values for grass land and crop fields were 7.6 to 8.3 and 7.3 to 8.3, respectively.

SAMPLING AND EXTRACTION

Monthly soil samples measuring 10 × 10 cm upto a depth of 15 cm. were collected from grass land, crop field and forest sites. Specimens were collected by using a series of modified Tullgren funnels and were sorted out under stereoscopic microscope. They were mounted in Kevan's fluid B, Canada balsam or DPX. The descriptions of the species given here are based on the study of individuals of each species. The descriptive terminology employed here is based on Yosii and Lee (1963) and Salmon (1964).

RESULTS

DESCRIPTION OF THE COLLEMBOLAN SPECIES (Table 1)

Super family — Entomobryoidea Womersley, 1934

Family — Isotomidae Borner, 1913

Sub family — Anuphorinae Borner, 1901

Table 1- Distribution of different species of Collembola in various study sites.

Name of the species	Super-Family	Family	Distribution of the species		
			Paddy field	Grass land	Forest
Folsomides parvulus	Entomobryoidea	Isotomidae	—	—	+
Folsomia brevifurca	—do—	—do—	+	—	—
Cryptopygus thermophilus	—do—	—do—	+	+	+
Desoria sp.	—do—	—do—	+	+	—
Lepidocyrtus caerulicornis	—do—	Entomobryidae	+	+	+
Acrocyrtus cryptocephalus	—do—	—do—	—	+	—
Alloscopus tetracantha	—do—	—do—	—	—	+
Sinella coeca	—do—	—do—	—	—	+
Seira cinerea	—do—	—do—	—	—	+
Seira indica	—do—	—do—	—	—	+
Cyphoderus albinus	—do—	—do—	—	—	+
Tullbergia sp.	Hypogastruroidea	Onychiuridae	—	—	+
Protaphorura sp.	—do—	—do—	+	—	—
Hypogastrura sp.	—do—	Hypogastruridae	—	+	+
Xenylla sp.	—do—	—do—	—	—	+
Brachystomella sp.	Neanuridea	Brachystomellidae	+	—	—

(+) indicates the presence and (−) indicates the absence of the species.

Folsomides parvulus Folsom, 1934.

The descriptions of the species in this study are same as given by Salmon (1964). It measures about 1.05 mm and there is a clothing of short plain setae arranged in transverse rows; thorax—II with 6 rows, thorax—III with 4 rows, abdomen—I—III with 3 rows each, abdomen—IV with 4 rows abdomen—V with 3 rows and abdomen—VI with 4 rows. Antennae shorter than the head. Post antennal organ is elliptical, distinctly bent and 5-6 times as long as broad. Ocelli-2 on each side and furcula reaches only upto the posterior margin of abdomen-III. Collected from the bottom forests of Kapilas.

Sub-family—Proisotominae Stach. 1947.

Folsomia brevifurca Bagnall, 1949.

White forms measuring about 1.15 mm and are clothed with short plain setae. Antenna subequal to head, Ant. IV. with an indistinct cone at the apex and Ant-I with one sense rod on each side. Post antennal organ (Pao) is elliptical, 2½ times as long as broad. Eyes absent and furcula reaches upto the middle of abdomen-II. Collected from the paddy fields of Bhubaneswar.

Sub-family—Isotominae Schaeffer, 1896

Cryptopygus thermophilus Axelson, 1900.

Grey coloured forms measuring about 1.95 mm, well clothed with short plain setae and occasional large setae on the dorsal and lateral sides of posterior abdominal segments. Antenna-IV uniformely pigmented and other segments with pigments more or less concentrated in the middle. Basal part of the manubrium is also with little pigment. Pao elliptical and ocelli 8+8 subequal. Furcula reaches upto the middle of abd-II; manubrium dorsally with many setae and ventrally with 1+1 strong setae at distal end. Collected from grass land, crop field and forest sites and is the dominant species in all the habitats.

Desoria (= *Isotoma*) Agassiz, 1841.

Measures about 1.9 mm. Ant-III organ has a shallow common groove. Ventral tube bears 6 pairs of weak setae anteriorly, posterior side with

4 pairs of setae and distal ones are longer than others. Manubrium dorsally hirsute, with fewer setae. Ocelli are situated in dark patches on each side of the head. Collected from paddy fields and grass lands.

Family—Entomobridae Tomosvary

Sub-family—Entomobryinae Schaeffer

Lepidocyrtus caerulicornis Bonet, 1930.

Yellowish forms, about 1.4 mm long and the entire body is clothed with hyaline, blunt, finely striated scales and ciliated setae. Antennae normal with 4 segments, without annulations; ocelli are present. Thorax-II as much larger as thrice than thorax-III. Trunk generally unpigmented. Ant-IV apically with a retractile vesicle. Dens with only ciliated setae and scales; claws without winglike teeth. Collected form grass land, paddy field and forest habitats.

Acrocyrtus cryptocephalus Handschin, 1929.

Body length measures about 1.1 mm; ground colour white, scattered with blue pigments especially upon distal half of antennae, abd II, III and upon posterior border of abdomen. Ant-I and II dorsally denuded of setae and heavily baset with scales. Eyes 8+8, black; the manubrium dorsally hirsute and laterally with a row of modified, blunt, ciliated setae. All legs intensely scaled until distal end of each tibiotarsus. Unguis slender, with paired basal and one distal inner tooth. Trochanteral organ composed of 35 setae in a quadrangle, marginal setae considerably long. Ventral tube anteriorly with 2+2 larger terminal and about 10 pairs of smaller setae. Collected from grass land.

Alloscopus tetracantha Borner, 1906.

Yellowish with a clothing of both scales and setae ; measuring about 1.7 mm. Antenna I subdivided into small proximal I and larger distal I, ant III and IV annulated. Ocelli 1+1, unpigmented. Furcula well developed and reaches beyond the ventral tube. Dens with 4-5 spines, mucro without basal spine and claw with wing like teeth. Collected from the top and middle forests of Kapilas

Sinella coeca Schott, 1899.

Colourless forms measuring about 1.4 mm and are devoid of eyes. Ant—IV having no subapical organ, the anterior face of the ventral tube

has 3+3 large and 4+4 small setae symmetrically arranged. The dorsal side of the manubrium only with ciliated setae, tibiotarsus without smooth setae and the mucro is falcate. Collected from the bottom forests of Kapilas.

Seira cinerea Yosii, 1960.

Body length measures about 1.95 mm, ground colour bluish-grey with slightly brown scales. Antennae darker than proximal two segments. Head is coloured ventrally and thorax II and III with coloured margins. Ventral side of the body, ventral tube and legs darkly pigmented Furca thinly pigmented basally. Eyes 6+6, in a common black eye patch. Legs scaled until tibiotarsus. Coloured ventral tube is anteriorly scaled and with 2+2 terminal setae. Manubrium and dentes ventrally scaled and dorsally bears many long ciliated setae. Collected only from the top forests of Kapilas.

Seira indica Ritter, 1911.

Body length 1.6 mm, slender in general form and the body colour is determined by the presence of brownish scales and bluish and yellowish brown pigment of the integument. There are two types of scales over the body, hyaline ones on head and on all extremities while heavily brown scales are on thoracic segment—II and on all segments posterior to abd. II. Ocelli 6+6, in a common black eye patch. Furca well developed. The yellowish pigments of the body may completely disappear within one year of preservation in alcohol. Collected only from the top forests of Kapilas.

Sub-family—Cyphoderinae Borner, 1913.

Cyphoderus albinus Nicolet, 1841.

Colourless forms that are devoid of eyes and measure about 1.4 mm. Ventral tube distally directed forwards, anterior face has 2+2 setae and the posterior face has 7 setae. Manubrium ventrally scaled and dorsally with many ciliated setae. Near the manubrial end there are 1 spiny and 2 ciliated setae. Mucro is apically bidentate. Collected from the top forest of Kapilas.

Superfamily—Hypogastruroidea Salmon, 1964.

Family— Onychiuridae Borner, 1913.

Sub-family— Tullberginae Bagnall, 1935.

Tullbergia sp. Womersley, 1930.

Colourless forms, devoid of eyes and measure about 0.7 mm. Pseudocelli present on the body. Pao with vesicles more or less closely packed to produce 2 rows. One pair of anal spines is present on abd-IV. Furcula entirely absent. No apical sensory papilla on ant-IV, the cuticular fold of ant-III is well developed and divided into papillae. Collected from the middle forests of Kapilas.

Sub-family—Onychiurinae Borner, 1966.

Protaphorura (= *Onychiurus*) sp. Absolon, 1901.

Body usually unpigmented, cylindrical but distinctly broadened at abd. III—IV. Measures about 0.8 mm and pseudocelli having chitinous borders. Pao composed of simple vesicles. Sense clubs at ant-III are generally granulated. Ant-IV apically with a subapical pit in which lies a sensory papilla. Collected from the paddy fields.

Family—Hypogastruridae Borner, 1913.

Hypogastrura sp. Bourlet, 1839.

Measures about 0.6 mm. Body wall is pigmented and cuticle finely granulated. Ant—IV with a retractile papilla at the apex. Pao present, with 4 peripheral vesicles. Anal spines 2, well developed and curved. Furca well developed, dentes with 6-7 setae. Collected from grass lands and top and middle forests of Kapilas.

Xenylla sp. Tullberg, 1869.

Body is usually well pigmented, blue-black froms measuring about 0.95 mm. Pseudocelli never present. Sense organs on ant—III but never with cuticular papillae. Ant—IV apically with a retractile papilla. Pao absent; eyes 5+5. Furcula with distinct joints and anal spines short. Collected from top and middle forests of Kapilas.

Super family—Neanuridea.

Family — Brachystomellidae Stach, 1949.

Brachystomella sp. Agren, 1903.

Colourless specimens measuring about 0.7 mm. Body is generally clothed with short setae. Abd—VI is visible from the dorsal side. Pao with

Table 2- Some morphological characters of Collembola species collected from different soils of Orissa.

Species Name	Body length in mm	Eye	Body colour	Furca
Folsomides parvulus	1.05	+	−	+
Folsomia brevifurca	1.15	−	−	+
Cryptopygus thermophilus	1.95	+	+	+
Desoria (= *Isotoma*) sp.	1.9	+	+	+
Lepidocyrtus caerulicornis	1.4	+	+	+
Acrocyrtus cryptocephalus	1.1	+	+	+
Alloscopus tetracantha	1.7	−	+	+
Sinella coeca	1 4	−	−	+
Seira cinerea	1.95	+	+	+
Seira indica	1.6	+	+	+
Cyphoderus albinus	1.4	−	−	+
Tullbergia sp.	0.7	−	−	−
Protaphorura (= Onychiurus) sp.	0.8	−	+	−
Hypogastrura sp.	0.6	+	+	+
Xenylla sp.	0.95	+	+	+
Brachystomella sp.	0.7	−	+	+

(+) indicates the presence and (−) indicates the absence of eye, body colour and furca.

7 vesicles, arranged in the from of a star. Ocelli 8+8. Furcula with all segments, well developed and distinctly separated from each other. Dens dorsally with setae only. Anal spines are absent. Collected from the paddy fields of Bhubaneswar.

DISCUSSION

In the present investigation sixteen species of Collembola were recorded belonging to fifteen genera, seven sub-families, five families and three super families. Eleven species were recorded from the forest sites as compared to the occurence of six species in crop fields and five species in the grass land site (Table 2). From this it may be concluded that the forest ecosystem provided a better niche for Collembolan species due to its rich organic content and thus had a greater species diversity. It is also interesting to note that two Collembolan species i.e. *Cryptopygus thermophilus* and *Lepidocyrtus caerulicornis* were common to all the sites and the former species dominated all the ecosystems that had been studied. All the sixteen Collembola species reported are new records of Orissa. There are very few taxonomical references for Collembola of Indian pedoecosystems. The geographic distribution of Collembola in India is not completely known. Therefore, the present report of the spring-tails in the soils of Orissa will be of considerable help to the taxonomy of Collembolan fauna of India.

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EFFECT OF SHORT-TERM STARVATION ON MALE SKIPPER FROG *RANA CYANOPHLYCTIS*

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ABSTRACT

Rana cyanophlyctis starved for 30 days showed a significant decrease in hepatosomatic and gonosomatic indices; body weight and fat-body weight. Protein and amino acid concentrations in liver varied significantly. While amino acid concentration in the skeletal muscle tissue showed a significant variation, variation in protein concentration was not significant.

INTRODUCTION

Frogs are exposed to different climatic conditions in different latitudes in India. In the northern climates they undergo hibernation but are active throughout the year in the southern regions where winter is rather mild The skipper frog *Rana cyanophlyctis* is a common aquatic anuran in India. It is of much experimental value since the females respond to induced multiple ovulations under captivity (Mohanty-Hejmadi *et al*, 1983). In the present work, effect of 30 day long starvation on some parameters in male *R. cyanophlyctis* has been studied. Studies of *R. pipiens* metabolism (Jungreis, 1970 and Jungreis and Hooper, 1970) show that the substrates used by fed animals vary throughout the year, essentially glucides in winter and triglycerides in summer. Under starvation conditions the liver and fat body stores are used up by the end of the second winter and the frogs have to fall back on residual muscle reserves and tissue protein. Data concerning seasonal fluctuations in amphibian

endocrine activity suggest that neglecting time scales, the energy metabolisms of starved frogs and mammals are similar (Grably and Piery, 1981) During winter hibernation in temperate regions, starvation continues for prolonged periods yet the depletion of endogenous energy stores is minimised by the greatly reduced metabolic requirements when body temperature is below 6° C (Fromm and Johnson, 1955). However, such data for most tropical frogs are not available. The purpose of this study is to identify to what extent endogenous energy sources are available in *R. cyanophlyctis* and to determine the ability of frogs to utilise those sources during the period of starvation.

MATERIALS AND METHODS

Male frogs were collected from Bhubaneswar area located at 25 meters above sea-level at 85°53'E longitude and 20°21'N latitude. They were brought to the laboratory and kept under conditions standardised by Mohanty-Hejmadi (1977). The frogs were kept for 24 hours to allow them to empty their stomach contents completely. Frogs were sacrificed after 24 hours (Control), 7 days, 15 days and 30 days. Ten frogs were used for each group. For each frog the snout-vent length, body weight were noted. Then the weight of liver, fatbody and gonad were determined. One hundred milligram of liver and thigh muscle from each frog were taken out to measure total protein and total free amino acid concentration. Protein estimation (Lowry *et al.* 1951) and amino acid estimation (Moore and Stein, 1948) were done using a visible range spectrophotometer, "SICOSPEC—100". Hepatosomatic index (HSI) was determined by the formula :

$$HSI = \frac{\text{Liver Weight}}{\text{Body Weight}} \times 100$$

Gonosomatic index (GSI) was determined by the formula :

$$GSI = \frac{\text{Gonad Weight}}{\text{Body Weight}} \times 100$$

To study the significance of the values obtained, the 'F' test (Analysis of variance) was conducted.

RESULTS

The changes in body weight, HSI, GSI, fat body weight, protein and amino acid concentrations in liver and muscle are presented in Table-1. There was a decrease in body weight and HSI as fasting prolonged; GSI also decreased in 7 day starved ones, elevated in 15 day starved ones and then again decreased in 30 day starved ones. Visible fat body varied erratically and showed no clear pattern except for the total depletion after 30 days of fasting.

Total free amino acid concentration in liver showed irregular values throughout the fasting period decreasing markedly by 68.05% after 7 days of fasting, and then increasing after 15 days of starvation. After 30 days of starvation it decreased by 62.14% compared to that of control. The test of analysis of variance shows that the variation is significant.

Muscle-free amino acid concentration decreased significantly after 7 days fasting, then increasing steadily and exceeding the control value after 30 days of starvation.

Liver total protein concentration varied significantly. On the 7th day of starvation, it decreased markedly (by 49.8%) from the control value and again started increasing on the 15th and 30th day of fasting. The value in 30-day starved frogs was 12.75% lower than that in control. Muscle total protein concentration followed the same pattern as that of liver. However, the value in 30 day starved frogs was 32.8% higher than that in control.

All the parameters except muscle protein concentration showed significant variations during the starvation stress (Table-2).

DISCUSSION

Starvation represents a significant component of the life history of many amphibians (Mould and Sever, 1982). Weight loss and structural changes have been recorded in *Rana* species after several months of starvation (Juszczyck *et al*, 1966 and Zamachowski, 1970). In *R. pipiens* 20% decrease in body weight was marked after 2.5 months of fasting (Farrar

and Frye, 1979). In male *Ambystoma tigrinum* body mass decreased to 45.5% of the initial weight but did not show a sequential decrease during a 70-day starvation stress (Mould and Sever, 1982). In *R. cyanophlyctis* a sequential decrease by 25.3% after 7-day starvation and upto 50% decrease in body weight after 30-day starvation indicates a species specific response to starvation stress.

Studies on *R. temporaria* show liver weight fluctuation throughout the annual cycle when the frog is prone to different nutritional stress depending on the season (Smith, 1950). In this study exposure to starvation stress shows a significant fall in HSI and GSI indicating thereby the weight loss of liver and testis compared to the body weight in *R. cyanophlyctis*.

Effect of medium-term starvation on *Xenopus laevis* plasma shows an abundance of alanine (Balinsky, 1970). Work on *R. esculenta* exposed to 18 months of starvation shows a minimal loss in heart muscle protein content, skeletal muscle proteins being used for a large part (Grably and Piery, 1981). *R. cyanophlyctis* exposed to a comparatively short-term starvation stress (30 days) however, shows an increase in skeletal muscle protein content after 30 days of fasting.

In *R. esculenta*, labile proteins provide energy during first days of starvation and amino acids are utilised to resynthesise the proteins of the weight retaining groups of organs like heart and kidney (Grably and Piery, 1981). During first 7 days of starvation, the labile proteins in *R. cyanophlyctis* probably provided energy resulting in a decrease (44.8%) in liver protein concentration. Apparently, at first gluconeogenesis from amino acids is intense, then it slows down thus checking too rapid a protein catabolism until atleast lipids have not been exhausted (Cahill, 1970). In *R. cyanophlyctis*, data show the beginning of conservation of protein beyond 7 days of fasting because there is a recovery of protein concentration in liver and muscle.

It is reported that as the fasting continues from days to weeks, the release of amino acid from muscle and liver for gluconeogenesis is reduced, consequently the brain's dependence on glucose being curtailed and ketone bodies meet 75% of the energy demand at that time (Cahill, 1970). In confirmation with this, a gradual increase in muscle amino acid concentration was noted in 7-30 day starved *R. cyanophylyctis*. But liver amino acid

concentration after 30 days of fasting decreased by 62.1% compared to that in control.

On the whole, it may be concluded that though during early starvation, protein and amino acid reserves start diminishing, after 30 days of starvation there was a recovery in their concentration. An ultimate rise in muscle protein concentration by 32 81% than the control value can be interpreted as conservation against the simultaneous loss of liver amino acid concentration by 62.1% than the control value.

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Table-1. Effect of starvation in male *Rana cyanophlyctis*

	Body Weight (gms)	Fat Body Weight (gms)	Hepato-somatic Index	Gonoso-matic Index	Liver Protein (gm/100 gm tissue)	Muscle Protein (gm/100 gm tissue)	Liver Free Amino Acid (gm/100 gm tissue)	Muscle Free Amino Acid (gm/100 gm tissue)
Control	10.5±0.751	0.176±0.003	4.337±0.133	1.219±0.032	29.49±0.297	17.8±0.578	0.745±0.031	0.28±0.020
7 day Starved	7.84±0.401	0.0079±0.002	3.399±0.264	0.215±0.002	16.28±0.214	13.79±0.124	0.238±0.019	0.081±0.002
15 day Starved	6.91±0.143	0.098±0.028	1.646±0.046	0.241±0.029	22.24±0.807	17.33±0.333	0.375±0.009	0.104±0.007
30 day Starved	5.21±0.020	0.0	0.711±0.098	0.068±0.0032	25.73±0.153	23.65±0.130	0.282±0.0065	0.389±0.0035

Table-2. Analysis of variance with 30 day starvation as covariate for comparision of different variables in male *Rana cyanophlyctis.*

VARIABLES	CALCULATED VALUE OF F3,37	SIGNIFICANCE LEVEL
Body Weight	96.73	$P < 0.001$
Fat Body Weight	20.59	$P < 0.001$
HSI	99.03	$P < 0.001$
GSI	668.03	$P < 0.001$
Liver Protein Concentration	13.92	$P < 0.001$
Muscle Protein concentration	0.956	N.S.*
Liver Amino acid concentration	3.42	$P < 0.05$
Muscle Amino acid concentration	56.815	$P < 0.001$

*N.S - Variation is not significant.

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HOST PREFERENCE OF *APHIS NERII* (FONSC) (APHIDIDAE : HOMOPTERA)

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ABSTRACT

A laboratory study on the host preference of *Aphis nerii* (Fonsc.) was undertaken at a temperature of 26±1°C and 63±2% RH. Aphids from *Pergularia daemia* were reared on the leaves of *Calotropis gigantea*, *Nerium odorum* and *P. daemia*. *P daemia* was found to be the most preferred host plant for *A. nerii* where nymphal developmental period was shortest, fecundity was maximum and longevity was highest among the three host plants. *C. gigantea* comes next to it and *N. odorum* was the least preferred. The latex constituency of these three plants is also determined.

Key words : *host, Aphid, Homoptera*

INTRODUCTION

Aphis nerii (Fonsc.), the commn yellow oleandar aphid is a polyphagous species, infesting a number of plants belonging to the family Asclepiadaceae, Apocynaceae and some of the plant of the Composite family (Eastop, 1961). In India, the aphid species is found during the months of October to March (Behura, 1963). This pest has been recorded from several host plants in India like *Nerium odorum*, (Das, 1918, Mukherjee and Behura, 1948; Behura, 1963), *Calotropis gigantea* (Bhowmik & Ray Choudhuri, 1959), *Bryophyllum pinnatum* (Behura and Dash, 1965) and out side India from *Pergularia sp.* (Eastop, 1961). This aphid is known to be a vector of sugar cane mosaic virus (Eastop, 1961). Because of the polyphagous nature of the aphid species it was felt necessary to study its host preference so that it may be possible to elimitate favourite hosts from the vicinity of the main crop.

MATERIALS AND METHODS

Adult apterous virginoparae of *A. nerii* were collected from the leaves of *P. daemia* and maintained in the laboratory on the same host leaves at a temperature of 26±1°C, 63±2% RH and 16 hour photoperiod. The newly born first instar nymphs, immediately after birth, were transferred to clean glass petridishes with moist blotting paper and provided with the leaves of the three host plants, namely *P. daemia C. gigantea*, and *N. odorum*. Observations were recorded on their development, longevity and fecundity. (A minimum of 10 adults were reared on each host plant separately from the first instar stage till they attained adulthood and death). Host preference was determined on the basis of developmental period, longevity and fecundity of aphids on each host plant.

RESULTS AND DISCUSSION

Observations made on host preference of *A. nerii* is presented in Table 1.

The minimum average developmental period of the aphid was of 108.22 hours in *P. daemia* while the maximum 142.61 hours in *N. odorum*. The highest fecundity was an average of 39.3 in *P. daemia* and the lowest 2.4 in *N. odorum*. Longevity was maximum, an average of 317.33 hours on *P. daemia* while minimum 216-8 hours in *N. odorum*.

On the basis of developmental period, the following was the order of preference.

P. daemia>*C. gigantea*>*N. odorum*

On the basis of longevity, the following was the order of preference.

P. daemia>*C. gigantea*>*N. odorum*

On the basis of fecundity, the order of preference was

P. daemia>*C. gigantea*>*N. odorum*

From the above studies, it was observed that *P. daemia* is the most favourable host showing the greatest speed of development (fast developers), highest longevity and maximum fecundity. *N. odorum* is the least preferred with slowest development, lowest longevity and minimum fecundity. *C. gigantea* comes close to *P. daemia* in this regard.

Table 1-Development, Longevity and Fecundity of *Aphis nerii* (Fonsc.) on three host plants.

Name of the host plants	Developmental period hrs	Longevity in hrs	Fecundity
P. daemia	Range : 107.55 - 108 75 Mean : 108 22	Range : 316.75 - 317.05 Mean : 317.33	Range : 16 - 79 Mean : 39.3
C. gigantea	Range : 131.05 - 136.90 Mean : 134.42	Range : 306 94 - 314 52 Mean : 311 21	Range : 18 - 70 Mean : 37.36
N. odorum	Range : 141.87 - 143.49 Mean : 142.61	Range : 215.92 - 219.64 Mean : 216.80	Range : 2 - 5 Mean : 2.4

It was observed that the fast developers (on *P. daemia*) produced significantly more nymphs than those on *C. gigantea* and *N. odorum*. Fast developers are probably advantageous for the survival of a colony because they can build it up rapidly at a time when predators deplete in numbers or eliminate a colony when it is small. In contrast, the slow developers help to prevent excessive multiplication as the colony enlarges.

The latex produced by these 3 different host plants differs in constituency. Latex of Asclepiadaceae to which belong *P. daemia* and *C. gigantea*, contains five types of alkaloids while that of Apocyanaceae, 250 alkaloids. In addition, the former contains tylophorin type and the later, complex indolic alkaloids (Swain 1966). It may be concluded that apparently aphid reproduction and development are primarily controlled by nutrition and in particular by the type of nutrients provided by the host plant which varies from plant to plant. *P. daemia* and *C. gigantea* with fewer alkaloids are more preferred host plants than *N. odorum* with more alkaloids in its latex which is toxic to animals.

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BURROWING SPECIALIZATIONS IN ANURANS

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ABSTRACT

Burrowing is widespread among anurans and nine of the twenty-three families of living anurans are burrowers (either facultative or subterranean). Burrowing probably is an ecological specialization of the anurans. There seems to be two types of burrowers, forward and backward and each type of burrower has a special kind of digging mechanism. Morphological parameters such as shape, size, and the limb are specialized for digging into the soil and some of the skeletal elements, such as the limb bones and the cranium are also modified. The burrowing frogs also show some preferences for particular types of food items that are available underground and accordingly, some species have specialized feeding behavior. Other aspects of the behavior of these frogs not associated directly with the burrowing behavior are peculiar ; an example is "gluing" during amplexus. Finally, the structural and morphological modifications suggest that burrowing is a primary or secondary adaptation among anurans.

Key words : Burrowing, anurans.

INTRODUCTION

A burrowing anuran is one that digs effectively, and this burrowing behavior is widespread among anurans. Frogs burrow for food, shelter and reproduction, and remain underground for varying period of time depending upon whether the frog is a facultative or obligate burrower. Of the twenty-three recent families, nine are facultative burrowers, and five of these nine families are obligate burrowers (Fig 1). Whether the frogs are facultative or subterranean, they have one of two patterns of burrowing, headfirst and backwards. The family Microhylidae contains the maximum number of species of burrowers which are either facultative or subterranean. *Rhinophrynus* (Rhinophrynidae) and *Hemisus* (Ranidae) are examples of obligate burrowers. Facultative burrowers are more numerous ; there are representatives among the microhylids, leptodactylids, bufonids and pelobatids.

BODY SHAPE AND SIZE

There is a sharp contrast in the body shapes of burrowing and nonburrowing anurans, and among burrowers, the body shapes of facultative and subterranean species differ. The subterranean species *Rhinophrynus dorsalis, Hemisus marmoratus, Uperodon systoma, Uperodon globulosum* and *Breviceps gibbosus* have a globular and fleshy body. In most species the tympanum is absent. In the forward burrowers such as *Rhinophrynus dorsalis* and *Hemisus marmoratus* the snout is narrow and truncate, and in *Rhinophrynus* Trueb and Gans (1983) found the skin to be pustulose and loose on all parts of the body except the snout, palmer and planter surfaces and the belly wall, where it is attached closely to underlying muscle. The skin of the snout in *Rhinophrynus* is bound closely to the underlying skull and elaborated into cushionlike pads; each cell of the free layer is armed with a keratinous spine or spicule. In *Hemisus marmoratus*, the dorsal surface is rough and bears small tubercular processes. Species of the African genus *Breviceps* are spherical in outline and tubercular upon the surface of the body (Beddard, 1911). Like *Rhinophrynus* the skin of the Indian microhylid *Uperodon globulosum* is also pustulose and loose, and is smooth or slightly tubercular dorsally. In *Uperodon systoma*, it has been reported that there is only one skin fold from the eye to the shoulder. The

	DISCOGLOSSIDAE	RHINOPHRYNIDAE	PIPIDAE	PELOBATIDAE	LEPTODACTYLIDAE	BUFONIDAE	RANIDAE	MICROHYLIDAE	HYLIDAE *
I. FACULTATIVE BURROWER	●	●	●	●	●	●	●	●	●[1]
A. HEAD FIRST			●		●[2]	●[2]	●?		●
B. FEET FIRST	●	●		●	●	●	●	●	
II. SUBTERRANEAN		●		●	●		●	●	
A. HEAD FIRST					●[1]		●[1]	●[2]	
B. FEET FIRST		●		●	●			●	

Fig. 1. Distribution of burrowing types among anuran families. Black dots represent all species in the families Discoglossidae, Pipidae and Rhinophrynidae and ten or more species in the remaining families. Number of species of head burrowers are indicated by superscripts (modified from Emerson, 1976).

*Only one species is known.

Australian species *Myobatrachus gouldii* is another specialized subterranean form with very small head and extremely short limbs, which give it a turtle-like appearance. So the general pattern of the body shape is almost same in all of the subterranean species.

LIMBS AND ASSOCIATED STRUCTURES

The ability of frogs to dig backwards to be unique among terrestrial vertebrates. Moreover, they seem to be preadapted for this mode of excavation owing to their posterolaterally placed hindlimbs, the high degree of folding at the joints and the associated musculature (Emerson, 1976). To a certain extent, the mode of life of a frog is reflected in the proportion of the long bones (humerus, radioulna, femur, tibiofibula, astragalus, and calcaneum). Species with burrowing habits tend to have heavier, stockier long bones than do the arboreal or terrestrial frogs in which the limb bones are relatively slender.

Forelimb and Pectoral girdle :

Head-first burrowing seems to require greater morphological specialization than hindlimb burrowing and this fact is probably responsible for its relative rarity in frogs (Emerson, 1976). All headfirst burrowers use their forelimbs and the head for digging. Accordingly, the forelimbs are short, stout, muscular and strong. In one of the hylids, *Pseudacris streckeri*, the forelimbs are wide, stocky and quite toadlike and the fingers are stout and lack terminal adhesive discs to facilitate them for burrowing in sand. The humerus is broader in the headfirst burrowers than it is in hindlimb burrowers. As the modification of the humerus seems more resonably associated with ecological adaptations, there are some deviations from the usual pattern. For example, a species of *Leptodactylus* (*Leptdactylus pentadactylus*) possesses heavier and stockier humerus (Lynch, 1973).

A radical morphological reorganization in the pectoral-cranial region of the body is required to enable the head to flex to a sufficient degree on the vertebral column and thus function as a brace for the forelimbs to generate adequate force for soil displacement. In *Hemisus marmoratus* even though there are metatarsal tubercles on the hind feet, they dive head-first into the ground, using their sharp snout for digging. The pectoral girdle of *Hemisus* has been modified extensively;

the coracoids are lengthened, the scapula is shifted forward and the ratio of clavicle to coracoid is relatively small. The coracoids join to form an approximately thirty degree angle with the midline, an angle more acute than that found in almost any other species of frogs. The cartilaginous sternum is missing and has been replaced by the extended coracoids. The pectorol girdle is basically a single unit with the fusion of the coracoids and clavicles with the scapula.

Hind limbs :

About 95% of burrowing anurans dig hind-feet first into the soil, and the hind limbs, although short, are powerfully built and often possess metatarsal tubercles used in digging. Some species possess only one metatarsal tubercle, whereas others have two, one outer and one inner. In some species, such as the Spade Foot Toad, *Scaphiopus couchi* (Pelobatidae), there is a single, sharp edged, sickle-shaped black spade on each hind foot to facilitate the toad's burrowing vertically downwards into sandy, loose soil. In *Rhinophrynus dorsalis* the limbs are robust, spatulate and show several modifications. The astragalus and calcaneum are short and fused to one another; the prehallux is large, and the fifth digit has only a single phalangeal element which is modified into a shovel-like structure. The most conspicuous feature of the hind limb of *Glyphoglossus molossus* (Microhylidae) is the short tibiofibula, which accounts for the decrease in the overall length of the hind limb. Decrease in the length of the tibiofibula is a modification found among anurans that walk or dig, and frogs with a shortened tibiofibula exhibit both digging and walking behavior (Zug, 1972) as well as a reduction in jumping ability. In African genus *Breviceps* (Microhylidae) the inner and outer toes are short. *Breviceps adspersus* is the one of the shortest-toed member of the genus, and the digging metatarsal tubercle is much more sharply ridged than in *Breviceps verrucosus*. Almost all the burrowing frogs lack terminal adhesive discs on the fingers, but in some facultative burrowers such as the Indian genus *Ramanella* (Microhylidae) and *Kaloula* (Microhylidae), the adhesive discs are present. In *Pseudacris streckeri* (Hylidae), the adhesive discs on the fingers (which are common with the hylids) are completely lost owing to the frog's burrowing habits.

The hind limb musculature associated with burrowing also supplies enough focre for soil dispalcement. Principally, there are three hind

limb muscles in burrowing frogs that help in digging. In *Kaloula pulchra* and *Glyphoglossus molossus* (Microhylidae) one of the muscles is involved primarily with the positioning of the metatarsal tubercles. For the tubercles to be an effective spade it must be Positioned in a vertical position relative to the soil, at the beginning of leg movement. Emerson (1976) reported that in the hind limb burrowers that she examined, the muscle tibialis anticus brevis which inverts the foot has a proximal origin on the tibiofibula. The shift in the origin lengthens the muscle and thus increases the velocity of contraction, bringing the metatarsal tubercle into position in a shorter amount of time. The modifications in the other two muscles seem primarily involved with increasing the force that can be exerted by the muscles.

BURROWS

All the burrowers burrow in different ways, and the size, shape and depth of the burrows vary interspecifically. The time required for a species to burrow depends upon the condition of the soil they live. For example, the Spade Foot Toad burrows in sandy or other loose soil, and they disappear quickly. Trueb and Cannatella (1982) observed that *Rhinophrynus* (Rhinophrynidae) is an adept burrower, being able to disappear beneath surface soil in a matter of soconds. *Rhinophrynus dorsalis* live underground throughout the year and emerge after rainstorms to breed in shallow bodies of water.

The burrowing habits of the genus *Breviceps* have been studied by Poyton and Pritchard (1976). They reported that all 13 species of the genus are burrowers, and that the burrows of *Breviceps verrucosus* are shallow, extending only 2-4 cm below the surface of the soil. Their lengths vary from about twice the length of the individual (5—11cm). One or two side branches may be present, with or without opening at the surface. The burrows of *Breviceps adspersus* are deeper than those of *Breviceps verrucosus* (51-60cm), and they are specialized in breeding and egg laying inside their burrows. The egg chambers of *Breviceps adspersus* have been found 30-45 cm below the ground.

Species of the genus *Uperodon* are excellent burrower and when they burrow in loose soil, no trace of their burrow is seen; when they burrow in swampy soil, an opening to the outside may be present. These

frogs are completely subterranean and come out during rainy seasons only for food and breeding. During the remaining of the year they live at considerable depths. (One specimen was collected at a depth of 8 ft.). I (SKD) suspect that both the species of the genus, *Uperodon globulosum* and *Uperodon systoma*, live at depths greater than 8 ft. Probably while burried they do not feed, because on many occassions I (SKD) have examined the stomachs of *Uperodon systoma*, which come out of their burrows at the early rainfall, and the stomach contains no food items. Mukerji (1931) kept a specimen of *Uperodon globulosum* in captivity; it lived in burrows for about 13 months without food and showed no effects of starvation during the first nine months. This observation supports the belief that this species does not feed underground excepting in the termite nests. I (SKD) have observed that *Tomopterna breviceps* (Ranidae) which is a hindlimb burrower, excavates into the soil to depths of 10 to 12 in; at the surface, the entrance to their burrow is marked by an opening at the surface of the soil.

BURROWING MECHANISM

Emerson (1976) described the burrowing mechanisms of a hind-limb burrower, *Glyphoglossus molossus*, and a head-first burrower, *Hemisus marmoratus*. As *Glyphoglossus molossus* starts burrowing, its hind limbs displace the soil backwards in a sweeping action, and the animal drops backwards and downwards into the ground. This movement is comprised of two phases. First, the limb is positioned by a lateral rotation of the femur and inversion of the foot. Second, a "scooping" action with medial rotation of the femur and partial extension of the knee. During "scooping" the metatarsal tubercle is placed in contact with the ground; this creates the force for digging. The "scooping" action involves partial extension of the leg at the knee and the extension at the knee tends to propel the animal forward. Forward movement is retarded by the action of the forelimbs against the ground, as during digging the anterior part of the body is held off the ground by partially extended forelimbs. When *Hemisus marmoratus* burrows, the head is flexed downwards and the snout is pushed below the surface of the soil. This head flexion is as essential to head-first digging, as is the action of the metatarsal tubercle to hind-limb digging. Once the head is flexed and positioned in the soil, the forelimbs move alternately in a

breast-stroke action; thus, the limbs are protracted against the substrate and then retracted to displace soil and thereby move the body forward.

FOOD AND FEEDING MECHANISMS

Owing to subterranean habit, obligate burrowers mainly concentrate on food items that are available below the ground, but facultative burrowers feed opportunistically above and below ground. The majority of them forage by "sit and wait" mechanisms, because the facultative burrowers are neither good jumpers nor walkers. The diets of frogs that feed underground consists primarily of termites, ants and worms.

By observing living *Myobatrachus* (Myobatrachidae), Calaby (1956) noticed that when a termite gallery is located, the frog sits by it and snaps up termites as they walk past Termites are abundant in the soil within the animal's range, and the sandy nature of the soil provides easy digging conditions. The same type of feeding behavior characterizes *Uperodon systoma* The main habitat of the animal is near termite nest, and when the winged forms of the termites emerge during the rainy season, the frog feeds on them; thus their major food item is termites, supplemented by earthworms and ants. Apart from collections made at the breeding sites, *Uperodon systoma* has been seen mainly in termite nests; apparently this sedentary species restricts its movements to finding and burrowing into termitaria and ant nests (Daniel, 1963). Another burrower, *Pseudacris streckeri* (Hylidae) feeds mainly on mealworms and leaves no doubt that they are capable of subterranean feeding It is questionable how widespread subterranean feeding is among fossorial species of frogs. A number of highly fossorial anurans in the families Leptodactylidae and Pelobatidae (*Cyclorana alboguttatus*, *Cyclorana platycephalus*, *Cyclorana australis*, *Limnodynastes spenceri*, *Neobatrachus pictus*, *Ceratophrys ornata*, *Lepidobatrachus llanensis* and *Scaphiopus couchi*) form a "cocoon" around their body when aestivating, and this suggests that they do not feed while underground (Brown, 1978). Ruibal *et al.* (1969) pointed out that *Scaphiopus hammondi* resides in shallow burrows in the day and emerges to forage on the surface at night. Whitaker *et al.* (1977) strongly suggested that *Scaphiopus* commonly feeds above ground. These observations suggest that a number of highly fossorial species show no indication of subterranean feeding.

Rhinophrynus dorsalis, which is a clearly subterranean animal, mainly feeds on termites. Trueb and Gans (1983) reported that the actual penetration of an ant or termite funnel probably is accomplished by the tip of the snout. Several morphological modifications are associated with this underground feeding. Among these is the wedge-shaped, strongly reinforced skull and the short, stiff mandible. The application of forces to the snout are facilitated by the effective elimination of a neck owing to the anterior position of the pectorl girdle which, in this species overlaps the skull. The spiny epithelium of the callused nose and mandibular tip probably are associated with this pattern of force application. Several other buccal and oesophageal specializations seem to be associated specifically with feeding on ants and termites. The most interesting of these are the grooves in the roof of the mouth and the leaflike infoldings of the oesophageal wall, which may allow frogs to withstand the bites of ants and termites (Trueb and Gans, 1983).

In addition to *Rhinophrynus*, two other species of frogs feed underground. *Myobatrachus gouldii* (Leptodactylidae) and *Hemisus marmoratus* (Ranidae) have been collected in termite nests and each species feeds almost exclusively on termites and ants. Interestingly, both species also burrow forward. *Myobatrachus gouldii* uses both forelimbs and hind limbs in excavating, whereas *Hemisus marmoratus* mainly uses its hand and spadelike snout. These characteristics support the hypothesis that forward burrowing facilitates subterranean predation by anurans.

SPECIALIZED MATING BEHAVIOR

Within the Amphibia, dermal adhesion during mating is presently known for only three microhylid genera, *Breviceps*, *Microhyla* and *Kaloula*. It has been suggested that adhesion functions to prvent separation of the pair during mating. The arm span and size of male *Breviceps* are inadequate for normal clasping; thus without "gluing" the amplectant pair would be dislodged during burrowing. The size differential between the sexes of *Breviceps* is the greatest of all the microhylids. The male *Breviceps* does not clasp the female during mating and his arms in fact adhere to her body. *Breviceps* come together above ground to make a nest and burrow backwards to make a nest chamber underground.

Some species of the Philippine genus *Kaloula* practice adhesion (Inger, 1954). A "belly gland" is a common secondary sex character in

the male *Kaloula*. Mating pair adhere to each other during floating oviposition in quiet ponds with the males in axillary clasp. The arm doesnot adhere during this activity. The functional value of adhesion is clearly independent of breeding mode within the microhylid for those genera for which it has been recorded, as the one African genus mates and lays underground (*Breviceps*) while the American genus *Microhyla* and Philippine genus *Kaloula* mate and lay in water. There is also a very marked difference in size between the male and the female brevicipitids, while very little size difference between the sexes is apparent in the other genera. In the Indian genera *Uperodon* and *Ramanella*, I (SKD) have observed the same type of adhesion during mating. *Uperodon systoma* and *Ramanella variegata* secrete a sticky mucus that adheres to both the male and the female during mating. This secretion is so sticky if one holds the frog they become attched to the palm. This mating adhesion in the genera is perhaps their familial relationship (all are microhylids, look rounded and terrestrial burrowers). It is evident that the burrowing morphology is hardly compatible with swimming ability or the prolonged aquatic egg laying process, so the adhesion plays a major role in the maintenance of bouyancy in *Microhyla* and *Kaloula* (Visser et al. 1981) and in *Uperodon* and *Ramanella* (Dutta, pers. observ.). It is not known whether this "adhesion" is associated with all the burrowers, whether facultative or subterranean. If it is present in the majority of them, then certainly this is a strong behavior related with burrowing mode of life.

EVOLUTIONARY IMPLICATIONS OF BURROWING

It is well established that the anurans burrow for food, shelter and reproduction, and the majority of species inhabiting arid environment avoid desiccation by burrowing. Whatever the reason for burrowing may be, the mechanism is oddly distributed among varied families and perhaps the ecological factors have led to the evolution of such a behavior. The majority of those frogs that burrow, do so backwards, and only few species in five families have been reported to be head-first burrowers. Some of them such as *Leptodactylus bufonius* and *Leptodactylus latinasus* use their heads in the construction of nests for egg deposition. Some are backward diggers but are capable of head-first subterranean movements (*Bufo calamita* and *Bufo viridis*). The others are *Rhinophrynus dorsalis*, *Pseudacris streckari*, *Myersiella subnigra*, *Dasypops schirschi*, *Myobatrachus gouldii*, *Hemisus guineensis* and *Hemisus*

marmoratus which burrow head first into the substrate or into the ground. The mechanism of prey detection underground is largely unknown. Perhaps the head-first burrowers primarily feed underground, and when the hind-limb burrowers feed underground they swith to headfirst burrowing for subterranean movement. This phenomenon is well examplified in the case of *Hemisus marmoratus* which has well-developed metatarsal tubercles for a backward movement. Inspite of that they are reported to be head-first burrowers. However, their body plan is well suited for both types of burrowing and occasionally they dig with their hind limbs first, but subsequently they switch to head-first burrowing. Whatever the type of burrowing may be, this is a specialized character possessed by anurans and in the case of *Hemisus marmoratus* the head-first burrowing is a secondarily specialized character, which facilitates the animal for rapid movement in the soil.

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SEASONAL QUANTITATIVE DIPMORPHISM IN THE MAIZE APHID, *RHOPALOSIPHUM MAIDIS* (FITCH) (APHIDIDAE : HOMOPTERA)

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ABSTRACT

Significant dimorphism occurs in the alate and apterous virginoparae *Rhopalosiphum maidis* (Fitch.) with regard to the length of body and rostrum in summer, body, rostrum and cornicle in the rainy season and the total length of the antenna in winter. No significant difference is noted with respect to the length of head, processus terminalis, base VI of antenna, segment III of antenna, ultimate rostral segment and hind tarsus II.

Key words : *Maize Aphid, dimorphism.*

INTRODUCTION

Aphids are highly polymorphic. As many as fifteen different reproducing forms have been reported in *Periphyllus* (Bodenheimer & Swirski, 1957). In the plains of India, only two forms of parthenogenetic viviparae, viz.. alatae and apterae are commonly found on which aphid taxonomy is usually based. Quantitative dimorphism has been studied in *Aphis gossypii* Glover (Mookhopadhyay and Roy Choudhury, 1961) and *Macrosphniella sanborni* (Gillettee) (Nayak and Behura, 1971). The present study deals with quantitative dimorphism in the maize

aphid *Rhopalosiphum maidis* (Fitch) in relation to three main seasons, viz., summer, rainy and winter.

MATERIALS AND METHODS

Adult alate and apterous parthenogenetic viviparae of *R. maidis* were collected at Bhubaneswar on maize plants during summer, rains and winter of 1975 and 1976.

Specimens were mounted in canada balsam in the conventional way. A minimum of 20 specimens were measured for each character for any morph.

The following formulae were employed for the analysis of measurements :

$$S.D. = \sqrt{\frac{(\bar{X} \sim X)^2}{(n-1)}}$$

Where, $\bar{X}$ is the mean value

X is the individual character

n is the number of observations

S.D. is standard Deviation

$$'t' = \sqrt{\frac{\bar{X}_1 \sim \bar{X}_2}{\frac{S_1+S_2}{N}}}$$

where $\bar{X}_1$ is the mean of the first sample

$\bar{X}_2$ is the mean of the second sample

S_1 is the standard deviation of the first sample

S_2 is the standard deviation of the second sample

N is the number of observations

RESULTS AND DISCUSSION

Length of eleven morphological characters often used in taxonomic differenation, viz., total length of body, head, antenna, processus

terminalis, base VI of antenna, segment III of antenna, rostrum, ultimate rostral, segment hind tarsus II, cornicle and cauda were taken into consideration and the data is presented in Table 1.

TABLE 1

Evaluation of quantitative difference with 't' as the parameter in alate and apterous virginoparae of *Rhopalosiphum maidis* (Fitch) collected in three different seasons of the year.

Sl. No.	Character-Length in mm.	Measurement of		Degrees of Freedom.	Value of 't'
		Apterae	Alate		
		(Mean of 20 individuals)			
		SUMMER (MARCH 1975 TO JUNE 1975)			
1.	Body.	1.885±0.046	1.603±0.095	38	3.375*
2.	Head.	0.193±0.013	0.195±0.022	38	0.461
3.	Antenna.	0.763±0.053	0.969±0.240	38	1.704
4.	Processus terminalis.	0.253±0.051	0.324±0.063	38	0.941
5.	Base VI	0.086±0.009	0.106±0.035	38	0.425
6.	Segment III of antenna.	0.201±0.020	0.252±0.050	38	0.860
7.	Rostrum.	0.443±0.040	0.275±0.023	38	3.017*
8.	Ultimate Rostral segment.	0.114±0.005	0.089±0.012	38	0.887
9.	Hind tarsus II.	0.083±0.009	0.081±0.007	38	0.067
10.	Cornicle	0.175±0.012	0.149±0.055	38	0.453
11.	Cauda	0.144±0.011	0.133±0.014	38	0.311

Sl. No.	Character-Length in mm.	Measuremnt of Apterae	Measuremnt of Alatae	Degrees of Freedom.	Value of 't'
	RAIN (JULY 1975 TO OCTOBER 1975)				
1.	Body.	2.579±0.219	1.682±0.077	38	6 580*
2.	Head.	0.276±0.045	0.170±0.027	38	1.772
3.	Antenna.	0.879±0.115	0.956±0.076	38	0.603
4.	Processus terminalis.	0.338±0.048	0.322±0.041	38	0.239
5.	Base VI	0.110±0 021	0.108±0.011	38	0.047
6	Segment III of antenna	0.298±0 055	0.327±0.040	38	0.421
7.	Rostrum	0.544±0 014	0 331±0.077	38	3.174*
8.	Ultimate rostral segment	0.166±0.031	0.097±0.013	38	1.472
9.	Hind tarsus II	0.108±0 014	0082.±0.011	38	0.752
10.	Cornicle.	0.244±0.036	0.127±0.018	38	2.250*
11.	Cauda.	0.183±0.029	0 122±0.010	38	1.401
	WINTER (NOVEMBER 1975 TO FEBRUARY 1976)				
1.	Body.	3.108±0.154	2.950±0.120	38	1.348
2.	Head,	0.203±0.032	0.151±0.012	38	1.108
3.	Antenna	1.350±0.085	1.748±0.069	38	4 476*
4.	Processus terminalis.	0.465±0.031	0.380±0.033	38	1.150
5.	Base VI.	0.148±0.010	0.120±0.015	38	0.807

Sl. No.	Character-Length in mm.	Mersurement of Apterae	Mersurement of Alate	Degrees of Freedom	Value of 't'
6.	Segment III of Antenna.	0.360±0.047	0.408±0 032	38	0.766
7.	Rostrum.	0.880±0.050	0.886±0.028	38	0.091
8.	Ultimate rostral segment.	0.162±0.014	0.140±0.005	38	0.734
9.	Hind tarsus II.	0.157±0.007	0.154±0.010	38	0.101
10.	Cornicle.	0.259±0.012	0.196±0.010	38	1.913
11.	Cauda.	0.218±0.038	0.243±0.013	38	0.351

(Items marked with an asterisk* are significant).

1. Significant dimorphism exists in the alate and apterous virginoparae of *R. maidis* with regard to length of particular characters and are seasonal.

2. The total length of the body and of the rostrum exhibit dimorphism in two seasons, namely, summer and rain.

3. Dimorphism with regard to the total length of the antenna occurs only in the winter and in no other season.

4. Dimorphism in the length of the cornicle occurs in the rainy season only.

5. Maximum dimorphism, that is, dimorphism in three characters, length of body, rostrum and cornicle, out of eleven characters taken into account, occurs in the rainy season.

6. Minimum dimorphism, that is, dimorphism with regard to one character, namely, the total length of the antenna occurs in the winter.

7. Dimorphism does not occur in any season with regard to the length of head, processus terminalis, base VI of antenna, segment III of antenna, hind tarsus II and cauda, implying thereby that these are constant in both alatae and apterae in all seasons.

MATERIAL AND METHODS

Culture of *R. nymphaeae* was maintained in the laboratory at 27±1°C and 65±2% RH and 16 hour photoperiod on lotus leaves. Ten glass petri dishes about 17 cm in diameter and 2.5 cm in depth, were oil painted with nine different colours in equal areas, viz., violet, indigo,

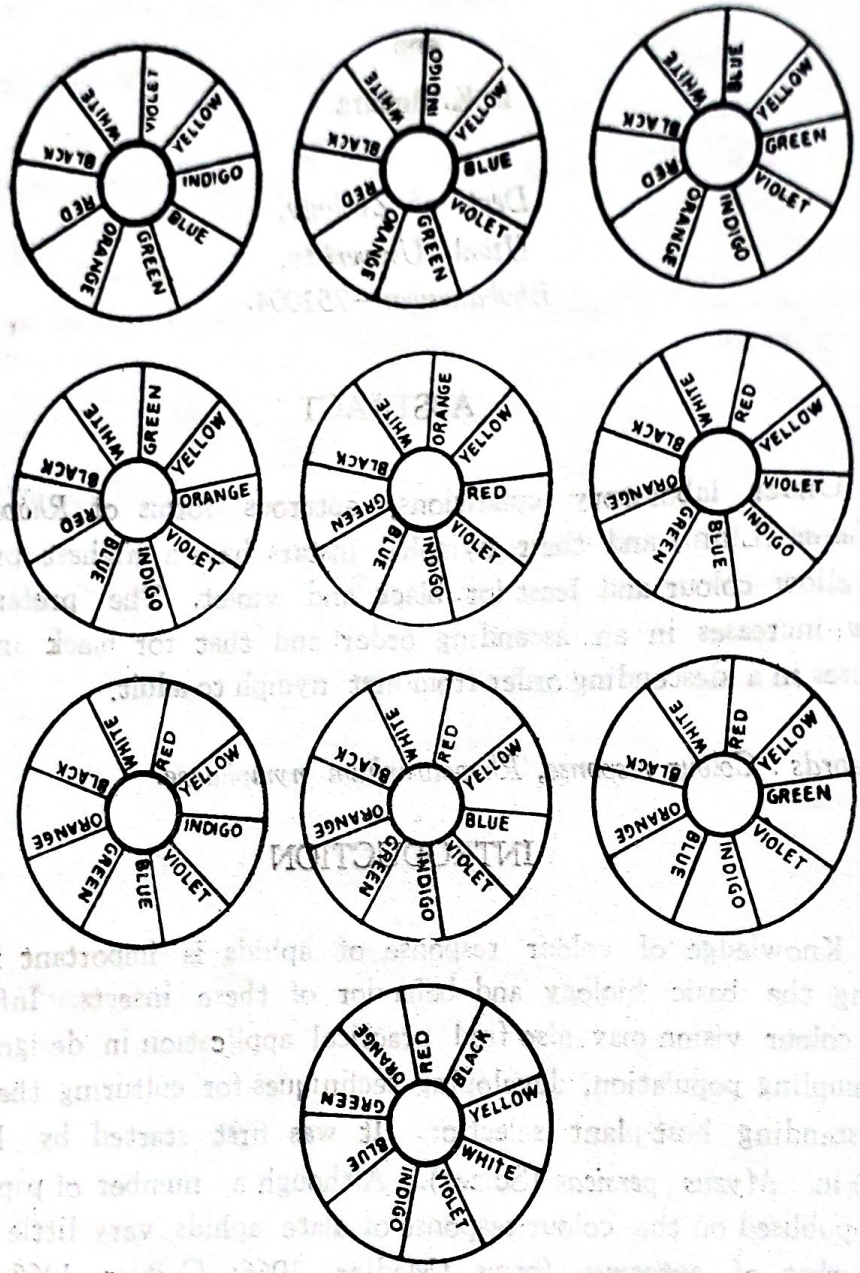

Fig. 1 - *Diagramatic representation of ten petridishes coloured with nine different colours in ten different combinations.*

blue, green, yellow, orange, red, black, and white and were arranged in ten different combinations as shown in Fig. 1. The central portion

and small portions of coloured areas adjacant to the central portion were kept-gum free for aphid's free movement and the rest was smeared with gum. One hundred aphids of any particular stage were released into the centre by means of a fine brush. Aphids were found moving to different coloured areas and the result was recorded after 6 hours. This was repeated for all stages of the aphid.

RESULTS

Fig. 2 shows the colour preference of lotus aphid and its nymphal instars. All stages have the highest preference for yellow and the

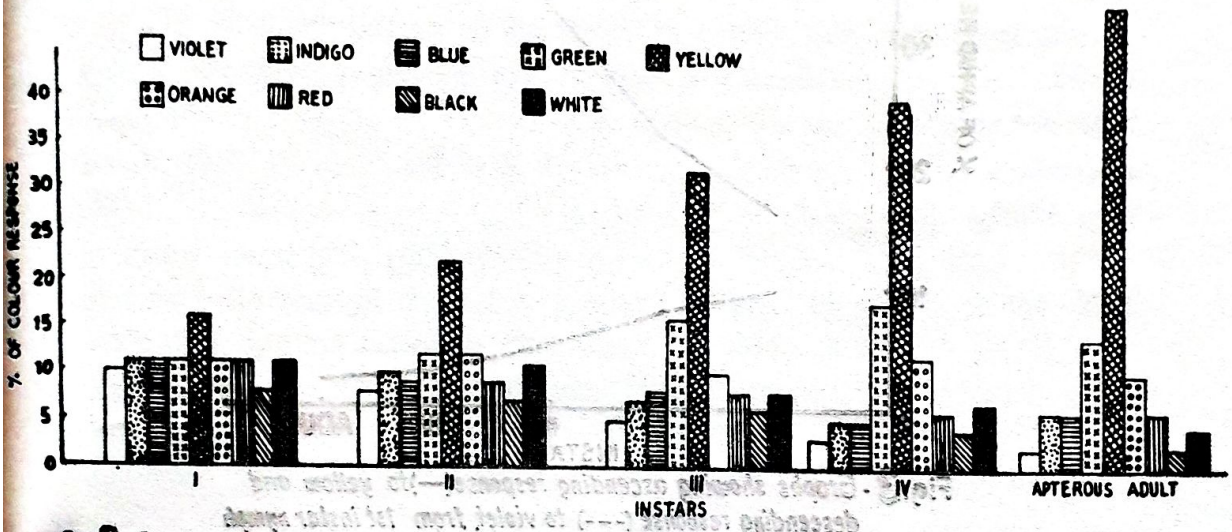

Fig. 2- *Response to different colours by nymphs and adult of Rhopalosiphum nymphaeae (Linn.)*

least for black and violet. The preference for yellow increases in an ascending order from 1st instar to adult. Similarly, attraction for black decreases in a descending fashion from 1st instar to adult (Fig. 3). Very interestingly the adult as well as all nymphal instar are attracted towards yellow irrespective of the colour arrangement in the petri dishes. It was also noted that aphids were found in maximum number in yellow when it is nearer to black and violet. The following shows the colour preference of the aphid and its instars :—

1st— yellow>green>white>orange>red>blue>indigo>violet>black

2nd— yellow>green>orange>blue>red>white>indigo>violet>black

3rd— yellow>green>orange>blue>red>indigo>white>violet>black

4th— yellow>green>orange>white>blue>indigo>red>violet>black

Adult— yellow>green>orange>white>blue>indigo>red>violet>black

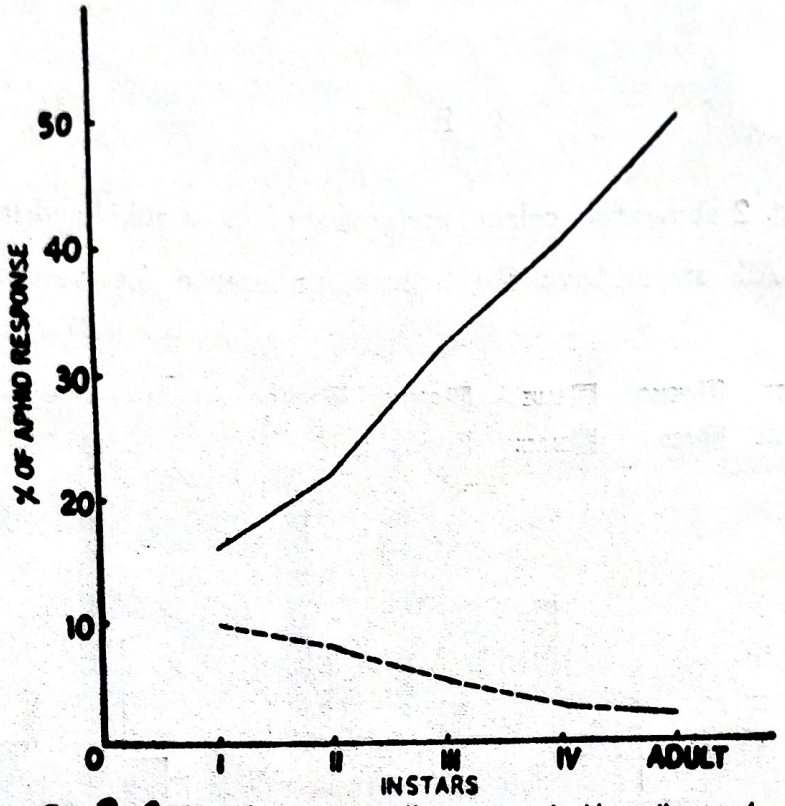

Fig. 3 - *Graphs showing ascending response(—)to yellow and descending response (---) to violet from 1st instar nymph to apterous adult of R. nymphaeae*

DISCUSSION

The highest preference of all stages of *R. nymhaeae* towards yellow is in general agreement with the results of Moericke (1952), Kieckhefer *et al.* (1976); and Behura and Bohidar (1983). This aphid also is attracted to white but in less number, which conflicts Moericke's (1955C) substantial evidence of repulsion by white. Broadbent (1948), and Lippold *et al.* (1977) have recorded more aphids on white than other colours.

After reviewing, Taylor and Palmer (1972) concluded that aphids feeding on dicotyledonous plants are more attracted to yellow. But their observations are based mainly on field study where the spectral and light intensity were usually not consistent. Eastop (1955) has shown that response of *Rhopalosiphnum maidis* (Fitch) to yellow varies with intensity of sun light.

The present result with *R. nymphaeae* showed decided preference for yellow and this is consistent through all the instars. Differences among the mean number of aphids responding to the preferred colour and that on other colours are highly significant ($P<0.01$) but differences among numbers under colours other than the preferred ones were usually not significant ($P>0.05$), a result fairly agreeing with the findings of Kieckhefer *et al*, (1976) and Behura and Bohidar (1983).

In this connection it has been suggested that prominent among 'yellow sensitive' aphids are the heteroecious species alternating between dicotyledonous herbs in summer and trees or shrubs in Autumn-winter (Lamb, 1958) to which agrees *R. nymphaeae*. The aphid's colour preference will help them to migrate to the right kind of plant, herb against tree or vice-versa at the right season, owing to seasonal alternation in the relative yellowness of these two kinds of foliage. However, colour alone is not the only criterion in this selection. More attention needs to be paid to the interacting role of hue, tint and intensity as investigated in Homoptera by Moericke (1969) and Vaishampayan *et al*, (1975).

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Pranikee, 6 : 65-70 (1985)

A PRELIMINARY REPORT ON THE SOMATIC CHROMOSOMES OF THE TREE FROG *POLYPEDATES MACULATUS* (GRAY, 1834) (ANURA : RHACOPHORIDAE) FROM BHUBANESWAR.

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ABSTRACT

A study of somatic chromosomes from the tail tip of tadpoles of *Polypedates maculatus* (Rhacophoridae) showed that the diploid number is 26. There are five large pairs and eight small pairs of chromosomes. Chromosomal formula is n=12 m+1 Sm. There is no heteromorphic pair.

Key words : Karyotype, tree frog.

INTRODUCTION

The amphibian fauna of India consists of 9 families, 32 genera and 184 species (Dutta, 1985). Several reports on the chromosomes of Indian anurans have been published (Manna and Bhunya, 1966 ; Natarajan, 1957 ; Chakrabarty and Banerjee 1984 and Singh, 1974). The present communication provides the information on the mitotic chromosomes of the Indian tree frog *P. maculatus.*

MATERIALS AND METHODS

The egg foams were collected from nature and reared in the laboratory following procedures standardised by Mohanty-Hejmadi (1977). Tail tip chromosomes were prepared following the squashing method of Bogart (1972). Karyotype analysis was done and the nomenclature of the chromosome was done following Levan *et al* (1964). The idiogram was constructed taking the chromosome pair, relative length and centromeric index.

RESULTS

From a study of 25 metaphase spreads, the diploid chromosome number has been determined to be 2n=26, N. F. =52 (Fig. 1). The

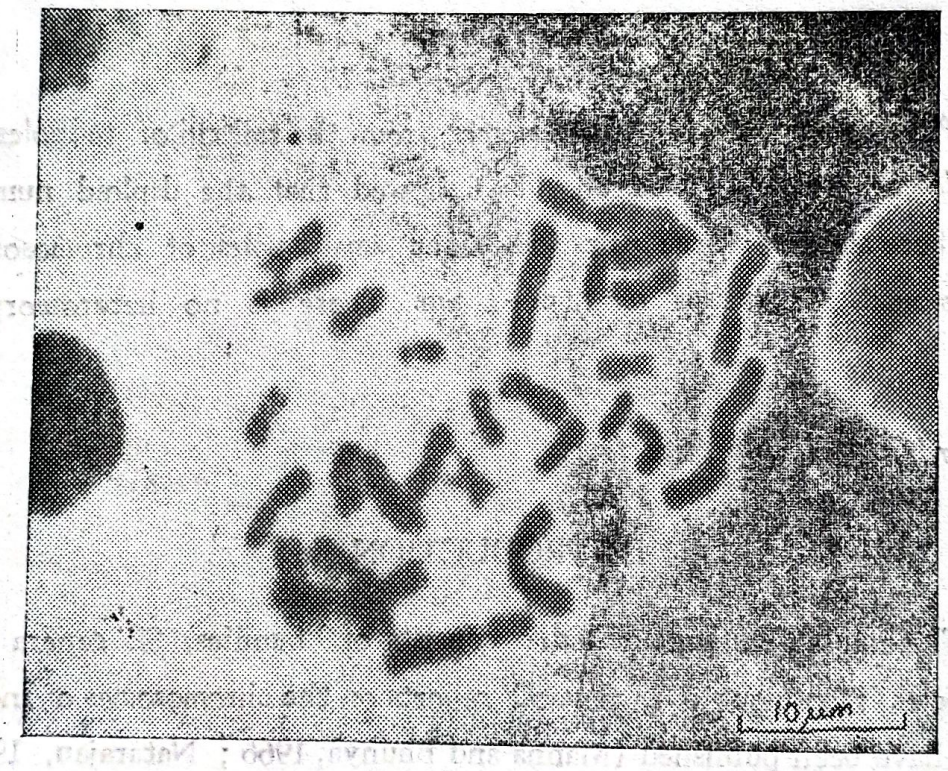


Fig. 1. Metaphase plate of mitotic chromosomes of *Polypedates maculatus* (X 1000)

chromosome can be categorised into 2 groups. Group I consists of 12 pairs of M-type and group II has 1 pair of Sm type (Fig. 2). The relative length ranges from 13. 18 ± 0.597 to 3. 18 ± 0. 139 (Table 1). The largest

Table-1 Morphometric data of the chromosomes of *Polypedates maculatus*.

Pair No.	Relative length (% of TCL)	Centrometic Index (I^c)	Type
1.	13.18±0.597	45.02±1.182	M
2.	11.34±0.484	34.2 ±1.789	SM
3.	10.86±0.377	42.18±3.064	M
4.	10.3 ±0.437	42.90±1.260	M
5.	8.9 ±0.401	47.08±1.258	M
6.	7.25±0.457	50 ± 00	M
7.	6.35±0.216	48.5 ±1.44	M
8.	5.99 ±0.104	47.78±1.456	M
9.	5.866±0.264	50	M
10.	5.48 ±0.139	50	M
11.	4.80 ±0.415	50	M
12.	4.32 +0.241	50	M
13.	3.18 +0.131	50	M

M=Metacentric : Sm=Submetacentric

chromosome is 4 times larger than the smallest one. The TCL has been determined to be 34. 2 μ. The idiogram shows the relative lenghth and

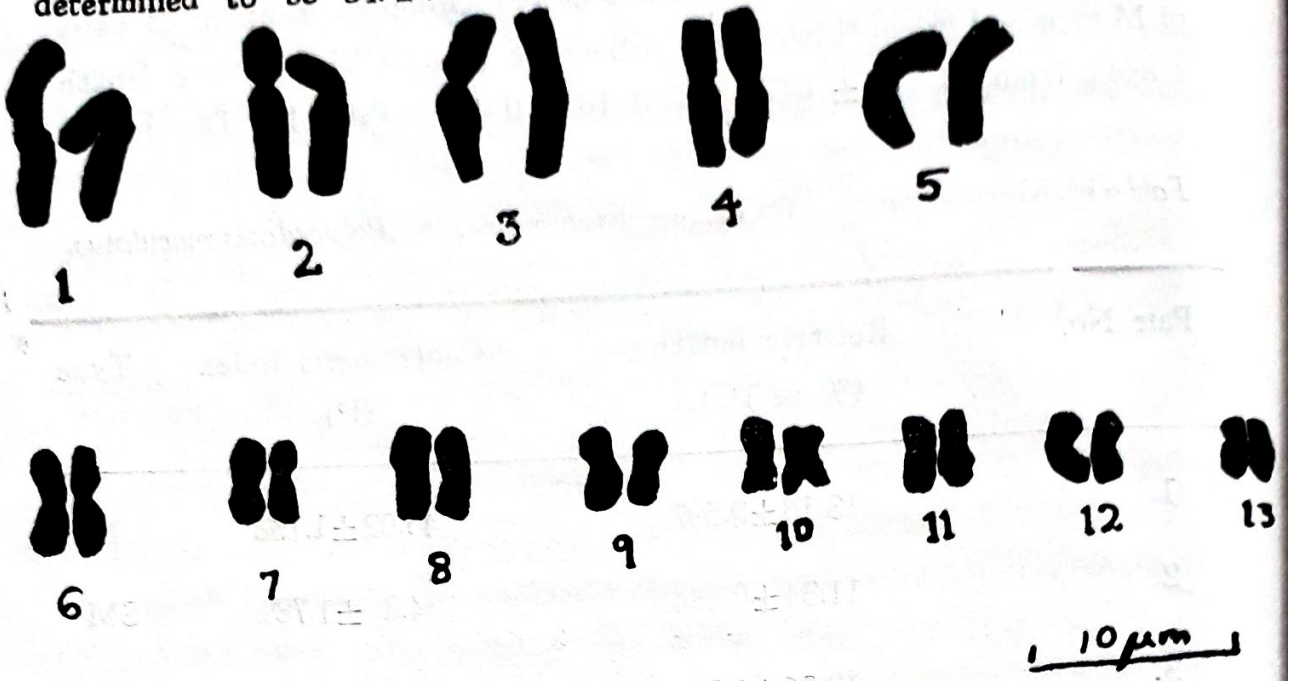
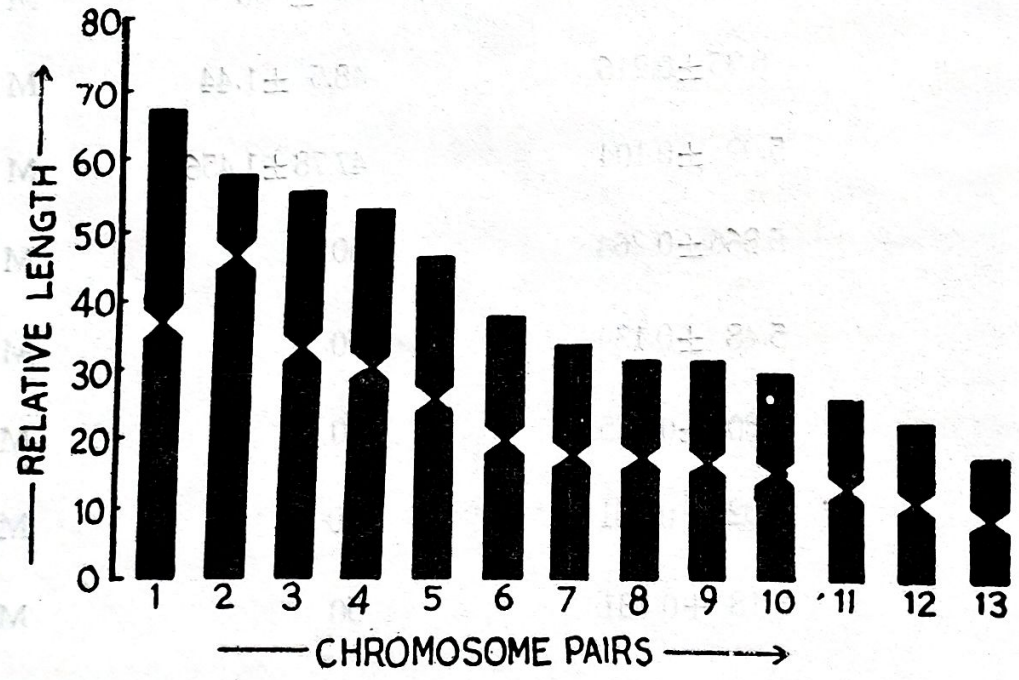


Fig. 2. Karyotypes of *P. maculatus* (X 1000)

centromeric index of the respective chromosome pair (Fig. 3). By the conventional squashing and staining technique, no heteromorphic pair could be recognised.



t.c.3 Idiogram of Polypedates maculatus

DISCUSSION

The diploid number of *P. maculatus* chromosome has been reported as 26 (Natarajan, 1957 ; Singh, 1974 ; Morescalchi, 1973, Chakrabarty and Banerjee, 1984). The present study confirms that the diploid chromosome number of *P. macnlatus* to be 26 with five large and eight small metacentric chromosomes (Natarajan, 1957 ; Chakrabarty and Banerjee, 1984 and Singh, 1974). From the five large pairs, 1 pair is submetacentric and rest are metacentric. The present status of sex chromosome of *P. maculatus* in not known. Chakrabarty and Banerjee (1984) could not find any hetermorphic pair by C-banding technique. Singh (1974) could not find any sex chromosome autoradiographically. Sex chromosome also could not be discerned in the present study.

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Pranikee, 6 : 71-74 (1985)

DEVELOPEMENTAL DEFECTS IN THE SEA TURTLE *LEPIDOCHELYS OLIVACEA*.

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ABSTRACT

Developmental defects in the olive ridley sea turtle *Lepidochelys olivacea* is described.

Key words : *Developmental defects, sea turtle.*

INTRODUCTION

Abnormal development of reptiles has received little attention (Ewert, 1979). However, it has been reported that in marine turtles the frequency of occurrence of abnormal embryos and hatchlings is very low. Mc Ghee (1979) has reported O. 6% and Blanck and Sawyer (1981) have reported 1% defect during embryonic development in the loggerhead *Caretta caretta*. The common malformation is the variation in scale patterns (Carr, 1952; Hughes, 1970). Other malformations include disproportionate growth of limbs, crumpled neck with reduced carapace, depigmention of eye, malocclusion of jaws and deformation of head. Although several workers (Crastz, 1982; Mc Coy, 1983; Mohanty-Hejmadi *et al*, 1985) have described the development of the olive ridley *L. olivacea*, no reports are available on the frequency or nature of malformations for this species. During the study of embryology and development of *L. olivacea*, several malformations were observed which are reported here.

MATERIALS AND METHODS

Four clutches of eggs (a total of 503) were collected at Gahiramatha beach, Orissa, located at 20° 42 'N, latitude, 87° 5' E, longitude and were transported to the laboratory at Utkal University, Bhubaneswar, during the nesting seasons of 1984 and 1985. Out of these 128, 208 and 167 eggs were incubated in hot (33 +0.5° C), cold (28±0.5° C) and room (29–32 C) temperatures, respectively. The eggs were candled every week and the bad eggs were opened. The embryos were staged according to that of Yntema (1968) for *Chelydra serpentina*.

RESULTS

Table—1 FREQUENCY AND NATURE OF MALFORMATION IN *L. olivacea*.

Year	Condition of Incubation	Eggs Incubated (N)	Haemorrhaged Eggs (N)	MALFORMATION				
				Limb Deformities (N)	Eye Deformities (N)	Crumpling of Neck (N)	Head Deformities (N)	%of Malformation
1984	HOT	58	16	2	–	3	2	12.06
	COLD	98	10	–	1	4	–	5.10
	ROOM	80	5	–	–	2	1	3.75
1985	HOT	70	15	1	–	1	–	2.85
	COLD	110	14	–	1	3	1	4.54
	ROOM	87	18	2	–	4	1	8.04

(N)=Number

During candling, a total of 78 eggs showed haemorrhage. About 1% of the haemorrhaged eggs revived but the rest of the embryos died within two to four weeks of incubation. Although most of the hatchlings had 6 to 7 central scutes, 5% of the hatchlings had only 5 central scutes. One hatchling (0.33%) had only four central scutes with an elevated carapace giving it a hunchback appearance.

Five embryos (0.9%) which died before stage 22 Y (Yntema) had disproportionate forelimbs. Two of these had a long right forelimb with unusual digitation and a paddle-shaped left forelimb. Two embryos (0.39%) which died at stage 16 Y had depigmented eyes. Interestingly enough, five embryos were found dead before three weeks of incubation without any distinct cephalisation, out of which two had well developed tail processes. Seventeen embryos (3.37%) which died perinatally had a long, wide crumpled neck with reduced carapace. By stages 20-22 Y under normal circumstances the pigmentation of lateral laminae precedes that of marginal laminae, however, during the present study, some embryos developed pigmentation in the reverse order. No difference was observed in the percentage of abnormal development in the three temperature regimes.

DISCUSSION

As reported in the introduction the percent of abnormality reported in the sea turtles is very low. In the present study 5.76% abnormality was observed which is higher than that for the loggerhead (Mc Ghee, 1979; Blanck Sawyer, 1981). The incubation temperature dose not affect the frequency of malformation.

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FREE AMINO ACIDS IN THE HAEMOLYMPH OF MALE AND FEMALE *POECILOCERUS PICTUS* DURING EARLY LIFE : A QUANTITATIVE STUDY.

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ABSTRACT

In male and female *P. pictus* 13 free amino acids are detected. Marked sex specific defference in the concentration of free amino acids has been observed.

Key words : *Amino acid, haemolymph, Insect*

INTRODUCTION

The concentration of free amino acids in insect haemolymph is many times higher than that in human blood. The free amino acid concentrations found in insect haemolymph are unique and have been proposed as a taxonomic characteristic of the class (Florkin 1959). A considerable literature exists on the concentration of amino acids in insect haemolymph (Chen 1966; Schoffeniels and Gilles, 1970 ; Jeuniaux, 1971; Florkin and Jeuniaux, 1974). The amino acids in the haemolymph are known to depend on food, nutrition, growth, moulting, reproduction, sex and the physiological state etc. (Stephen and Steinhauer, 1963; Levenbook and Dinamarca, 1966; Whitmore and Gilbert, 1974; Barret and Friend, 1975; Nath and Shrivastava, 1980, 1981; Nath and Prasad; 1981).

This paper presents the quantitative data on free amino acids in male *P. pictus* during early life.

MATERIALS AND METHODS

Nymphs of P. *pictus* were collected from the field and reared in the laboratory on the plant *Calotropis*. Male and female adult insects of a particular age were used for experimental purposes. The haemolymph was collected by cutting the antenna or legs of the insects and proteins were precipitated with 95% ethanol in the ratio 1:4 and centrifuged at 6000 rpm for 30 minutes. The free amino acids (FAA), were dissolved in ethanol. The alcoholic extract was stored in glass stoppered tube in refrigerator for the analysis of free amino acids.

The presence of FAA was determined qualitatively using two dimensional descending paper chromatography, as described by Zweig and Whitaker (1971) and Consden *et al.* (1964).

For quantitative determination of different amino acids, the chromatogram was dipped in liquid paraffin blotted on filter paper and was scanned under a densitomer. Concentration was determined on the basis of conversion of optical density readings in terms of mg/100 ml of haemolymph from calibration curve using known amount of standard amino acids.

RESULTS

The free amino acids were estimated qualitatively and quantitatively in the haemolymph of P. *pictus*. The data presented in Table 1 show that 13 ninhydrin positive amino acids were identified.

These are cystine, cysteine, histidine, arginine, aspartic acid, serine, alanine, methionine, tyrosine, valine, proline, B-phenylalanine and glutamic acid. In male insects cysteine, histidine, aspartic, serine, B-phenylalanine occur to a greater extent in the haemolymph while methionine occurs to a less extent, cystine and proline occur only in traces. Valine, tyrosine, alanine and arginine are of moderate intensity. During one to three day period, there was a slight increase in histidine concentration but later it decreased. The same pattern was found with aspartic

acid, serine, alanine, glutamic acid and cysteine. The amino acids which increased considerably in concentration on the 5th and 7th day were, valine and arginine.

In females (Table-1), histidine concentration was comparatively less than that of males up to 3rd day, but later it increased substantially. On the other hand, aspartic acid concentration in female was very high in comparison to that of male during 1-5 day period. In contrast to males, arginine concentration in females was high from the beginning. Tyrosine concentrations was also higher in females than that in males. The concentration of valine was higher in females during 1-3 day period.

These fluctuations in the concentration of amino acids in the haemolymph are very common in insects as they are taken out at any time from the amino acid pool for the sythesis of proteins and returned back to maintain the normal composition of the haemolymph.

DISCUSSION

The presence of high concentration of amino acids (amino acedemia), is a characteristic feature in insects. The amino acids are in the state of flux in the haemolymph of insects i.e., they can be withdrawn from the haemolymph at any time and utilized in the synthesis of proteins.

Duchateau *et al.* (1952) reported 16 amino acids in *Locusta migratoria* while Dikshith *et al.* (1968) observed 19 free amino acids in the haemolymph of *P. pictus*. In the present study only 13 free amino acids could be separated in the haemolymph of *P. pictus*. Since Dikshit *et al* (1968) neither mentioned the age nor laboratory conditions under which the insects were reared the difference in the observation of Dikshit *et al* (1968) and the present study, may be because of difference in age, diet and other factors.

During the present investigation marked sex specific differences have been observed in the free amino acid contents of the haemolymph of male and female grasshoppers. It has been observed that histidine, serine, B-phenylalanine; cysteine were in higher concentration in males as compared to those of the females. On the other hand, aspartic acid, alanine, methionine, tyrosine, valine, glutamic acid and arginine were

Table-1. Free amino acids (mg/100 ml) in haemolymph of male and female

Amino acids	First day		Second day	
	Male	Female	Male	Female
Cystine	Tr	Tr	Tr	Tr
Cysteine	437.50	275.00	531.25	375.00
Histidine	425.00	312.50	425.00	143.75
Arginine	75.00	106.25	75.00	150.00
Aspartic acid	387.50	418.75	387.50	418.75
Serine	187.50	165.62	212.50	168.75
Alanine	68.75	96.87	187.50	206.25
Methionine	12.50	25.00	25.00	31.50
Tyrosine	68.75	187.50	162.50	293.75
Valine	90.62	212.50	62.50	168.75
Proline	Tr	Tr	Tr	Tr
B-Phenylalanine	156.25	140.60	312.50	312.50
Glumatic acid	106.25	287.50	318.75	296.87

Poecilocerus pictus

Third day		Fifth day		Seventh day	
Male	Female	Male	Female	Male	Female
Tr	Tr	Tr	Tr	Tr	Tr
687.50	687.50	375.00	375.00	168.75	375.00
437.50	293.75	331.25	437.50	293.75	437.50
150.00	293.75	175.00	250.00	293.75	22 .00
456.25	418.75	281.25	353.12	281.25	281.25
468.75	315.62	316.87	262.50	131.25	150.00
237.50	265.62	100.00	190.62	56.25	68.75
25.00	37.50	25.00	25.00	31.50	25.00
200.00	312.50	200.00	312.50	162.50	462.50
62.50	100.00	128.12	81.25	181.25	187.50
Tr	Tr	Tr	Tr	Tr	Tr
418.75	418.50	275 00	250.00	125.00	125.00
400.00	287.50	253.12	287.50	156.25	156.25

in higher concentration in females than in males. Majority of the amino acids were found in higher concentration in females in comparison to males. Nowosielski and Patton (1965) also arrived at a similar conclusion in house cricket. The high concentration of tyrosine in the haemolymph of female *P. pictus* can be accounted because of its utilization in the formation of chorion of the eggs.

In the present study, it has been found that high concentration of amino acids in both males and females occurs on the 3rd day. This is in agreement with the observations recorded by Treherne (1959), Benassi *et al.* (1961), Srivastava *et al.* (1961, 1962) and Nowosielski and Patton (1965). Decreased concentration of amino acids on the 5th and 7th day in *Poecilocerus* may be accounted on the basis of their utilization in sperm formation in males and egg formation in females.

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SHORT COMMUNICATION

BREEDING OF BLACK PANTHER, *PANTHERA PARDUS* AT NANDANKANAN BIOLOGICAL PARK, ORISSA.

The black panther, *Panthera pardus*, the melanistic variety of normal spotted panther is common in the humid forests of Burma and Assam and in the rain forests of the lower Himalayas and Western Ghats (Prater, 1971). It has been stated that production of melanism is increased when there is combination of high temperature, excessive humidity and reduced light. The spots in the black panther though obscure, were still visible on close observation in good light. Observations in captivity indicate that black specimens are usually bigger in size and appear to be more cunning than their spotted counterparts. Black panthers are rare both in the wild and in captivity. Hence attempts were made to breed them in captivity at Nandankanan Biological Park, Orissa; after procuring one four-year old zoo-born male black panther from Assam State Zoo, Gauhati; in October, 1972.

This male black panther was mated with two normal coloured pantheresses named "Spotty" and "Rupa"-both procured from the forests of Phulbani District, (Orissa); as young specimens and reared in captivity.

As a result of these matings, the pantheress "Spotty" gave birth to the cubs in three litters, all with normal spotted coat colour like the mother. But interestingly the pantheress "Rupa" gave birth to eight cubs in four litters, out of which four were black and the rest four normal coloured.

These two breeding experiments suggest that the pantheress "Spotty" was having homo-zygous normal coat colour whereas the pantheress "Rupa" was having heterozygous normal coat colour with a gene for black coat colour. This also indicates that one of the parents of "Rupa" in the wild must have been black.

Unfortunately, the male black panther procured from Gauhati died in December, 1976. Therefore, breeding of black panthers was practised in the park between zoo-born specimens utilising both black and heterozygous normal coloured panthers having a gene for black coat colour. So far 20 black panther cubs were born including one litter of six black panther cubs. The breeding experiments indicated that :

(i) mating of black coloured pantheress with black coloured panther always resulted in the birth of black coloured cubs only.

(ii) mating between heterozygous normal colouredpanther and black panther resulted in the birth of both colour phases—normal colour and black colour.

(iii) mating of homozygous normal coloured pantheress and black panther resulted in the birth of normal coloured cubs only.

Besides, earlier breeding records between homozygous normal coloured pantheress and panther showed the birth of only normal spotted coloured cubs.

Prater (1971) states that both black and normal coloured panther cubs may be produced in the same litter. Crandall (1965) states that captive pairs in which both animals were black have produced only black young and no black young have been born to spotted parents. He further states that late *Axelreventlow* once told him that a pair of leopards in the Zoological Gardens of Copenhagan, one spotted and the other black, bred cubs of both colour phases. Black leopards mating with black invariably produce black cubs but black mating with normal coloured will produce both kinds of cubs (Gee, 1964).

A pair of zoo-born black panthers of this park were supplied to National Zoological park, New Delhi in March 1980 ; and one male black panther was supplied to Vandalur Zoo, Madras in October, 1985. At present there are six black panthers (2 males+4 females), all born in the park. The breeding results thus confirm the earlier occurrence of black panther in the forests of Phulbani district (Orissa). It is hoped that more black panthers can be bred successfully in the park to meet the increasing demands of the Zoological parks of the country.

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APPEARANCF OF TUSKS IN MALE INDIAN ELEPHANT (ELEPHAS MAXIMUS)

One male baby Indian elephant (*Elephas maximus*) with an estimated age of about four months, was received at the Nandankanan Biological Park, Orissa on 28.4.1967. There was no trace of tusks at the time of receipt. The tusks cut through the gums for the first time on 2.5.1968 (left) and 20.5.1968 (right). In May, 1969 the projecting tusks measured 9 cm (left) and 8 cm (right), respectively. It died on 4.4.1970 at an estimated age of about 3 years and 3 months.

Another male baby elephant with an estimated age of about one month was received in the park on 19.3.1979. No tusks were visible at the time of receipt. The tusks erupted for the first time on 22.10.1980 (left) and 1.12.1980 (right), respectively. On 20.3.1983 each of the exposed portion of the tusks measured 16 cm. On 18.8.1984 the tusks measured 24 cm (left) and 25 cm (right), respectively. By frequent rubbing against wall and trees the tusk tips were sharpened.

These two observations suggest that the tusks in male baby Indian elephant erupt at an estimated age of 16-21 months. At least upto an age of five years and six months the tusks are neither shed nor renewed. In the first two years the tusks grew at the rate of approximately 8 to 9 cm per year and in the subsequent years it grew at the rate of approximately 6 cm per year.

An elephant calf of $4\frac{1}{2}$ feet tall and aged aproximately two years in Corbett National Park had a pair of tusks measuring 6 to 8 inches (Lamba, 1975). Ali (1977) from his field experience is of the opinion that an elephant calf is born with tusks (concealed) that are seldom shed in males and continue to grow throughout its life span. The tusks of the male elephant calf show almost from birth, they are never renewed and the tusks are permanent (Sanderson, 1878). Basing on the informations collected from experienced Forestors, Karens and Burmese; Evans (1910) states that the tusk in male elephant are not shed, though he was told of one or two instances where the milk tusks were shed and renewed.

Sanderson (1960) states that tusks in males of both *Loxodonta* and *Elephas* show at birth and are not replaced. The present observations indicate that tusks are concealed at birth and erupt at an age after the first year but before the completion of the second year.

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CLASTOGENICITY TESTING OF A PROCESSED TOBACCO, KHAINI (LIME MIXED) IN THE MEIOTIC CHROMOSOMES OF A GRASSHOPPER, CROTOGONUS TRACHYPTERUS

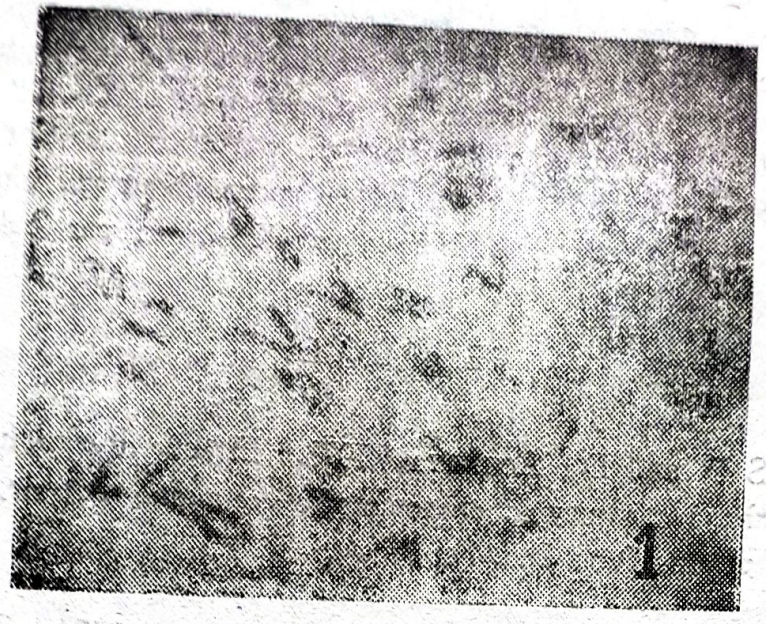
Large number of people of tropical countries are addicted to a variety of processed and raw tobaccos. The powdered raw tobacco leaves with lime is popularly known as "Khaini". Large number of people of Bihar and Uttar Pradesh are Khaini users. The main ingredient of Khaini is "Nicotine". Almost nothing is known about the physiological activities of Khaini and so also the mutagenicity.

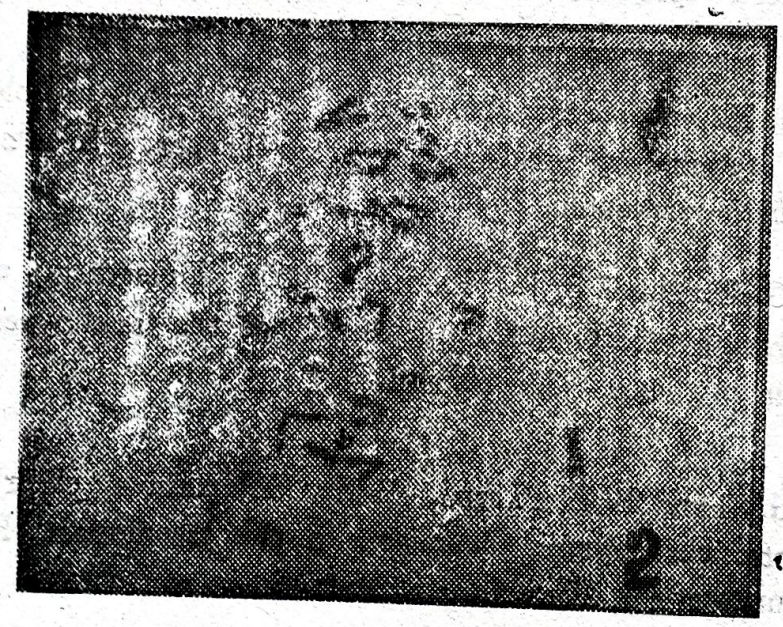
Records on chemically induced spermatocytic chromosome aberrations of grasshoppers are very limited. During last two decades some work has been done in this line (Yosida, 1950; Sarkar, 1958, Manna and Mazumdar, Manna and Parida, 1965 a and b, 1966, Bhunya, and Acharya. 1973; Bhunya, Parida and Ghosh, 1974). However, mutagenicity of lime mixed "Khaini" is not at all known. Considering all these studies on "the clastogenicity of Khaini in the insect test system" have been carried out in the present project.

An aqueous extract of Khaini was prepared by soaking Khaini in 100 ml distilled water for one hour. Then the mixture was filtered and the filtrate was used for treatment. In the present study 1% and 3% extracts were used. Each individual of commonly available grasshopper, *Chrotogonous trachypterus* was injected with freshly prepared Khaini extract at the rate of 0.05 ml. The specimens were sacrificed after 6 hours exposure. The cytological slides from the testis material were prepared following Smith's technique (1943) modified by Manna and Talukdar (1964).

In grasshoppers receiving the vehicle only (control), a total of 213 cells of different stages were examined and aberrations like that of the treated series were not observed.

In the treated series, chromosomal anomalies like stickiness, centromeric stretching, chromatin bridge, laggards, break etc., were observed (*Figs. 1, 2*). In the diplotene stage anomalies like chromatid and chromosome breaks were observed. At Met-II stages physiological defects like stickiness of chromosome were observed. Aberrations like





pseudo-bridge formations, laggards, centromeric stretchings and centromeric fission were observed in Ana-I. In Met-I and Ana-II, no aberration was observed. The frequency of aberrations was about 3.12% and ana-I and met-II cells were found to be more sensitive.

In the present investigation the aqueous extract of "Khaini" induced some chromosomal injuries including centromeric stretching. Anomalies like sticky-bridge and pseudo-bridge formation indicate that the chemical acted upon the protein moiety of the chromosome. Break type aberration indicates that the chemical directly affected the DNA. It is evident that the aqueous extract of "lime mixed Khaini" induced both genotoxic and cytotoxic effects. Such types of effects warrant the cautious use of this type of raw tobacco. It is further envisaged that certain percentage of oral cancer among 'Khaini' users might have some linkage with some typs of genotoxic property of the chemical. Detailed research in this line will reveal more about the mutagenic property of tabacco in general and lime mixed Khaini in particular.

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CLASTOGENIC EFFECT OF A METALLIC SALT, NICKEL NITRATE ON THE SPERAMATOCYTIC CELLS OF A GRASSHOPPERS, *SPATHOSTERNUM PRASINIFERUM*.

Metallic salts especially the heavy metals like lead, cobalt, mercury have been reported to be not only teratogenic but also mutagenic (von Rosen, 1954, 1957; Sharma and Sharma 1960). In recent times nickel poisoning has also attracted the attention of biomedical researchers. The present paper reports the effect of nickel nitrate, $Ni(NO_3)_2$, on the spermatocytic chromosome of a grasshopper, *Spathosternum prasiniferum*. Each adult male of *Spathosternum prasiniferum* was injected intra-abdominally with freshly prepared 2% and 4% of $Ni(NO_3)_2$ aqueous solution at the rate of 0.05 ml. The specimens were sacrificed after 6, 12 and 24 hours of exposure. The tissue processing and slide preparations were done according to the method of Smith (1943).

Control Series : For comparing the effects in the treated series, parallel controls were made following the injection of equal volume of distilled water. In this series out of total 100 cells studied, not a single case of true break or gap type aberration was observed.

Treated Series : In this series during the course of observation, the aberrations could be ascertained from diplotene onwards. At diplotene chromosome type break, gap; chromatid type break, gap; centromeric stretching and stickiness were observed. At diakinesis chromosome type gap, break and chromosome stickiness were observed. Aberrations like chromosome type gap and break, chromatid type break, centromeric stretching and constriction were observed at metaphase I cells. At anaphase I cells, aberration like sticky bridge and laggards were observed.

In some rare cells, the dissolution of spidle fibre was also observed (Photo3). In metaphase II cells only anomalies like chromatin stretching and stickiness were recorded. The erosion of chromatin material was also observed in some rare metaphase II cells. Aberrations like sticky bridge and laggards were observed in anaphase II cells. While considering the frequency percentage of aberrations induced by the chemical, it has been recorded that 2% and 4% solutions induced 2.3% and 3% aberrations, respectively.

Some heavy metals like lead and mercury etc. have been reported to induce chromosome aberration in plants (see Sharma and Sharma, 1960). Mutagenicity of metals like lead and arsenic also have been reported in individuals exposing to it by Nordenson *et al*, (1978). Similarly metallic salt like aluminium chloride was also found to be clastogenic in mouse by Manna and Das (1972). Parida *et al* (1972) also reported calcium chloride induced chromosome aberration in grasshopper, *Spathosternum prasiniferum*. Bhunya and Sahoo (unpublished) have also reported lead induced chromosome aberration in mouse bone marrow and Bhunya and Samal (1982) have observed chromosome aberration in grasshopper, *Oxya velox* induced by copper salt. von Rosen (1954 & 1957) classified the radiomimetic substances under the halogen series, strong and weak metals. Among these metals, the Nickel has strong radiomimetic actions.

In the present study, the effects like choromatin stretching, stickiness and erosion of the chromatin material reveals that the chemical has acted upon the protein moiety of chromosome. The chemical also has acted upon the heterochromatic part of the chromosome since centromeric stretching has been observed. Aberrations like breaks and gaps indicate that the chemical also acted upon DNA. Since gap and break type aberrations have been produced by the chemical, it is suggested that Nickel is genotoxic in the present test system and its use should be restricted.

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BOOK REVIEW

THE APHIDS, Edited by B. K. Behura, 1983 (Available from The Zoological Society of Orissa, C/o Post-Graduate Department of Zoology, Utkal University, Vani Vihar, Bhubaneswar 751004, Orissa, India) pp 440+6+vi, India Rs. 150.00+ Postage and forwarding Rs. 15.00; Foreign $ 20+$ 5 (Postage & forwarding by surface mail).

The volume under review is a collection of sixty papers on various aspects of aphids, viz, ecology, zoogeography, morphology, anatomy, developmental biology, cytology and role in agriculture which were presented in a four-day national symposium on "Recent trends in aphidological studies" held at Bhubaneswar in 1979.

Aphids play a vital role in agriculture due to the damage they cause to crop plants, fruit trees and vegetables, etc.; by sucking the sap and in transmitting viral diseases. The yield loss due to the mustard aphid, *Lipaphis erysimi* (Kalt.) alone, to the variety of *Brassica* ranges from 8.9 to 77.5 per cent. The loss in grain yield in barley due to the attack of *Rhopalosiphum maidis* (Fitch) ranges from 3 to 68 per cent in different commercial varieties.

The publication will serve as an important reference book to Indian workers on plant lice as it contains papers in various aspects of the work that is being carried out in the country.

INSTRUCTIONS TO AUTHORS

Manuscripts should be typewritten, double spaced, in English. Tables should be typed on separate pages. Illustratrions should not be larger than 22 × 28 cms ($8\frac{1}{2} \times 11$ inches). Reference to literature should be alphabetically arranged under author's name in the following format.

Gould, S. J., 1977—Ontogeny. Belkamp Press, Cambridge, Mass.

Martin, R. F., 1972—Evidence from osteology, pp. 37-70, In : Evolution of the genus Bufo. W. F. Blair (eds.). Univ. Texas Press, Austin, Texas.

Pierce, B. A. and H. M. Smith, 979—Neoteny or paedogenesis ? J. Herpetol. 13 : 119-121.

Two copies of the manuscript with an abstract should be sent to :

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