PRANIKEE

Volume II 1981

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BRIEF HISTORY :

Pranikee, the annual journal of the Zoological Society of Orissa, publishes original research articles on Zoology.

The Society was founded in 1958 in order to promote effective communication between Zoologists through its publication, seminars and annual meetings.

MEMBERSHIP AND SUBSCRIPTION :

Membership is open to anyone interested in Zoology. Regular dues are Rs.5.00 (life membership Rs.60.00). All enquiries about membership should be addressed to the Secretary by designation.

PRANIKEE

Journal of
ZOOLOGICAL SOCIETY OF ORISSA

Post-Graduate Department of Zoology
Utkal University
Bhuhaneswar-751004

Volume II 1981

PRANIKEE

Journal of the Zoological Society of Orissa

Abbreviation : *Pranikee*

Vol. 2 | 1981 | Pages 1-80

CONTENTS

SHORT COMMUNICATION

The Zoological Society of Orissa published the first volume of the journal in 1980 which contained articles and seminar papers by students and staff of the Departmnt of Zoology.

This second volume is more in the line of a scientific journal. The first five papers were presented in the symposium on the "Role of Zoology in rural development" held from 13th to 15th February, 1981, at Patia village, a few kilometers from Bhubaneswar under the auspices of the Zoological Society of Orissa. The rest are papers based on original research.

A lot of people wanted to know about the peculiar creature (emblem) on the cover page of the journal. Therefore, I have written about its significance in this volume.

The financial aid for the publication has been provided by the Director of Public Instructions, Orissa; State Youth Welfare Board, Orissa; Utkal University and Zoological Society of Orissa.

P. Mohanty-Hejmadi
Editor

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 paintings. 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 form 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 "stylzied 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. Mohanty-Hejmadi

Editor

Pranikee, 2 : 1-5 (1981)

ROLE OF PISCICULTURE IN RURAL DEVELOPMENT OF INDIA AND ORISSA

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INTRODUCTION

Pisciculture has made considerable progress in the country in the last decade and many workers have claimed high production of sweet water fish from one hectare of water area by intensive fish production. The fish production per hectare per annum may reach as high as 3 to 4 tonnes (Alikhuni *et al*, 1971; Lakshmanan *et al*, 1971; Singh *et al*, 1972). But a production of 2.5 tonnes per hectare is generally possible (Mishra, 1980), provided all the pre-requisites are available at the farm site. The Cental and State Governments have also taken various steps to provide the different prerequisites to encourage pisciculture by the people in the rural areas, where water areas are generally utilised for growing fish. The present inland fish production of the Country is about 800,000 tonnes per annum from the various inland resources such as tanks, ponds, lakes, canals, reservoirs and rivers. This production is not satisfactory considering the vast water areas available for pisciculture and the expected yeild by intensive pisciculture. Therefore, the rich inland resources in the country require careful planning to increase the production at optimum level to improve the socio-economic conditions in the rural areas.

Rural conditions in India and Orissa :

Although there are big cities and towns in India, it is mainly a rural country. India is full of villages and the total number of villages in the country is about 576,000. About 75% of the population of the country live in the villages.

The economy of the villages is dependent on various factors. The richness of the natural resources such as land or water governed by soil

conditions, climatic conditions, availability of labour and capital, are the important factors responsible for production. If we consider pisciculture, importance is given to the availability of water areas. Water areas for pisciculture are generally available in most of the country except the arid regions like Rajasthan. The fertility of the water area can be increased by scientific methods. Labour in rural areas is easily available. It is generally acknowledged that there are not adequate opportunities in our rural areas to earn a wage and many labourers migrate from the rural areas to the urban areas to find employment. Capital which includes money and capital goods such as machinery, equipments, roads, etc., are not adequate in the rural areas and these items are to be provided to step up production. Water areas are to be reclaimed, fertilised, stocked with fish seeds and provided with artificial feeds for fish production. Money is to be invested to convert water areas to production of fish.

In Orissa there are about 51,639 villages and 80% of the population live in rural areas. Water areas and labour are plenty in the villages, but capital investment is necessary for fish production.

Main steps for Intensive fish production :

The fish farm which consists of nursery, rearing, stocking and marketing tanks,should be located in properly selected site where there is availability of water throughout the year. The water retaining capacity of the soil and the drainage system should be satisfactory. When single pond or tank is used for fish production, the availability of water, water retention of the soil, and the drainage system are to be considered for effective pisciculture. Manures and fertilisers are usually applied in proper proportion for removal of the predators and satisfactory growth of planktons and other food items of the fish. Wherever possible, poisons and insecticides are used with caution to remove the predators.

In general, fingerlings of rohu (*Labeo rohita*), bhakur (*Catla catla*), mirkali (*Cirrhina mrigala*), common carp (*Cyprinus carpio*), silver carp (*Hypopthalmichthyes molitrix*) and grass carp (*Ctenopharyngodon idella*) are stocked in fish ponds in various combinations. The fingerlings are generally 10 to 20 cm to get high production. Since transport of fry and fingerlings is risky and many a time good quality fish seeds are not supplied, the induced breeding of some fishes can be practised by fish farmers if they are properly trained. The author conducted induced breeding experiments in all the districts of Orissa and found that the production of fish seed from

rohu, common carp and mirkali by induced breeding method was successful from 80 to 90%. The induced breeding of bhakur was successful in about 40 to 50%. But the success of induced breeding of silver carp and grass carp was negligible and considerable patience and several trials are needed to spawn these fishes. Hence there should be a suitable agency to supply the pure fish seeds to the fish farmers. Particularly the supply of fish seeds of bhakur, silver carp and grass carp should be ensured. The garss carp seeds are in high demand, since it feeds on many emergent and submerged weeds such as *Hydrilla, Wolffia,* duckweeds (*Lemna* and *Spirodela*), *Azolla, Salvinia, Najas, Ceratophyllum, Vallisneria, Utricularia, Myriophyllum, Potamogeton, Spirogyra* etc. The common carp also feeds on few weeds such as *Caratophyllum, Myriophyllum,* filamentous algae and Pithophora and its fry are easily produced.

During intensive fish culture several supplementary feeds such as groundnut oil cake, mustard oil cake, rice bran, wheat bran are given and there is no difficulty to procure these materials in the rural areas. The cowdung which is frequently used as a fertilizer, is available in plenty in the villages. By artificial feeding the carps grow to about one kilogram in nine months and become suitable for marketing. For catching the fish durable nylon nets are required. Hence for proper itensive fish production various materials such as weedicides, fertilisers, fish seeds, artificial feeds, nets etc. should be available. People should be trained to conduct fish farming successfully. Production of sweet water fish upto 4 tonnes per hectare, has been claimed by various workers by proper feeding and selective manipulation (Alikhuni *et al,* 1971; Lakshmanan *et al* 1971, and Singh *et al,* 1972). But experience shows that a production of 2.5 tons per hectare is more realistic provided all the pre-requisites are available at the farm site (Misra, 1980).

Economics of carp culture :

The price of the materials required for inland fish culture is rising every year. At the same time, the selling price of sweet water fish is also increasing. The selling price of fish is dependent upon the selling price of other animal proteins such as mutton and chicken. It is generally observed that mutton and cut pieces of rohu or bhakur are being sold almost at the same rate per kilogram, although whole fish of rohu or bhakur per kilogram is cheper than mutton. It is assumed that the avarage selling price per kilogram of whole carp is about eight rupees only in the villages. One hectare of water area by intensive fish production can produce about $2\frac{1}{2}$

tonnes of fish per annum, the worth of which will be Rs. 20,000. The production cost will be about Rs. 8000/- per hectare when one owns a tank, but if one rents a tank it will be about Rs. 10,000/- per hectare. When one reclaims a swamp or excavates a new tank, then there will be additional cost of Rs. 3,000 to Rs. 6,000 per hectare. In the first year about Rs. 15,000/- will be required for the reclamation of the swamp per hectare and in case of excavation of a new tank at a suitable site per hectare about Rs. 25,000/- will be required. Generally a tank life time can be about ten years with suitable maintenance. Usually high interest is to be paid for loans from the bank. However if the prerequisites can be supplied at the farm site and a tank is available on long term basis, pisciculture can be economical even after incurring a loan from the commercial bank. The efficiency of the farmer and the social conditions of the area should also be satisfactory to take up pisciculture.

Pisciculture in Gramapanchayats :

The Gramapanchayat system of administration is prevalent in the country and the community tanks are owned by the Gramapanchayats. In Orissa also Panchayatraj is in operation according to which Gramapanchayat, Panchayat samiti, District advisory board are present for the village, block and district respectively. A Gramapanchayat consists of either one or more villages. It takes up various welfare work such as construction of road, water supply, construction of tanks, pisciculture, poultry, village industry and adult education etc. The State Government gave various aid to the Gramapanchayat for pisciculture, but it was not successful in many areas. Hence community tanks which can not produce satisfactory quantity of fish by the Gramapanchayats should be given to individual pisciculturist on long term lease basis to stepup production. Where Gramapanchayats are practising pisciculture successfully, they should be encouraged to take up further piscicultural progammes. Thus pisciculture at the village level can be operated by the Gramapanchayats or by the individual pisciculturists.

Fish and Nutrition :

The present population of the country is about 65 crores and population experts have estimated that the population of the country will be about 100 crores towards 2000 A. D. The requirement of animal protein per person in the country is about 35 grams per day, out of which fifty per cent will be met from the fish (Misra, 1979). In that case the requirement of

fish protein will be about 6.3 million tonnes for the country towards 2000 A. D. Although the present protein requirement of Orissa on the above basis is about 1.32 lakh tonnes (Misra, 1979), it will be about 2 to 2.5 lakh tonnes towards 2000 A. D. Emphasis shall have to be given to the culture of fish since marine fish production may not increase further due to high cost of production and non-availability of diesel.

If at village level pisciculture can be taken in one hectare water area per village, then in the country, four lakhs of villages can produce 10 lakh tonns of sweet water fish at the rate of 2.5 tonnes per hectare. Considering the wholesale rate of fish as Rs. 8/- per kg. the value of 1000,000 tonnes will be Rs. 800/- crores. In Orissa, if 30,000 villages can be utilised for fish production, one hectare per village, the sweet water fish production will be 75,000 tonnes, the value of which will be about Rs. 60/- cores. The sweet water fish production will generate considerable rural employment in the reclamation of the tanks, fry and fingerling trade, piscicultural practice, fish catching and fish marketing, in addition to the contribution of the protein supply to the people.

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Pranikee, 2 : 6-11 (1981)

GROW MORE FISH THROUGH CAGE CULTURE

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ABSTRACT

Cage culture of fish can result in fish production as high as 400 tonnes per hectare within a period of six months, as against the present highest production of 3 tonnes per ha/annum through the best khown fish culture methods. While in countries like Japan, U. S. A., Cambodia and Indonesia, fish culture in cages has risen to the level of highly paying commercial enterprise, it is yet an unknown industry in India, though, ample resources for its development do exist. The object of this paper is to create interest among the fish farmers in this new method of fish culture and to provide guide-lines on the subject.

INTRODUCTION

Recent fish culture advances through intensive culture practice have brought the level of production to about 3,000 kg. per ha/annum and in some cases as high as 9,000 kg. per ha/annum. These have indeed opened avenues for rural aquaculture development. Another new method yet unexplored in India, is the cage culture of fish, where the yield per hectare can be as high as 400 tonnes in about 6 months of rearing. Cage culture is a large scale commercial undertaking in Japan and U. S. A. where thousands of hectares are put to use in not only large standing fresh water bodies, but in sheltered bays and creeks. It is also being practiced on a limited scale in Cambodia and Indonesia.

A cage for fish culture is essentially a framed enclosure with meshes or holes small enough to prevent the escape of fish from within. The principle behind cage culture is to provide highest degree of care in fish stock management, by limiting the size of the culture medium while eliminating factors inhibiting growth and production associated with the reduction of the size of the culture medium.

The culture medium :

Aeration of water being the fundamental requirement for the success of cage culture, water areas with high levels of dissolved Oxygen and an efficient circulation system, are the ideal media for the cage culture. Under this category belong slow moving rivers or irrigation channels, enclosed bays and creecks, lakes, reservoirs and irrigation projects and large deep tanks.

The more extensive the water body, the better is the aeration as wind action enriches it with Oxygen to saturation levels. Constant ripples and waves help eliminate obnoxious gases by diffusion. From these considerations bays and creeks are nearly as ideal for cage culture as the running water of rivers and irrigation channels. The open bays are however, subject to high wave action. The fast running rivers or channels having ideal physico-chemical conditions for cage culture, do have a disadvantage in the vulnerability of the cages to damage. Besides, the loss of feed, artificially given to the fish is greater in lotic waters.

Conversely, small ponds rich in organic matter are unsuitable for cage culture, primarily because such waters are deficient in Oxygen content and a lot of harmful metabolites remain accmulated. The extensive swampy areas with decaying vegetation which are usually deficient in dissolved oxygen are unsuitable for cage culture for gill breathing fishes. If however, air-breathing fishes endowed with accessory respiratory organs are sought to be reared, no other environment could be more suitable.

The cage construction :

The second important requirement for cage culture operations is the construction of the framed enclosure or the cage proper. A cage for fish culture is a square or rectangular trough open on the top. The material for cage construction is required to be of sufficient tensile strength so as to withstand the stress and strain imposed on it by the wave and wind action, by accidental encounter with the boats and by two or more cages colliding in water. Besides it should be able to withstand the weight of the water and fish inside the cage. The cost and availability of the material in relation to the durability are the guiding factors in the selection of the construction material. From technical and economic considerations, bamboo is the best material under Indian conditions. A bamboo cage of standard dimension and specification in fresh water lakes or reservoirs is expected to last 3 to 4 years. Bamboo cages are used in Cambodia,

Indonesia and parts of Japan, though a variety of other materials like galvanised welded wires and nylon meshes are also in use. In Japan the cages made of other synthetic materials are also in use. The dimension of the cage would depend on the species of fish to be cultured, the number and the size of the fingerlings to be stacked, the duration of culture, the growth rate, total quantity of fish to be expected at the end of rearing period and the degree of handiness required. While very small cages would make the operations uneconomical, very large ones would render them unwieldy. A reasonable size for carp culture would be 4 m×3 m. In Japan the cages with 8--12 sq.m are preferred for carp, whereas in Cambodia the size of the cages range from 7m to 10m in length and 2.5m to 4m. in breadth. In Indonesia the standard dimension of the cages are 12′×4′.

The ideal depth of the cage for carps in Japan is 2m., whereas in Cambodia it ranges from 1.5m to 2m. for *Pangasius*. In Indonesia the depth of the cage is 2′. For culture in marine environment, a depth range of 3m to 5 m is preferred in Japan. The mesh size of the cage walls is another aspect which is determined by taking into account the minimum size of the fingerlings to be stocked and the amount of water circulation that the mesh size would permit. A mesh size of 1½″ is considered optimum for culture of carps below which water circulation is affected and above which fingerlings can escape. The cage is held by long bamboo poles. Commercial fish farm in Japan use steel frames for the purpose. The cages are kept afloat by a series of polythene floats or sealed empty drums. A depth of 3m of water is usually preferred for fixing standard size cages. To prevent them from drifting they are either tied to the fixed pegs on the ground or held by anchors of stone weights in deeper waters.

The top of the cage is left open to facilitate aeration and in order to prevent the fish from escaping, a piece of closeknit webbing about ½ m in width is fixed all round the cage externally vertically above tbe water level.

Stock material :

Criteria for selection : As physico-chemical conditions of water inside the cages are drastically different from those in a fish pond or a lake, those species which can well adapt themselves to the changed ecosystem, are preferred. Among features that one may look for in deciding the species are :—(1) Sluggish nature of fish. Fast moving fish find themselves at bay in a restricted enclosure. (2) Capacity to withstand dissolved Oxygen

deficiency to a marked degree. (3) Capacity to utilise artificial feed. (4) Capacity for rapid increase in growth.

Species cultured :—Bottom-dwelling fishes like mrigal, calbasu and common carp are well-suited for cage culture. Air breathing fishes like *Anabas*, *Clarias* etc., fulfil the first three conditions. *Catla* and Silver carp meet the fourth requirement but do not satisfy the first, second and the third criteria. The ideal fish for cage culture in India is the common carp. It is also cultured in Indonesia and Japan. *Pangasius* and channel cat fish are also cultured in cages in Cambodia and U. S. A., respectively.

Size and stock-density :—The mesh size of the cage would determine the size of the fingerlings to be stocked. Fingerlings between 50 & 100 grams each, which do not pass through 1½" diameter meshes, are usually stocked. The stock density is dependent on the growth rate of fish and the expected yield per unit area of the cage surface at the end of the rearing period. The stocking rate is as high as 5 lakh fingerlings per hectare in Japan for common carp or 50 fingerlings per meter square of cage surface. In Cambodia for *Panagasius* a very high stock-density of about 200 fingerlings per meter is followed, in U. S, A. a stock-density of 300 fingerlings of 6 inches in length per cubic yard is preferred for the culture of channel cat fish. In Indonesia however, a low stock-density of 20-30 fingerlings weighing 100 gms each per square foot of cage area is considered adequate.

Artificial feeding :

The success of cage culture operations depends on the quality and quantity of artificial feed given to the growing fish. The fish in the cage has very little space to hunt for food. The use of artificial feed therefore, is very important. Feed which is preferred by the fish and has the greatest forage ratio, is used. This is different for different species. For the economics of cage culture, the type of feed is to be determined in relation to the cost and availability. Trash fish like horse mackerel, anchovy and sandlance are commonly used for culture of carnivorous fish like Yellow Tail in Japan. There are also a large number of firms in Japan manufacturing feed pellets to cater to the need of the fish farmers. The feed contains about 60% animal matter. In Indonesia, the common carp is reared in cages in flowing rivers which draws its nutrients from the raw city sewage fed into the river. In Indian conditions, pulverised meal of trash fish unloaded by trawlers composed of scianeids, bombay ducks, ribbon fish etc., and *Acetes indicus* collected in the bagnets from estuaries

together with groundnut oil cake and slaugher house waste would serve as a good feed for common carp. Over-feeding the fish has positive disadvantages in that frequent voiding of faecal matter pollutes the water and causes Oxygen depletion. For that matter for some fishes like Yellow Tail, feeding to a degree of 70-80% staiety has been considered adequate in Japan. The feed is dropped in small quantities at a time into the cage so that it is used up by the fish before being washed away. Frequency of feeding varies from fish to fish. Five to six feeds per day have better effect in common carp, whereas in the case of Yellow Tail two feeds per day has been found to be enough in Japan.

Period of rearing :

The period of rearing depends on factors like growth of fish and the production capacity of the cage. For fish in a standard cage, rearing for a period longer than 5—6 months is not necessary. However, longer periods of rearing in larger cages have been found to result in higher yield.

Harvesting :

Harvesting the yield from a cage is a relatively simple process. At the end of the rearing period the cages are lifted out of the water and emptied into baskets or boats. In larger cages, the use of scoop-nets would be necessary. The yield per unit area of cage culture is very high. In Japan the common carp yields about 30—40 kg of fish per metre square of cage surface which works out to 300—400 tonnes per hectare in five months of rearing. In U. S. A., at the end of six months, channel cat fish yields about 400—450 lbs per cubic yard. In Indonesia common carp reared in flowing water and fed with sewage yields about 30—40 kg in 48 square feet of cage space.

Prospects of development of cage culture in Orissa :

Cage culture holds wide prospects for development in Orissa due to the availability of extensive suitable water resources and because a variety of fish species of diverse habitats can be grown in them. There are 56,000 hectares of reservoirs; and 1,80,000 hectares of fresh water lakes in the State where cage culture of fishes like common carp, mrigal and calbasu can be taken up. Besides an area of 2,68,000 hectare of brackish water lakes including Chilka lake and back water lagoons of Sonapur and 2,98,000 hectares of estuaries are available for culture of brackish water fish species

like mullets and *Etroplus* etc. In addition, there are vast areas of swamps which can be gainfully utilised for cage culture of air-breathing fishes.

Even one thousand out of the total of 8 lakh hectares suitable for cage culture can lead to fish production of 3.2 lakh tonnes which is about 7 times the present production of the State, fresh water and marine included. This revolutionary idea of fish production would catch up with the fish farmers, once the technology is made known to them.

Pranikee, **2** : 12.15 (1981)

WILD LIFE FARMING FOR THE CONSERVATION OF WILD ANIMALS AND FOREST ECOSYSTEM

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The environment for human existence is a huge ecosystem. Wild life is one of the important elements maintaining and co-ordinating the balance of this ecosystem. Forests are the habitat for wild life. A segment of our population who have a direct bearing in the conservation and rational utilization of wild life are the people who dwell in or on the fringes of the forests. They mostly comprise the *adivasis* or the tribal people. They are mostly uneducated. Newspapers, circulars and acts of the Government do not reach them. They lead a life of traditions. They have their annual *mela shikar*. On that day, they must go out in pursuit of a forest animal and would not stop until they kill a wild buffalo, sambar, chital deer, wild boar, bison, nilgai or even a monkey or rabbit. They are not concerned whether this act exterminates the last animal of a species from the forest. In addition, the educated poacher whose greed for venison and hide, tusks or antlers impels him to sneak into the forest, be it reserve forest, sanctuary or national park, to slaughter the last protected denizens of the forest. The non-pastoral nomad tribes in different states of the Union are notorious in their adaptations to hunting practices. They trap almost all kinds of mammals, birds and reptiles The Nandivallas of Maharashtra hunt the palm squirrels, the staple diet of the poverty-stricken Bhainabaiga tribals of Madhya Pradesh is rat meat, the menu of Paliyans of Tamil Nadu includes the meat of wild boar, monitor lizards and squirrels etc.

During the current century India has witnessed a gradual and rapid depletion of wild life. The factors contributing to this are : (a) a rapid increase in human population, (b) acute pressure on land and forests, (c) growing urbanization and industrialization, and (d) indiscriminate shooting of animals for pleasure and profit.

In Asia and the Pacific region extending over more than 30 countries, with roughly half the world's population, there are atleast 300 endangered species of animals of which 25 are marsupials/monotremes, 114 carnivores, 10 small mammals, 30 primates and 121 ungulates (Anon, 1980). The

number of endangered species in each country of the Region is roughly proportional to the size and ecological diversity of the country. The great majority of the Region's large grazing animals are included in the list, the only exceptions being the sambar (*Cervus unicolor*) and the barking deer (*Muntiacus muntjak*).

The International Union for Conservation of Nature and Natural Resources (I. U. C. N.) have in their "Red Data Book" listed 28 mammals of India under the "endangered" list which includes 3 species of Primates (Lion-tailed macaque, Golden langur and John's langur) one species of Lagomorpha (Assam rabbit), 8 species of Carnivora (Indian tiger, Asiatic lion, leopard, snow leopard, clouded leopard, Malabar large-spotted civet, wolf and sloth bear), 13 species of Ungulata (Indian wild ass, great Indian rhinoceros, Sumatran rhinoceros, Indian bison, wild yak, Asiatic buffalo, Markhor, Nilgiri tahr, Kashmir stag, swamp deer, Manipur brow-antlered deer, Himalayan musk deer and pygmy hog), one species of Proboscidia (Asian elephant), and one species of Cetacea (Indus dolphin) and a species of Sirenia (Dugong), the last two being aquatic (Behura, 1980).

There are various ways in which wild life serves mankind, besides contributing to the wholsesomeness and beauty of man's environment. It is not only of value in the fields of aesthetics, but also in education, economy and ecology. Wild life plays a critical role in safeguarding the inherent balance of nature and their usefulness to humanity. To ameliorate the dehumanising effect of the present-day industrialised civilisation, it is necessary that wild life and wilderness should exist within reasonable distance of major centres of urbanization in the form of wild life gardens, farms, sanctuaries, parks and ranches.

India has 19 national parks and 203 sanctuaries covering a total area of 75,763 sq. km. which is about 10% of the total forest area in India. A special project for protecting the tiger is being implemented in 11 areas in 10 states. The latest count shows, there were 2,484 tigers in 1979 as against 2,278 in 1977 and 1,827 in 1972.

India's forests and waters contain roughly 15,000 species of plants, 458 mammals, 1,259 birds, 700 reptiles, 1650 fishes, 50,000 insects and perhaps 21,900 other vertebrates and invertebrates (Roonwal and Ali, 1965).

Decreasing forest area is one of the major reasons for the depletion of wild life in India. Some 4 million hectares of land have been lost to

forestry during the last 25 years. Other major factors are poaching, liberal issue of crop protection fire arms, use of pesticides, lucrative prices for skins, ivory, trophies etc. The Wild Life (Protection) Act,1972 provides for stringent punishment for wild life offences. Enough legislation exists for the protection of wild life in this country. It is the law enforcement which is inadequate and ineffective. This is a major drawback in the conservation and management of wild life.

One of the effective ways of conserving the fast vanishing wild life and rapid destruction of the forest ecosystem is wild life farming. This can help in the utilization of wild life resources for education, employment and deep involvement of tribals and other people living on the fringes of the forests; in the conservation of the forest ecosystem and the wild life.

India has great potentialities for various types of wild life farming. In Papua New Guinea 'The Insect Farming and Trading Project' was started by the Government in 1977 with two primary objectives: (a) to assist interested villagers in collecting and farming butterflies and insects: (b) to establish export market systems. More than 500 farmers and collectors are engaged in insect farming and trading. To help them Government has set up a marketing centre which purchases the insects and butterflies from the rural people and sells them to oversea dealers. In order to make wild life farming beneficial, useful and successful, a careful selection of species of animals is necessary. The choosing of species of wild animals suitable for farming would require full knowlege of their natural history, habits, the rate of reproduction, yield of meat, resistance to diseases, behaviour under controlled conditions, quality of the marketale products, market for the products and enconomics of the enterprise. The attitude and acceptability of the local people to the endeavour is important. No rural development programme can achieve any success without the active involvement and participation of the local people in the planning, development and operation of the programme. They have to realize that they are the beneficiaries of the intended project and that the successful implementation of the project would improve their nutritional, social and economic status.

Some of the potential wild animals suitable for farming are chital (*Axis axis*), blackbuck (*Antilope cervicapra*), sambar (*Cervus unicolor*) nilgai (*Boselaphus tragocamelus*), elephant (*Elephas maximus*) and pheasants. Chital and sambar can adapt to a variety of conditions. Quite some time ago, they were imported to Australia and U. S. A. At present

they have established themselves in those countries in selected preserves and are allowed to be shot in limited numbers.

Wild life farming and wild life tourism can go side by side. Wild life farming may have to be subsidized initially until they become economically viable operations. Two typee of game ranches can be established. One could be a fairly small unit of 1.2 to 2,023 hectares (3 to 5,000 acres) where animals could be reared for meat, hide and transfer. The other kind would be a much larger area of 130 sq. kilometers (50 sq. miles) or more which could be managed as a commercial shooting block cum game ranch where conditions would be almost entirely natural with controlled shooting combined with additional cropping for the market.

In India in addition to people's demand for timber and other forest products, the high grazing pressure on reserve forests, sanctuaries and national parks poses a serious problem. Alternate pastures have to be found out for grazing of cattle to meet the demands of rural population.

Persistent propaganda and education must have to be carried out to arouse the whole population, especially the rural people and the people of the forest regions, to an awareness of the close relationship between wild animals and the natural environment as well as the important role that wild animals play in maintaining the ecological balance. Conservation implies not only prerervation and protection of a species, but also its sustenance and wise utilisation.

Materials published in 'Tiger paper' Vol. VII. No. 3, July, 1980 embodying report on the 'International Consultation on Wild life Resources for rural development : 7-11 July, 1980, Hyderabad, India have been freely used and quoted in compiling this paper.

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Pranikee, 2 : 16-21 (1981)

MOSQUITO CONTROL PROGRAMME IN RURAL ORISSA

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The importance of mosquitoes as vectors of diseases had been reviewed several times. Out of the five main diseases such as malaria, filaria, encephalitis, Dengue and Yellow fever, transmitted by mosquitoes (Chandler and Read, 1961, Roy and Brown, 1970), malaria stands as the major public health problem in India as well as in rural Orissa. The control of mosquitoes in rural Orissa in only restricted to the National Malaria Eradication Programme. Other programmes for mosquito control such as National Filaria Control Programme and Urban Malaria Scheme are limited to urban areas. The mosquito-borne diseases other than malaria are not as common in rural Orissa. In India the economic loss on account of the adverse effect of this disease on agriculture, industries and commerce was estimated at 750 crores of rupees annually, before the malaria control programme became effective in 1953.

Problematic Mosquitoes of Rural Orissa

Malaria, transmitted by female Anophelines through man-mosquito-man contact, has been a great hindrance in the development of socio-economic status of rural Orissa. With the recognition of species complexes the number of *Anopheles* species has risen to 45 in our country and among the malaria vectors only nine species are recognised (Wattal, 1973). There has not been any systematic study of mosquitoes in Orissa during the past several years (Guha *et al*, 1979). Consequently there is not much information available on mosquito fauna and vector species in the districts of Orissa. According to earlier records during 1940 (Senior White, 1937-1938 and 1943; Rao, 1949), 25 *Anopheles* species were available in Orissa out of which eight vector species were found (Puri 1955). During the past three

decades, due to various changes in the ecosystem, replacement, disappearance and additions to the Anopheline fauna might have taken place as has been reported in the neighbouring state such as Assam and West Bengal.

Anopheles minimus Th,, which was the main vector of malaria in Assam is reported to have disappeared from the State. *A. philippinensis* Lud and *A. varuna* Iye., have not been found in West Bengal. *A. fluviatilis*, James which was the only malaria vector in the foot hills of the Nilgiris has been reported to be on the verge of disappearance from the region. Recent reports, however, claim their reappearance. Three new additions including *A. annularis* have been made to the existing list in West Bengal. Such information in the Anopheline biology and bionomics in Orissa is not available. Surveys have been made by the Regional Coordinating Organisation, Bhubaneswar from 1971 in different areas of Orissa. However, all the districts are yet to be covered. An I. C. M. R. Project is functioning in the Keonjhar district to observe the biology and bionomics of Anophelines. A total of 21 species of *Anopheles* are found in rural Orissa (reports on districts like Dhenkanal, Phulbani, Puri, Bolangir and Kalahandi are lacking) including four vector species. *A. stephensi* List. *A. minimus* and *A. philippinensis* have not been found in Orissa which were reported to be transmitting malaria in early days. Two vector species viz., *A. annularis*, V. d. Wulp and *A. culicifacies* Giles are found in all the areas of rural Orissa and these two species have developed resistance to DDT and Dieldrin in most of the areas. *A. fluviatilis* and *A. varuna* are restricted to hilly and forest areas and their susceptibility status is not known.

Malaria in Orissa

Till 1953, it was estimated that in India approximately 100 million persons suffer from malaria every year out of which one million die due to direct effect of the disease and an another million due to its indirect effects. During epidemic years this number would almost double. Against this back ground, the Health Survey and Development Committee of the Government of India, known as the Bhore Committee, as well as the Planning Commission gave highest priority for control of malaria. Consequently in the first five year plan, a nation-wide malaria control programme (NMEP) was launched in 1953 and was run for five years. This programme was highly successful with dramatic fall in the incidence of the disease Encouraged by the results, the Government switched over to the National Malaria Eradication Progromme in 1958. The entire country including

Orissa was covered by this programme except areas 5000 ft. above sea level consisting of population around 15 million where malaria transmission does not occur. This programme reduced the incidence of the disease from 100 million to one lakh per year in 1965 and completely eliminated deaths due to malaria. The annual loss was brought down to Rs. 13.6 crores from Rs. 750 crores. Inspite of the above success, malaria incidence is increasing from 1967, gradually year after year reaching its peak in 1976 (Guha *et al*, 1979).

Inspite of several years of anti-malarial operation, major part of Orissa could not enter into the consolidation or maintenance phase and transmission of the disease is going on in rural Orissa. The total detected cases in 1966 was about 10,000 which came to 3,29,104 in 1976. The other problem is ***falciparum*** malaria is caused by ***Plasmodium falciparum***, which is a dominant parasite in Orissa. The total number of malaria cases recorded by N. M. E. P. from Orissa during 1961-1980 and the proportion of infection of *P. falciparum* is given below.

Year	Total cases	Percent *P. falciparum*
1961	5,052	13.4
1962	11,758	25.2
1963	17,376	23.1
1964	31,796	21.8
1965	24,992	29.9
1966	9,949	71.8
1967	18,561	83.2
1968	31,794	78.2
1969	28,962	77.3
1970	11,388	46.9
1971	33,260	40.8
1972	51,226	45.8
1973	1,89,767	41.8
1974	2,97,701	52.0
1975	3,17,669	46.5
1976	3,29,104	63.9
1977	2,12,337	64.5
1978	2,77,906	63.4
1979	2,96,383	71.9
1980 (Upto November)	2 04,847	74.75

In recent years it has also been reported from rural areas of Orissa that the malaria parasites are not responding well to Chloroquine, the drug of choice (Guha *et al*, 1979).

Control activities

In rural areas, mosquito control activities are only conducted by the National Malaria Eradication Programme as stated earlier. The programme was based mostly on elimination of Anopheline vectors through indoor residual spraying of the insecticides.

Prior to DDT, Pyrethrum and Kerosine sprays were used to kill the larvae and adult mosquitoes. The advent of DDT (dichloro-diphenyl-trichloroethane) synthesized first in 1874 brought new hopes for malaria control. When DDT became available at the close of world war II, it became possible to control malaria over large sections of the globe. DDT applications made in Orissa in 1948 materially reduced the number of *A. annularis*. In Jeypore Hills DDT spray conducted in 1949 succeeded in eliminating *A. culicifacies* in Orissa. In the Joda and Barbil (mining areas) of Keonjhar district malaria incidence was reduced due to antilarval measures taken by the Britishers during late 1920s.

In the anti-mosquito measures, DDT has been in use for indoor residual insecticidal spray. The standard method for obtaining control of the disease through killing the adult mosquitoes is to apply 100 mg. DDT per square feet. DDT (5%) is sprayed in the human dwellings and also in the cattle sheds. This deposit remains effective against the anophelines for six montns. Therefore in the anti-mosquito measures DDT is sprayed twice a year to give year round protection, once before and the second after the monsoon. DDT is not effective for killing the mosquito immediately, however, it is capable of reducing the adult life span of the mosquitoes.

In urban areas, in lieu of indoor residual spray, anti-larval measures are taken since the urban localities are compact areas with less mosquito breeding places. Recently fogging is being done in large cities through TIFA (Todd Insecticidal Fog Applicator).

Problems of adulticide spray operations

Though the administrative and operational aspects for adulticide spray operation have been receiving attention, persistance of transmission

of the disease by mosquitoes is still there in rural Orissa due to various reasons. The important causes are as follows :

1. Because of the continuous use of DDT, the major anophelines have become tolerant/resistant to DDT.

2. Along with the mosquitoes, the bed-bug nuisance is felt in rural areas. At the beginning, DDT was able to kill the mosquitoes as well as bed bugs and their predators.

Therefore, the villagers were accepting the spray and cooperating with the spraying. Now bed bugs are highly resistant and their predators are susceptible to DDT. So spraying of DDT indirectly increases the bed bug population and the villagers are reluctant to co-operate with the spraying programme for this reason. To increase the acceptibility of spray in rural areas, 30 gms of diazinon is being mixed with one pound of DDT for bed bug control.

3. The vector mosquitoes behaviorally avoid the sprayed surfaces. Some have adapted to rest outside and enter the house temporarilly only for a blood meal. Some even rest outside and bite outside, thus avoiding contact with the sprayed areas inside the room completely.

4. Nonavailability of insecticides.

5. In the rural areas, majority of the houses are low built huts. The walls of these houses are made up of wood pieces held together by mud plastering. As a matter of routine maintenance these walls are mud plastered frequently. Since rural people do not have much faith in DDT, sometimes they mud plaster their houses immediately after the spray. This habit of frequent mud-plastering affects prolonged residual effectiveness of DDT on the wall surface.

Need for the programme

The World Health Organisation had forecast a steep increase in malaria incidence in India, upto two crore cases by 1980 with 25% of them due to *P. falciparum* of the virulent form which could damage the brain. Due to the modified plan of operation of the Government from 1977 the incidence of malaria cases has been checked from this expected rise The only need is peoples' participation which can be achieved by proper health education.

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Pranikee, **2** : 22.24 (1981)

DRUG RESISTANCE IN MALARIA PARASITE

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Malaria is produced in man by four species of *Plasmodium* viz., ***P. falciparum***, ***P. malariae***, ***P. ovale*** and ***P. vivax*** (Chandler and Read, 1961). ***P. ovale*** is not found in India and ***P. falciparum*** is the most dangerous human malaria parasite. The number of cases of attack by ***P. falciparum*** in India was recorded as 100, 115 in 1970 and as 753, 713 *i. e.*, as increase in 7.5 fold, in 1976 (Ray, 1979). In Orissa, the percentage of ***P. falciparum*** infection in total malaria cases during 1978 to 1980 was more than 70%.

The popular chloroquine tablets, the drug of choice during an attack of malaria, may prove ineffective at times because some strains of *P. falciparum* are now resistant to this drug. The resistance varies from occasional loss of the effect of chloroquine on asexual stages of the parasite to a complete loss in severe infection. Under normal circumstances, chloroquine enters the red cells, chloroquine sensitive parasites have a high affinity for the drug and accumulate it on their membranes. Resistance to chloroquine is due to a simple parasite mutation resulting in decrease in the affinity for binding sites for the drug. Due to this the drug may not bind to the parasite. Chloroquine that reaches the parasite acts on stages that are actively digesting haemoglobin such as the trophozoite schizonts and young immature gametocytes.

Grading of resistance

In 1967, the World Health Organisation suggested an arbitrary system for grading the response to chloroquine which is as follows :

Response	Recommended symbol	Evidence
Sensitivity	S	Clearance of asexual parasitaemia within 7 days of initiation of

Response	Recommended symbol	Evidence
		treatment without subsequent recrudescence.
Resistance	R I	Clearance of asexual parasitaemia in sensitivity, followed by recrudescences.
	R II	Marked reduction in asexual parasitaemia but no clearance.
	R III	No marked reduction in asexual parasitaemia.

Drug resistance in malaria is defined as the "ability of a parasite strain to survive and/or to multiply despite the administration and absorption of a drug given in recommended does".

P. falciparum resistance to chloroquine was first suspected in Thailand in 1957 and confirmed in that country in 1961. At present the drug resistant strain is extensively distributed throughout Thailand and has spread south and westwards into Burma, Indonesia and Bangladesh, and has reached the north-eastern States of India. Drug resistance in *P. falciparum* has already been indentified in districts on the southern banks of Brahmaputra in Assam, Meghalaya, Tripura, Mizoram, Manipur, Nagaland and Arunachal Pradesh and several other places. Clyde (1973) had correctly predicted the spread of chloroquine resistant *P. falciparum* to India through Manipur and Himalayan foot hills of Assam from Burmese Pegue Yoma range of hills, and to Bangladesh through Chittagong Hill tracts.

Resistance of *P. falciparum* to chloroquine was first reported in India in 1973 in Karbi Anglong district of Assam (Pattanayak *et al*, 1979). Since then it is spreading throughout India. Resistance at R I level has already been established in Gujarat and Maharashtra. R II and R III level strains have already been detected in Nagaland and Meghalaya and resistance at all the levels (R I, II and III) have been reported in Mizoram and Arunachal Pradesh. In Orissa, first resistance and R I level was detected in the Phulbani district in May 1979 and resistance at R II level was detected in

lhe Keonjhar district in May 1979. In Bolangir district one resistant case at R I level was reported in January 1980. Resistance at R III level has not yet been detected in Orissa.

Considering the gravity of the situation in the country, the Indian Council of Medical Research recommended that monitoring schemes should be deployed at places where resistance has been detected and in those areas where *P. falciparum* incidence is high. In response, the Government has started special provision under Modified Plan of Operation and one *Plasmodium falciparum* Containment Programme (PfCP) has been conceived within the modificd plan of operation for the specific purpose of intensification of the campaign in areas where the incidence of *P. falcipārum* is high. Accordingly one monitoring scheme has been functioning at Bhubaneswar for Orissa and Bihar since 1978.

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Pranikee, **2** : 25 28 (1981)

A NOTE ON THE EGG PREDATORS OF THE SALTWATER CROCODILE, *CROCODYLUS POROSUS* SCHNEIDER IN THE BHITARKANIKA WILDLIFE SANCTUARY, ORISSA.

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ABSTRACT

The egg predators of the saltwater crocodile, *Crocodylus porosus* in the Bhitarkanika Wildlife sanctuary, Orissa, are described.

INTRODUCTION

Egg-eating predators take a heavy toll of eggs laid by the nesting female saltwater crocodile, *Crocodylus porosus* Schneid, in the Bhitarkanika wildlife sanctuary, Orissa. The female crocodile defends the nest by charging at the intruders. But, sometimes the female is also fooled by the egg-eating predators. The most active and dangerous of the predators is the water monitor lizard, *Varanus salvator* which is seen in large numbers in and around the sanctuary. Deraniyagala (1939) studied predation of *C. porosus* eggs by *V. salvator* in Sri Lanka. Other crocodilian species have different though often related nest enemies. Studies of Cott (1961) showed that in the Nile Crocodile, *Crocodylus niloticus*, a large lizard, the Nile monitor, *Varanus niloticus* is an important egg predator and is kept away from crocodile nests only by the presence of the guardian female. The presence of monitors in crocodiles' stomach (Cott, 1961) indicates that these predators are sometimes eaten by the crocodile. However, when the water monitors work in pairs they may outwit the nest guarding crocodile and succeed in robbing the nest.

Cott (1969) has also recorded the Black kites (*Milvus migrans*), Marabou stork (*Leptoptilos crumeniferus*) and Palmnut vulture

(*Cypophierax angolensis*) as important predators of Nile crocodile eggs. In Lake Rudolf, Grey heron (*Ardea cinerea*), Goliath heron (*Ardea goliath*) and Sacred ibis (*Threskiornis aethiopicus*) are known to prey on Nile crocodile eggs (Modha, 1967).

In North Australia, eggs of *C. porosus* are rooted and eaten by wild pigs (Barrett, 1939). In many parts of India tribal people are important predators of crocodile eggs. At Satkosia gorge, Matia (Munda) tribals eat Gharial (*Gavialis gangeticus*) eggs. In the Bihar-Nepal border Gharial eggs are taken by Tharus tribals.

OBSERVATIONS AND RESULTS

Observations were made to determine the predators of saltwater crocodile eggs inside the Bhitarkanika sanctuary of Orissa. The female saltwater crocodile was observed to stay in the immediate vicinity of the nest to guard it against egg predators until the eggs hatched

While approaching a nest in forest block IX in the Sanctuary on 10th July 1975 for egg collection, it was observed that all the eggs had been eaten away. The manner in which the empty egg shells were found scattered near and around the nest, and the presence of four to five holes in the nest itself, indicated that the nest had been robbed by the water monitor lizard *V. salvator*. In 1979, two nests were observed to have been predated upon by *V. salvator* in forest block VIII. Pieces of uneaten egg shells were found scattered near the nests. Pieces of egg shells were collected from a tree hole close by. Studies of other nests indicated the movement of water monitor lizards near these nests from identification of their tracks and foot prints.

Mammalian enemies of *C. porosus* eggs include wild pigs (*Sus scrofa*). In the Bhitarkanika sanctuary, the population of wild pigs is quite large and the pigs take a heavy toll of crocodile eggs. It was reported by an oldman of Dangmal village to one of us (S. K. K.) that in 1972 he had faced a male wildboar inside the Bhitarkanika Block while he was in search of honey. The wildboar chased him when it was disturbed while eating crocodile eggs from a nest. According to him, the mother crocodile was not there either near the nest or in the wallow. Some eggs still left uneaten were found by him in the nest. At the time of egg collection in the months of June and July, the presence of a number of wild pigs in the area of the nesting ground of the crocodiles was observed but actual predation has not been observed by the authors as the eggs are immediately collected from the nest when located, for Project hatchery incubation.

In addition to the above animal egg predators, man is often a deadly predator. In the Sanctuary, prior to the establishment of the Crocodile Project in mid-1975, honey collectors and some other local people, although did not collect the eggs for food, damaged the developing eggs in the nest they came across in the forest, out of fun or mischief.

One migrated tribal from Andhra Pradesh, now settled inside the Sanctuary named Jhadu Singh is known to have killed one guardian mother crocodile in 1971 which was actively defending her clutches in forest block VI, by applying bait near the nest. This killing was done for the purpose of obtaining the skin of the crocodile. He subsequently collected a basketful of eggs from the nest. Though he wanted to eat the eggs he could not do so since in all the eggs, the embryos were in an advanced stage of development. Later he killed all the embryos.

Avian egg predators of *C. porosus* were not recorded inside the Sanctuary. While approaching nests, the presence of Openbilled storks (*Anastomus oscitanus*), White ibis (*Threskiornis melanocephalus*), Sea eagle (*Haliaetus leucogaster*), Brahminy kite (*Haliastus indus*) and Pariah kite (*Milvus migrans*) were noticed in the crocodile nesting sites but no actual damage to the eggs from these sources was observed. Although it is probable that atleast some of the above bird species will eat crocodile eggs, none are likely to open the nest themselves. Their role will be that of secondary predators or scavengers attending the nest once it has been opened by monitor lizards or egg eating mammals.

Due to predation of Saltwater crocodile eggs by predatory reptiles, birds and mammals, in nature, the successful hatching of eggs is extremely hard. It is said that a pair of animals at their death leave behind them only a pair of progeny provided the parents survive from the hands of poachers (FAO, 1974).

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Pranikee, 2: 29-36 (1981)

STUDIES ON THE SEX-RATIO AND SIZE CORRELATION OF THE INDIAN BULL FROG, *RANA TIGERINA* (DAUDIN)

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ABSTRACT

The sex ratio and size correlation of the Indian bull frog *Rana tigerina* (Daudin) based on collections for three years from 1976 to 1978, are reported.

INTRODUCTION

In general, information on the biology of Indian anurans is limited. Prior to this study the biology of *Rana tigerina* has been described by several workers (Annandale, 1917; Annandale & Rao, 1918; McCann, 1932; Kirtisinghe, 1957 ; Bhati, 1969 ; Daniel, 1975 ; Mohanty-Hejmadi, 1977). McCann (1932) and Daniel (1975) gave detailed accounts of the biology of *Rana tigerina* from Western India. However, not much is known about the populations from Eastern region specially from Orissa. Dutta (1979) and Dutta and Mohanty (1981) studied the biology of this frog population from Bhubaneswar area, and the sex ratio and size correlations are reported here.

Materials and methods :

To determine the sex ratio and size correlations, the animals were caught around Utkal University campus area of Bhubaneswar located 25 metres above sea level at 85° 53'E longitude & 20° 21'N latitude, for three years from 1976 to 1979. The relationship of S—V length and femur length, S—V length and weight, femur length and weight of males and females were determined by least square regression analysis using the formula : $Y = a + bx$. From this the coefficient correlationship was deduced.

Results & discussion :

Sex Ratio : In 1976 a total of 49 specimens were collected out of which 32 were male and 17 female. So the number of males were nearly

twice as compared to females and the sex ratio of male : female was 1.8. In 1977 out of 175 specimens, 108 were males and 67 females and the sex ratio of male : female was 1.6. Likewise in 1978, 153 frogs were collected from January to August, of which 89 were males and 64 females, and the sex ratio was 1.3 (Table-1).

Out of the total of 377 frogs collected over three years, average ratio of male : female was 1.5 (Table-1). These observations indicate that there are more males than females. Due to this there is a keen competition among the males to pair with the females which also ensures successful breeding for the species.

Size of males : The snout vent (S-V) length of the smallest immature measured was 73 mm and the femur length was 31 mm. It weighed 50 gms. The S-V length and femur length of the smallest mature frog were 93 mm and 42 mm respectively. The largest immature male had a S V length of 165 mm and the femur length was 71 mm. The S-V length and femur length of the largest mature male were 176 mm and 78 mm respectively and it weighed 425 gms.

In males the relation of S-V to femur length was linear (Fig. 1). The "r" value was 0.426 indicating a positive relationship between the two parameters. The relationship of S-V length to weight in males was also linear (Fig. 2) with the coefficient correlation of 0.287 indicating a positive relationship. The relation between femur to weight in males was also linear (Fig. 3). The "r" was 1.097 which indicated a highly positive relationship. Thus length of femur can be a good indicator of weight in *R. tigerina.*

Size of females : The number of females collected during the course of the investigation was 148 including both mature and immature ones. A detailed analysis of all the frog specimens revealed that the S-V and femur lengths of the smallest one were 82 & 32 mm respectively. Likewise the S-V and femur lengths of the largest one were 187 & 82 mm respectively (Table-3). Comparatively the frogs collected in 1978 were larger than in other years due to selective collection of large females during the breeding season. The relationship between S-V length and femur length was linear (Fig. 4). The "r" being 0.505 indicates a positive relationship. The relationship between S-V length and weight was also linear (Fig. 5), the "r" value was 0.316 indicating a positive relationship. The relationship between femur length and weight was linear (Fig. 6). There was a highly positive relationship between the two because the "r" value was 0.937.

TABLE-1

SEX RATIO OF *RANA TIGERINA*

Year of collection.	Total No. collected in each year.	No. of males.	No. of females.	Sex ratio male : female.	Total No. of males.	Total No, of females.	Average sex ratio male : female.
1976	49	32	17	32 : 17 (1.8)			
1977	175	108	67	108 67 (1.6)	229	148	229 : 148 (1.5)
1978	153	89	64	89 : 64 (1.3)			

TABLE-2

SNOUT-VENT (S-V), FEMUR LENGTH AND WEIGHT OF *R. TIGERINA* MALES IN DIFFERENT YEARS

Year of collection.	(S-V) Length (mm)		Femur length (mm)		Weight (gm)	
	Range	Mean	Range	Mean	Range	Mean
1976	98-160	131.4±15.7*	42-72	54.4± 7.2	**	—
1977	73-176	134.8±21.9	31-78	60.7± 9.9	50-435	208.4±83.7
1978	77-176	136.7±22.6	34-80	62.0±10.5	65-390	215.2±87.5

* Standard deviation. ** Not available.

TABLE-3

SNOUT-VENT (S-V), FEMUR LENGTH AND WEIGHT OF *R. TIGERINA* FEMALES IN DIFFERENT YEARS.

Year of collection-	(S-V) Length (mm)		Femur length (mm)		Weight (gm)	
	Range	Mean	Range	Mean	Range	Mean
1976	82-187	135.8±24.7	32-82	58.8±10.7	**	**
1977	82-185	143.7±24.6	36-83	63.9±10.6	55-560	256.9±134.2
1978	95-186	154.6±24.6	41-80	67.7± 9.4	80-500	297.4±109.4

** Data not taken.

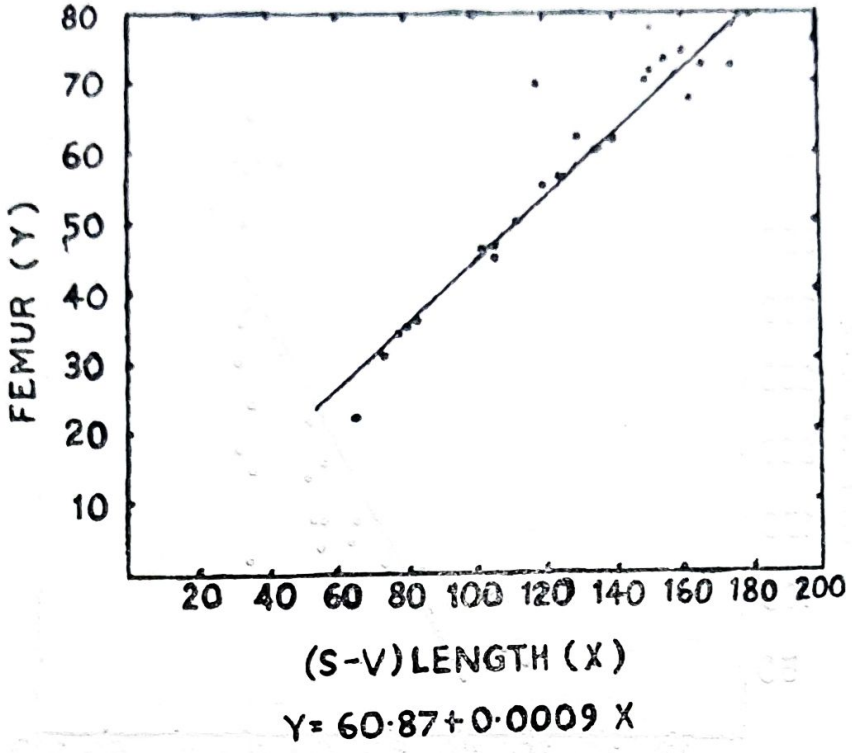

Fig. 1. Relationship of S-V and femur length for male *R. tigerina* collected in 1977 and 1978.

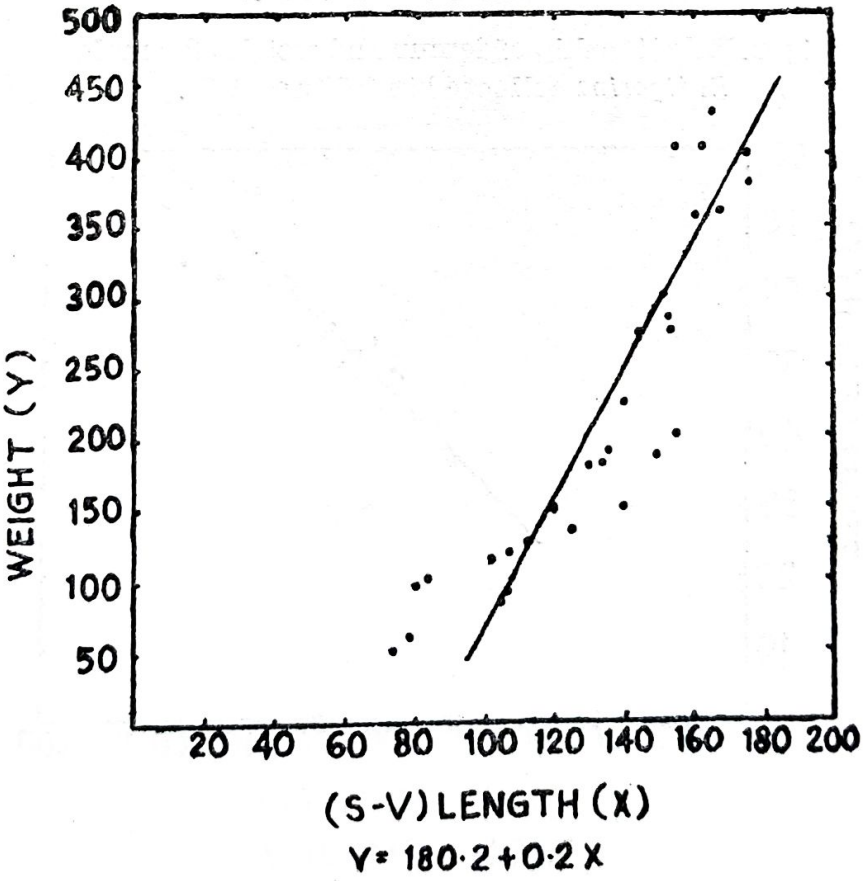

Fig. 2. Relationship of S-V and weight for male *R. tigerina* collected in 1977 and 1978.

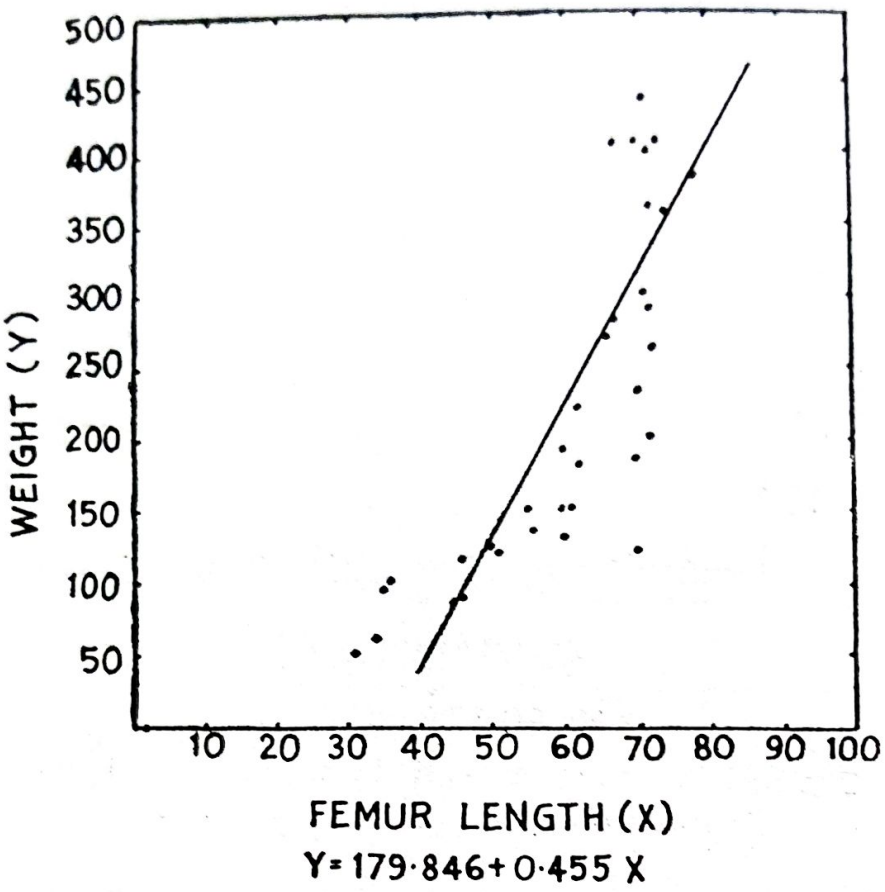

Fig. 3. Relationship of femur and weight for male *R. tigerina* collected in 1977 and 1978.

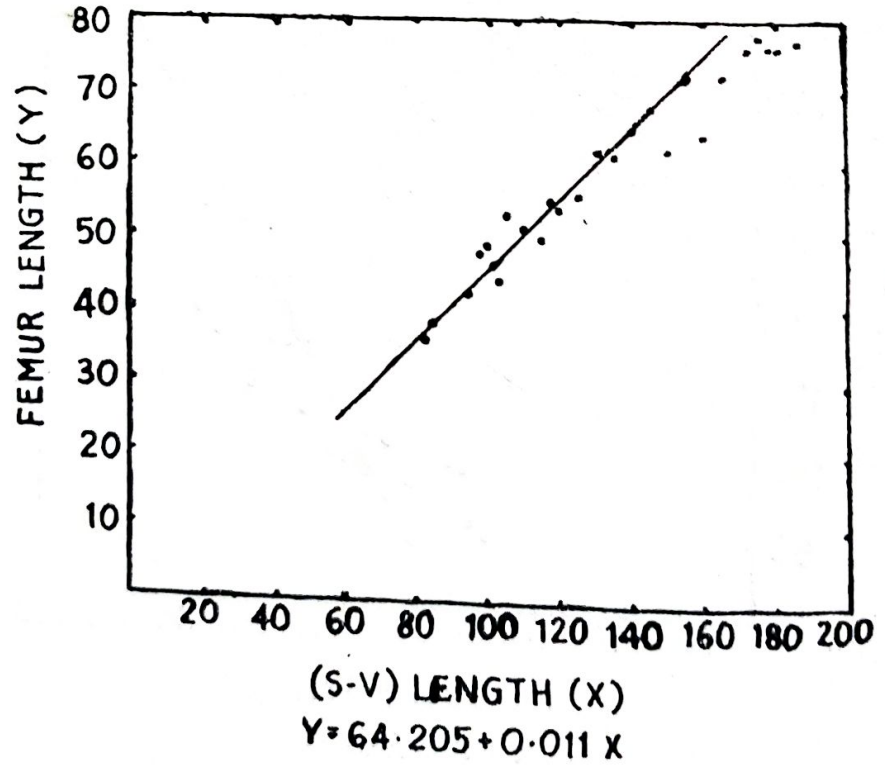

Fig. 4. Relationship of S-V and femur length for female *R. tigerina* collected in 1977 and 1978.

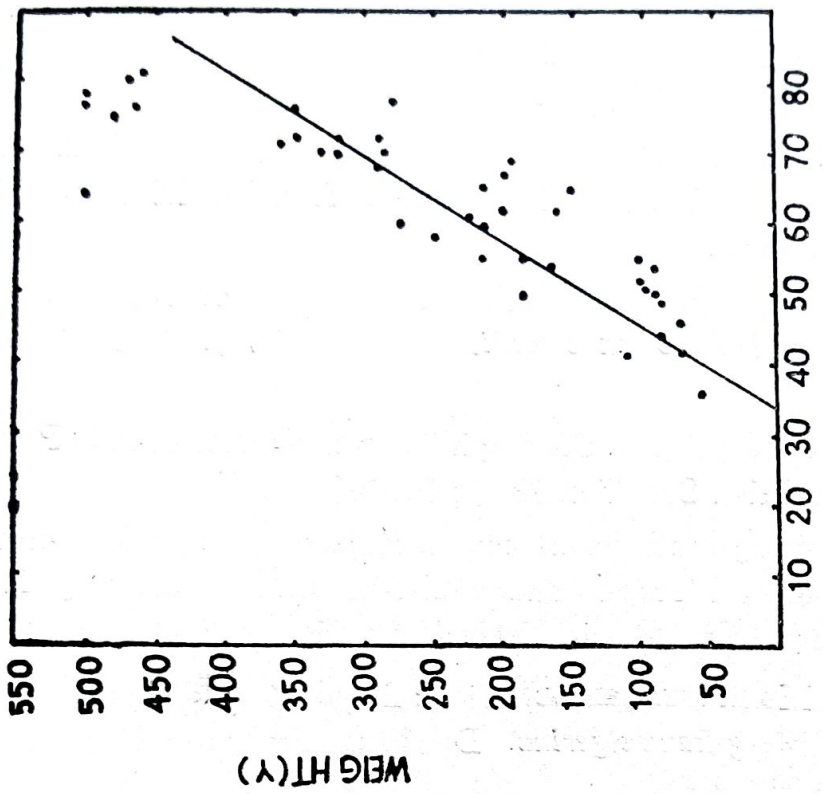

Fig. 5. Relationship between S-V length and weight for female *R. tigerina* collected in 1977 and 1978.

Fig. 6. Relationship of femur length and weight for female *R. tigerina* collected in 1977 and 1978.

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THE KARYOTYPE OF BLACKHEADED SHRIKE, *LANIUS SCHACH TRICOLOR* (HODGSON)

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ABSTRACT

The somatic and meiotic chromosome complements of Black Headed Shrike *Lanius schach tricolor* (Hodgson) have been analysed. The diploid chromosome number has been ascertained to be 2n=72±. The karyotype comprises 16 macro and 56 micro chromosomes. The Z and W chromosomes have been identified. All the chromosomes form regular bivalents in diakinesis stages. The results have been discussed with a note on cytotaxonomical relationship of this species.

INTRODUCTION

The cytotaxonomical studies in class Aves are much less compared to the literature in other vertebrate groups (Ray-Chaudhury, 1973; Takagi and Sasaki, 1974). Family Laniidae (72 species) of Order Passeriformes is known cytologically by only 4 species (Srb, 1974). The present paper pertains to the study of another species *Lanius schach tricolor* which is common around Bhubaneswar.

MATERIALS AND METHODS

Three female and two male birds could be procured for the present course of investigation. The cytological preparations were obtained from the bone marrow and testes cells by conventional air drying techinque. Karyotype analysis has been done as described earlier (Bhunya and Sultana, 1979).

RESULTS

The diploid chromosome count in more than 60% of metaphases studied show the 2n to be 72 . Eight pairs of macro-and 28 pairs of microchromosomes constitute the karyotype. The sex chromosomes, the Z and

W chromosomes are identified in the female karyotype; the former is at chromosome comprising 5% of the TCL and the latter chromosome is a sm chromsome comprising 3.4% of the TCL. The remaining 7 pairs of macro-auto somes are arranged in 4 groups depending upon their centromeric indices and relative lengths. Group I comprises 2 pairs of m chromosomes, Group II comprises a single pair of sm chromosome and Group III and IV comprise each of 2 pairs of st and t chromosomes respectively. The micro-chromosomes are all acrocentric in nature (Fig.1). The morpho. metric data of all the macrochromosomes are given in Table-I.

The meiotic chromosome preparations show regular bivalents in diakinesis (Fig.2) and metaphase-I stages. A constant 36 number of bivalents was observed in most of the diakinesis and metaphase-I stages. The largest chromosome (no. 1) only formed 3 chiasmata, rest of the macro-

TABLE-I

Morphometric data of macrochromosomes of *L. s. tricolor*.

Chromosome pair No.	Relative length.	Centromeric index.
1	11.9	42.1
2	6.6	38.1
3	6.2	30.0
4	11.3	13.8
5	5.3	17.6
6	9.1	—
7	3.1	—
Z	5.0	—
W	3.4	27.2

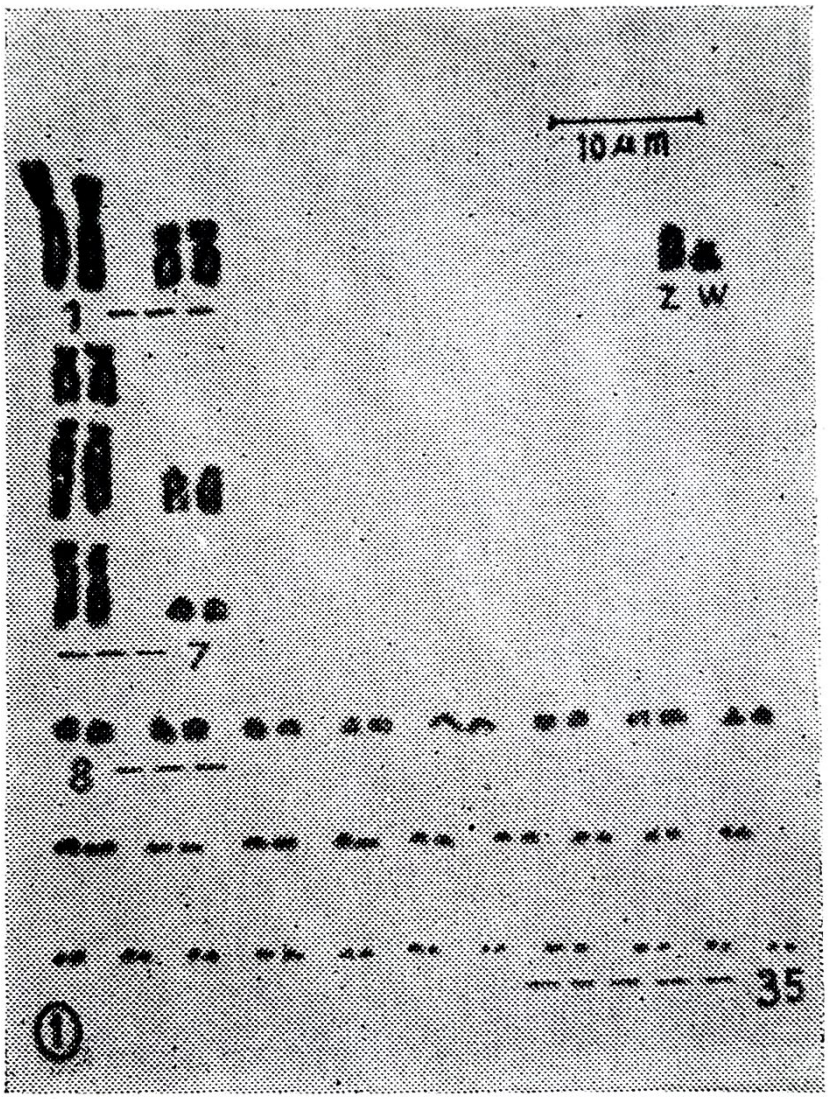

Fig. 1. Karyogram from somatic metaphase complement of female bird.

chromosomes formed 2 chiasmata The Z chromosome (arrow Fig.2) too formed 2 chiasmata. The microchromosomes formed regular bivalents.

Fig. 2. Spermatocytic diakinesis

DISCUSSION

The karyotype of *Lanius schach tricolor* is in accordance with the karyotypes usually found in Passeriform species. On comparing the chromosomes of *L. s. tricolor* with four other species, *Lanius bucephala* (Udagawa, 1954), *L. cristatus* (Yamashina, 1951), *L. c. f. super ciliosus* (Udagawa, 1959) and *L. trigrinus* (Udagawa, 1952), of the same genus, an uniform $2n = 72 \pm$ is observed. A general chromosomal uniformity is also evident with slight structural rearrengements.

Nothing much is understood from the meiotic chromosomes except that they are as found in most of the avian meiosis (Shoffner, 1974). However, for taxonomic differences in the karyotypes among these species, one has to venture into the field of C and G banding of chromosomes.

ACKNOWLEDGMENT

The authors gratefully acknowledge the Laboratory and Library facilities extended by Prof. B. K. Behura, Head P. G. Deptt., of Zoology, Utkal University. TS. is grateful to CSIR for financial assistance.

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MORPHOLOGY, HISTOLOGY AND HISTOCHEMISTRY OF MALE ACCESSORY REPRODUCTIVE GLANDS OF *POECILOCERUS PICTUS* (FABR.) (PYRGOMORPHIDÆ : ORTHOPTERA)

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ABSTRACT

Fifteen tubular accessory glands open on either side of the upper ejaculatory duct of the adult male of *Poecilocerus pictus* Fabr., as white, hyaline and opalescent glands. Histologically the glands consist of an outer muscular layer, a basement membrane and an inner epithelium followed by a central lumen. Histochemical studies reveal that the glandular secretion contains mainly protein and glycogen which help respectively in spermatophore formation and in supplying nutrition to the stored sperms inside spermatheca.

INTRODUCTION

Excepting Apterygota and some Diptera, almost all insects, both male and female possess accessory reproductive glands (Chapman, 1969). Most of the workers have regarded these glands of the male insects as secretory, the secretion mainly helping in the formation of spermatophores (Uvarov, 1966; Chapman, 1969; Romoser, 1973).

Acridoidea is a group where almost all male members possess varying number of paired accessory reproductive glands. Workers like Fenard (1896), Ivanova (1926), Fedorov (1927), Payne (1933), Jannone (1939), Hodge (1943), Khalifa (1949, 1950) and Uvarov (1966) have studied the morphology of such glands. Louis and Kumar (1971) have worked out the morphology and histology of Dictyopteran male accessory reproductive glands. Gregory (1965) has dealt with the detailed histology of Orthopteran glands. Ito (1924), Omura (1938) and Srivastava and Srivastava (1957) suggested its secretory function in helping in the production of spermatophore and supply of nutrition to the spermatozoids. Histochemical studies by Humprey and Robertson (1949), Khalifa (1950), Blum, Glowska and Taber (1962), De Wilde (1974), Srivastava and Das (1966) Srivastava

and Verma (1971) and Swaiiles (1971) have proved the secretory nature of the male accessory reproductive glands in Acridoidea.

The present work describes the male accessory reproductive glands of the Pyrgomorphid, *Poeci locerus pictus* Fabr. hitherto undescribed.

MATERIALS AND METHODS

The glands being associated with exclusively the reproductive system, sexually mature male specimens of *P. pictus* were collected from Bhubaneswar for our study. For the study of histology, the material was fixed in Bouins fluid and stained in Haematoxylene and Eosin.

OBSERVATIONS

Morphology

Into the upper ejaculatory duct on either side, open the long tubular accessory glands along with the seminal vesicle (Fig. 1). Most of the glands are more coiled towards the distal end than at the proximal end. The glands consist of delicate blind tubes in two bunches, fifteen in each bunch, lying on either side of the hind gut. On the basis of their appearance and contents, the glands are distinguished into three types :

White glands—They are four in number; length varies from 6-14 mm, and 0.3-0.6 mm in diameter. They contain a chalky white secretion.

Hyaline glands—They are ten in number vaying in length from 2 to 3 mm and 0.2 mm in diameter and contain a colourless liquid.

Opalescent gland :

There is a single opalescent gland which is clearly distinguishable from the rest with opalesent granular contents. It is 12-14 mm in length and 0.2 to 0.6 mm in diameter.

In all types of glands, as described in *Locusta* by Gregory (1965), two distinguished regions can be identified, a distal and a proximal although the junction between the two is not very clear. The distal region is thin walled and has a wider lumen whereas the proximal is thick walled with a narrow lumen. The distal region is believed to be the secretory region and the proximal as the conducting region (Gregory, 1965).

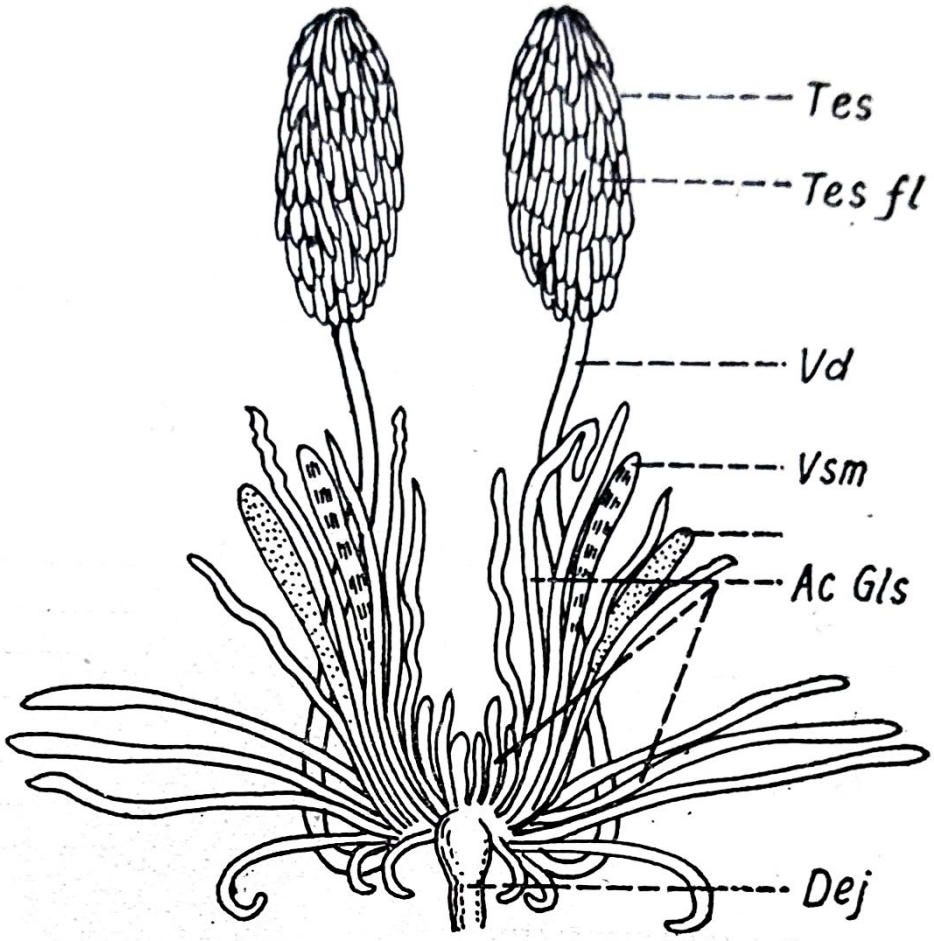

Fig.1- ACCESSORY GLANDS ASSOCIATED WITH MALE REPRODUCTIVE SYSTEM OF P. PICTUS

Histology.

The tubular glands are more or less circular in cruss section. Basically all the gland types have a similar structure. From outside to inside, the wall possesses an outermost muscular coat with both circular and longitudinal muscles, a median thin basement membrane and an inner epithelium with a single layer of epithelial cells followed by a central lumen containing glandular secretions (Fig. 2).

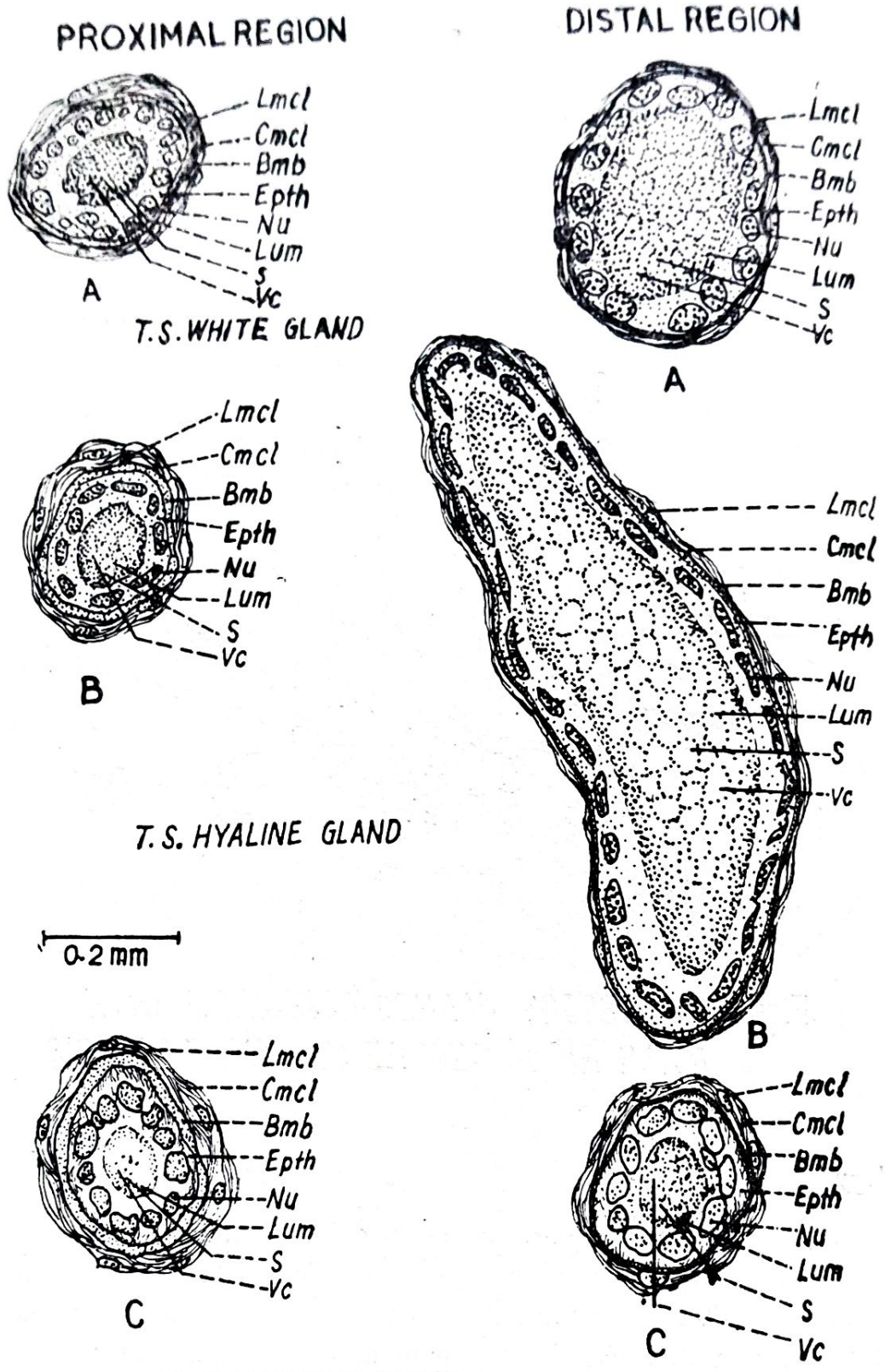

Fig.2- DETAILS OF GLANDS OF P. PICTUS

KEY TO LETTERING OF FIGURES

Ac Gls	...	Accessory glands
Bmb	...	Basement membrane
Cmcl	...	Circular muscle fibres
Dej	...	Ductus ejaculatorius
Epth	...	Epithelium
Lmcl	...	Longitudinal muscle fibres
Lum	...	Lumen
Nu	...	Nucleus
S	...	Secretion
Tes	...	Testis
Tes fl	...	Testicular follicles
Vc	...	Vacuolated cells
Vd	...	Vas deferens
Vsm	...	Vesicula seminalis

Histologically in all the glands, the structure of the proximal region differs considerably from that of the distal region. In the dorsal region, the muscular coat is somewhat thinner. The basement membrane is less prominent and the epithelium contains columnar cells of larger size with enlarged nuclei. The lumen is filled with secretion. In the proximal region, on the other hand, the outer muscular coat is thicker with several layers of muscles, the basement membrane is well marked, the epithelial cells are comparatively narrower and the lumen may or may not contain secretions.

Some special features are observed in the structures of epithelial cells specially in the distal secretory region of the different types of glands In white glands, the cells are usually shorter and columnar with large rounded nucleus at the base (more towards basement membrane). The cells are with reticulate cytoplasm and the lumen is filled with fine granular secretion. The epithelial cells of hyaline glands are rather narrower and columnar. Nuclei are spherical to oval in shape and the lumen contains secretions with numerous vacuoles. In the opalescent gland, the cells vary from cuboidal to columnar in shape with large oval nucleus and highly reticulate cytoplasm. The lumen is filled with large rounded granules.

Histochemistry :

The pH of the secretions of the accessory glands varies from 6.1 to 6.7. From different histochemical tests, it is found that the glands secrete protein, glycogen, different groups of amino acids and lipids. The following table shows the presence of different chemical substances in the apical and proximal regions of the gland tubule.

Tests applied	*Intensity of reaction*	
	apical region	*proximal region*
1. Millon's test for protein groups	+ + +	+ +
2. Ninhydrin test for amino acids	+ + +	+ +
3. Best's carmine test for glycogen	+ + +	+
4. Sudan IV method for lipids.	+ +	+

+ + + strong reaction, + + moderate reaction, + weak reaction.

From this table, it is observed that both the regions respond to all tests and contain secretion of proteins, amino acids, glycogen and lipids. It is also evident from the intensity of reactions that the chemical substances

are more concentrated in the apical region than those in the proximal region indicating thereby secretory nature of the apical cells and that the proximal portion is simply a conducting pathway of the secretion into the ejaculatory duct.

DISCUSSION

It is interesting to note that among Acridoidea, the male members possess variable number of accessory glands. In *Locusta* 18 tubules on each side have been recorded by Ivanov (1926) and 16 by Albrecht (1953), but Mika (1959) and Gregory (1965) concluded the number to be 15.

In *Dociostaurus*, *Anacridium* and *Chortophaga* the number is 14 (Jannone, 1939; Ito, 1924; Fedorov, 1927; Payne, 1933). The number varies from 9 to 12 in *Pamphagus*, *Tmethis*, *Oedipoda Oedaleus*, *Chorthippus* and *Acrida* (Fenard, 1986). Hodge (1943) found only 2 glands in *Opshomala* and *Leptysma*. Alb and Pickford (1975) have described 15 tubules on either side of the ejaculatory duct in the clear winged grasshopper, *Camnula pellucida*. In *Poecilocerus pictus* the number is also found to be 15 and very much resembles that of *Locusta* and *Camnula* as described by Ivanov (1926) and Alb and Pickford (1975) respectively.

De Wilde (1964) has proved that the spermatophores contain proteinaceous substances and Khalifa (1950) confirmed this fact in the moth *Galleria* and some Trichoptera. Srivastava *et al* (1971) also agreed that in *Catantops*, protein released from the male accessory reproductive glands contributes to the formation of spermatophores.

Humphrey and Robertson (1949), Blum *et al* (1962), Srivastava and Verma (1971) suggest, that the high carbohydrate content in the secretions helps in the long term storage of sperms in the female body by serving as storage nutrient for the spematozoids in *Locusta migratoria*, drone honey bee and *Catantops indicus* respectively.

Scientists like Swaiiles (1971) and Riemann and Thorson (1969) have shown that the male glandular secretion helps to stimulate oviposition and decreases receptivity for mating in the females of the flies *Hylemya brassicae*.

In *P. pictus*, the high content of protein in the accessory glands appear to help in spermatophore formation and supplies glycogen for nutrition of the stored spermatozoids inside the spermatheca of the female.

Histologically in all the glands, the structure of the proximal region differs considerably from that of the distal region. In the dorsal region, the muscular coat is somewhat thinner. The basement membrane is less prominent and the epithelium contains columnar cells of larger size with enlarged nuclei. The lumen is filled with secretion. In the proximal region, on the other hand, the outer muscular coat is thicker with several layers of muscles, the basement membrane is well marked, the epithelial cells are comparatively narrower and the lumen may or may not contain secretions.

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Pranikee **2** : *49-50 (1981)*

ON A COLLECTION OF MOLLUSCS FROM PARADEEP COAST, ORISSA

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ABSTRACT

A Total of 15 species of molluscs, 14 species from class gastropoda and one species from class bivalvia, are reported from Paradip Coast, Orissa.

INTRODUCTION

The only comprehensive work done on the molluscan fauna of Orissa is the study of molluscan fauna of the Mahanadi estuary by Subba Rao and Mookherjee (1975) in which they recorded 21 species. Information on the marine molluscan fauna from the coasts of Orissa is rather limited. Therefore, marine mollusc shells were collected from the catch of fishing trawlers operating in Paradeep coast, Orissa located at Latitude 20° 15′ 56″ N and Longitude 86° 40′ 34″ E. The collection includes 14 species of gastropods belonging to 10 families and one species from bivalvia.

Class—Gastropoda

Order—Archaeogastropoda

Family—Trochidae

1. Species—*Umbonium vestiarium* Linnaeus (Fig. 1).

Order—Mesogastropoda

Family—Turritellidae

2. Species—*Turritella attenuata* Reeve (Fig. 2).

Family—Naticidae

3. Species—*Natica chemnitzii* Recluz (Figs. 3-4).

4. Species—*Natica lineata* Gmelin (Figs. 5-6).

Family—Bursidae

5. Species—*Bursa spinosa* Lamarck (Figs. 7-8).

Family—Tonnidae

6. Species—*Tonna maculata* Linnaeus (Figs. 9-10).

Family—Pirulidae

7. Species—*Pirula ficus* Linnaeus (Figs. 11-12).

Order—Neogastropoda

Family—Muricidae

8. Species—***Murex tribulus*** Lamarck (Figs. 13-14).

9. Species—*Rapana bulbosa* Solander (Figs. 15-16).

Family—Olividae

10. Species—*Olivancillaria* (Agaronaia) *gibbosa* Born (Figs. 17-18).

Family—Harpidae

11. Species—*Harpa major* Roding (Figs. 19-20).

Family—Turridae

12. Species—*Surcula jāvana* Linnaeus (Figs. 21-22).

Family—Buccinidae

13. Species—*Babylonia canaliculata* Schaumacher (Fig. 23).

Family—Volutidae

14. Species—*Cymbium melo* Solander (Figs. 24-25).

CLASS—BIVALVIA

Sub-Class—Heterodonta

Order—Veneroidea

Family—Veneridae

15. Species—*Sunetta scripta* Linnaeus (Figs. 26-27).

ACKNOWLEDGEMENTS

We would like to thank the Zoological Survey of India, Calcutta, especially Zoologist Dr. N. V. Subba Rao for identifying the specimens. Thanks are also due to Dr. B. B. Parida of the Department of Zoology, Utkal University for his helpful suggestions, and Sri S. Mishra for his help in photography.

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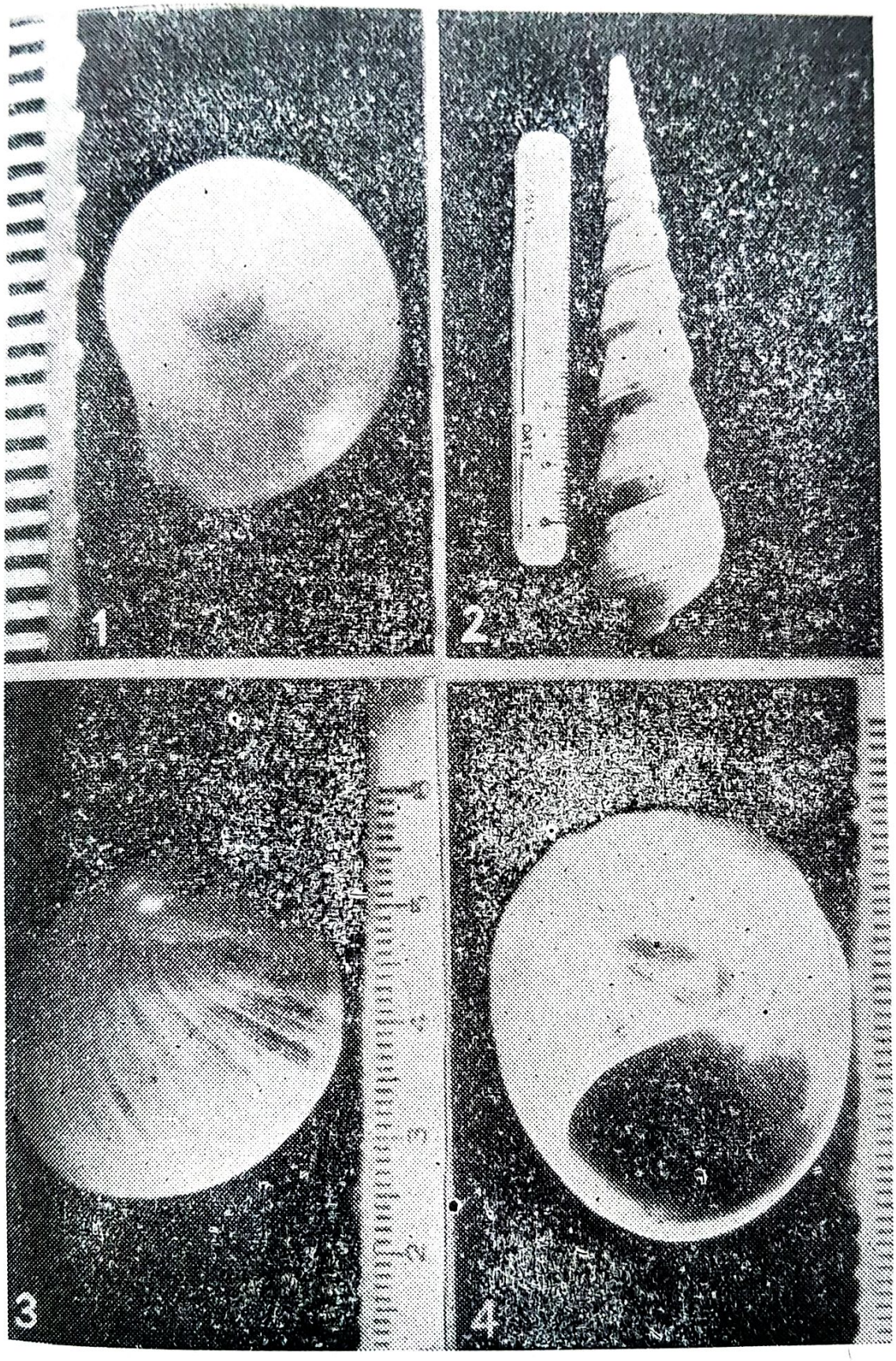
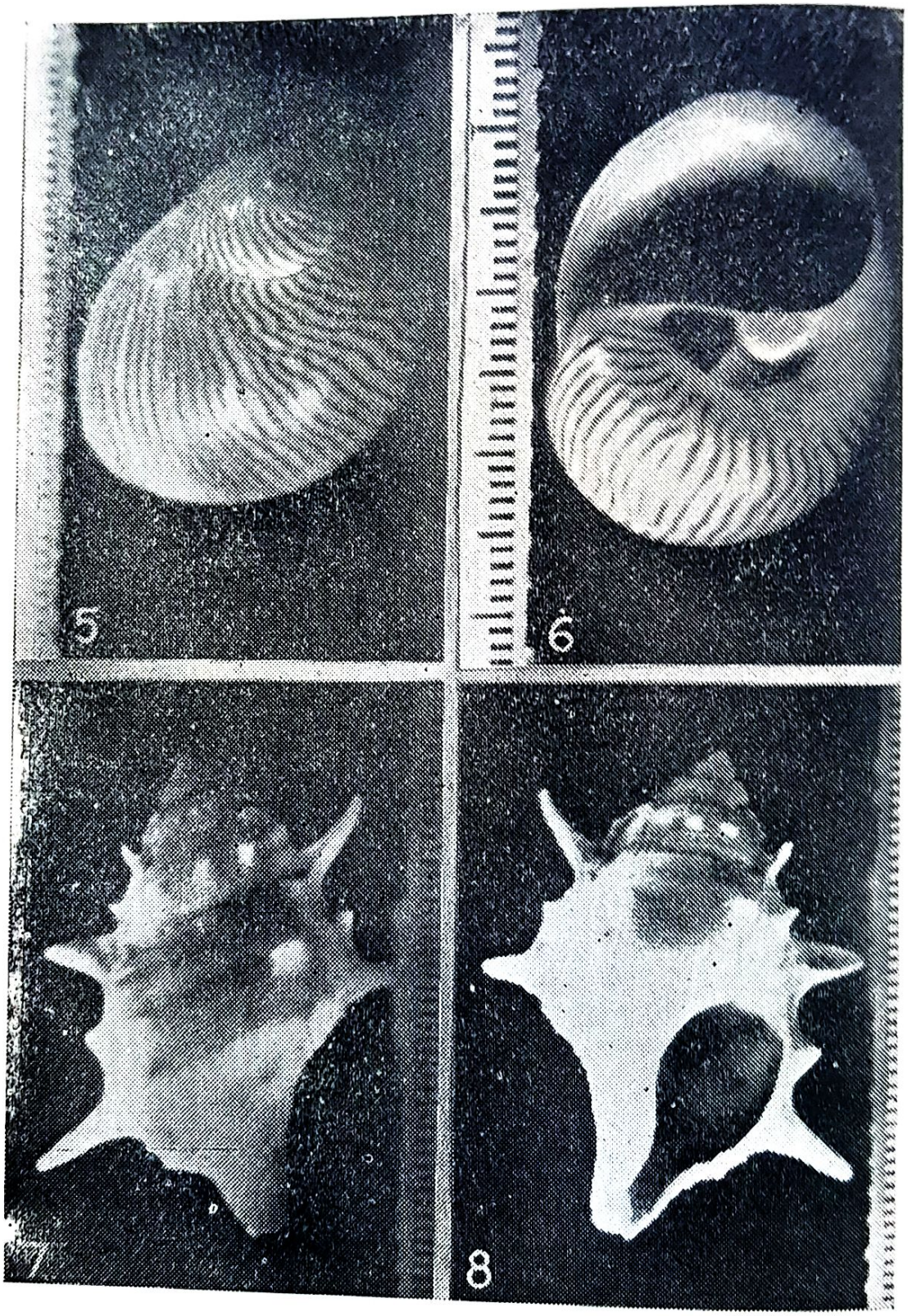


FIGURE LEGEND

Fig. 1-27. Shells from Paradeep coast. Scale in mm. See text for details.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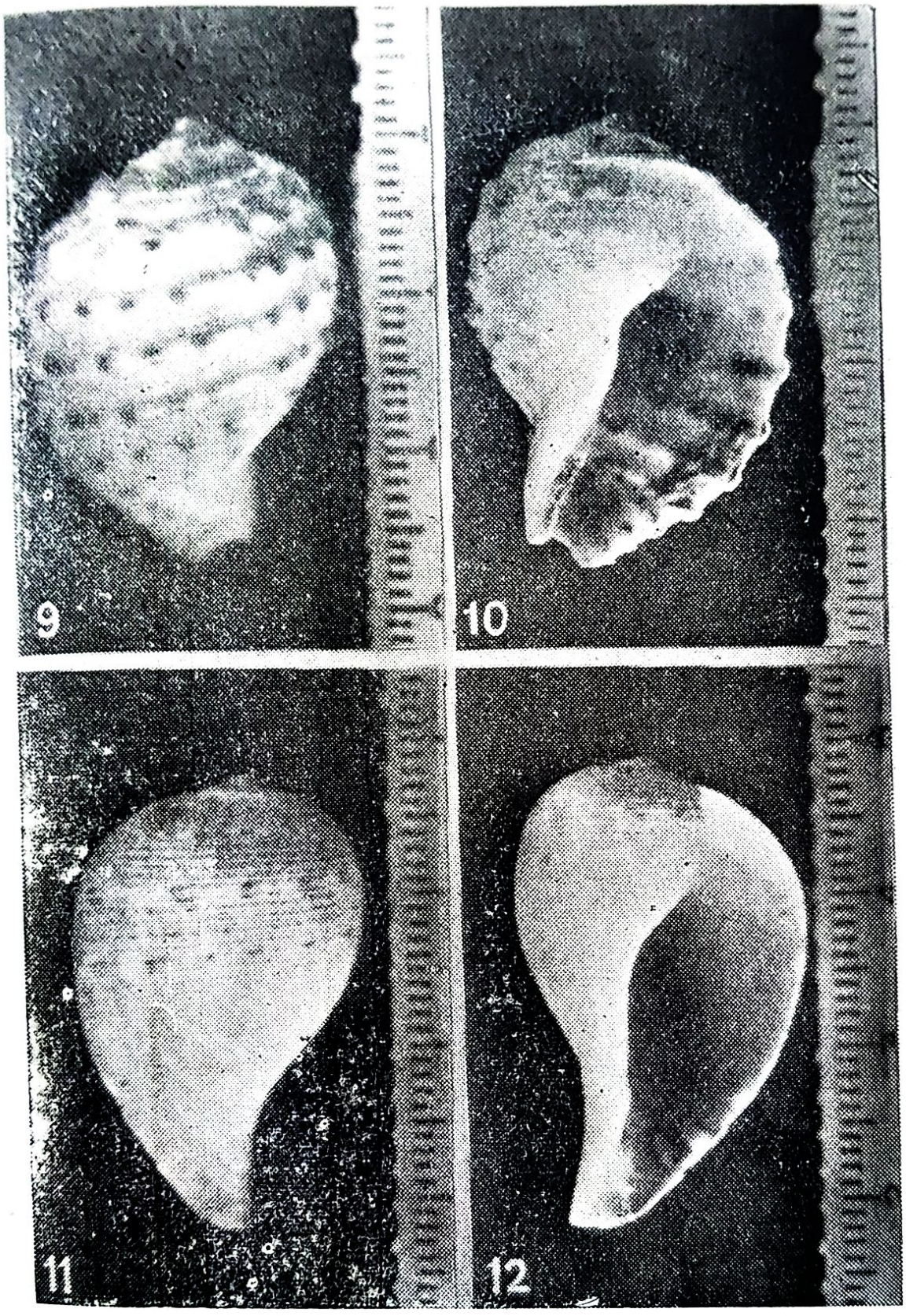
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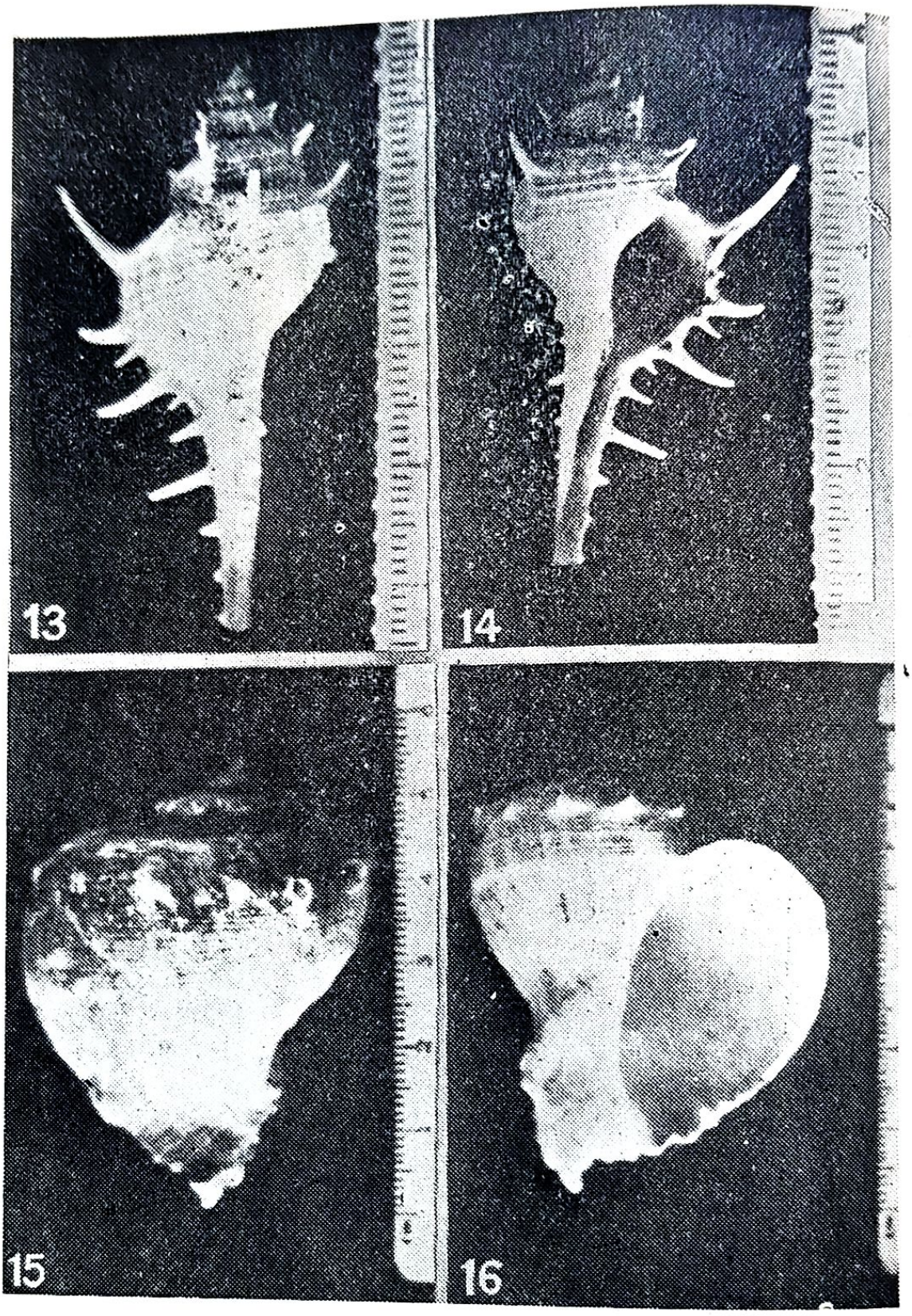
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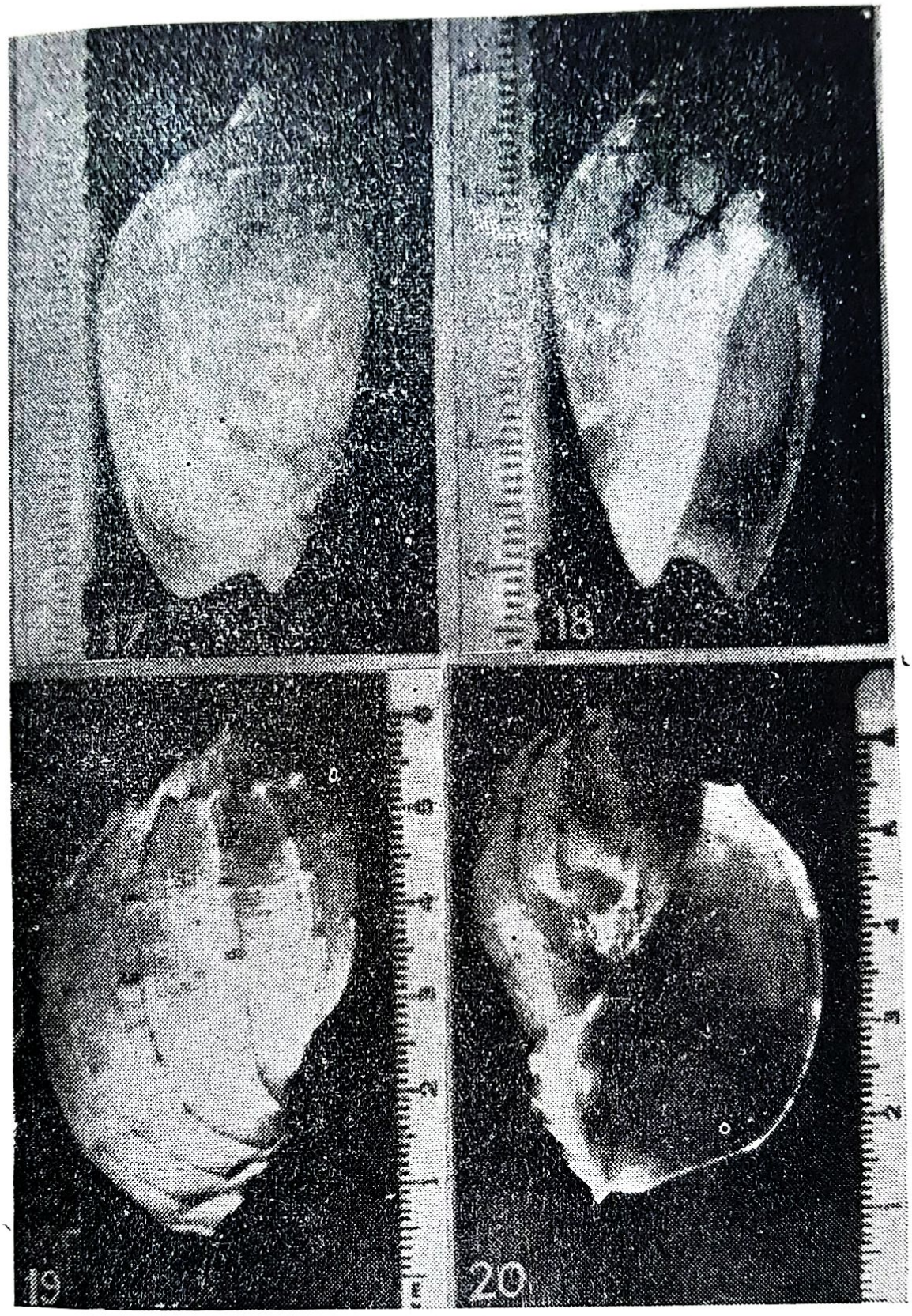
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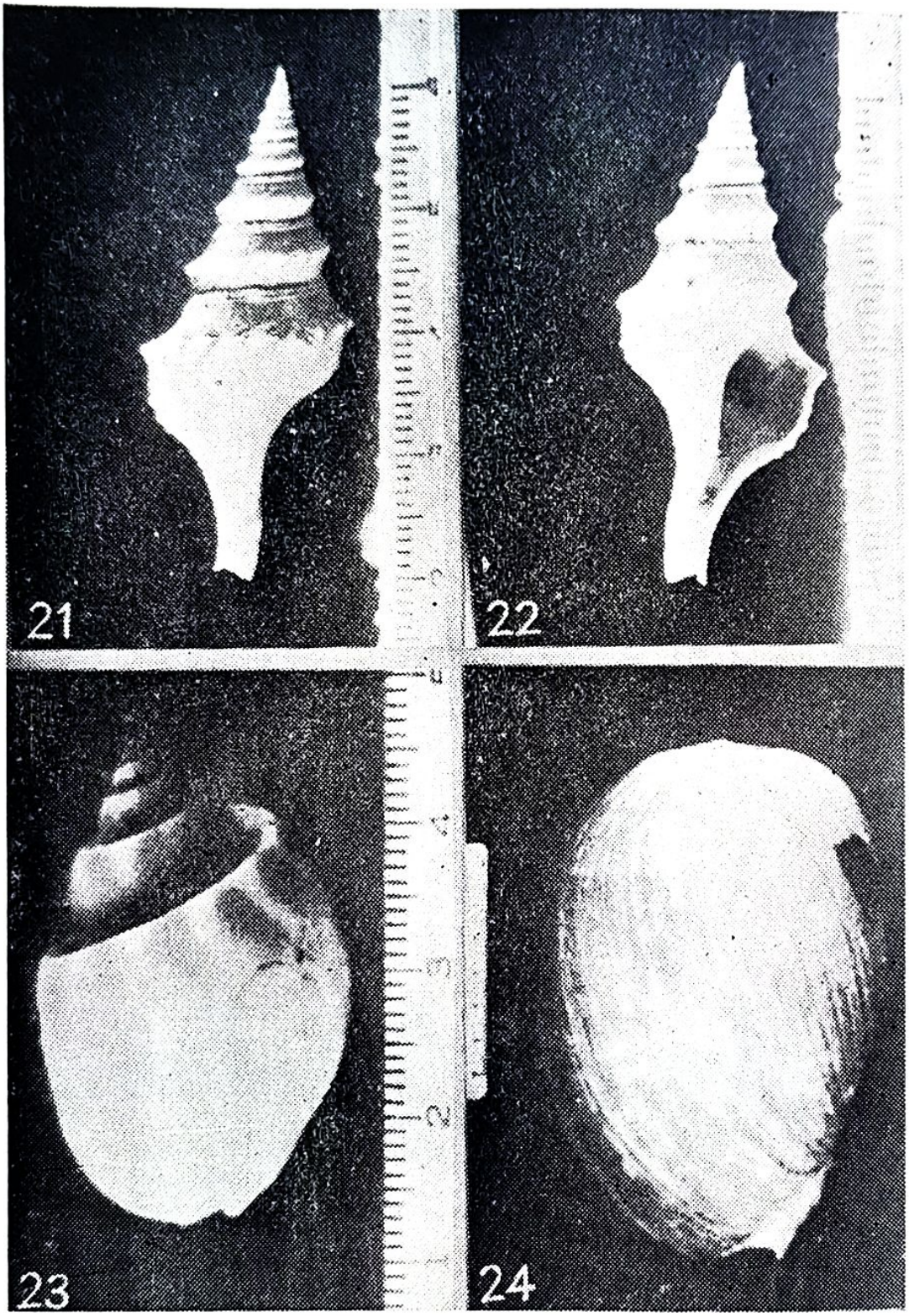
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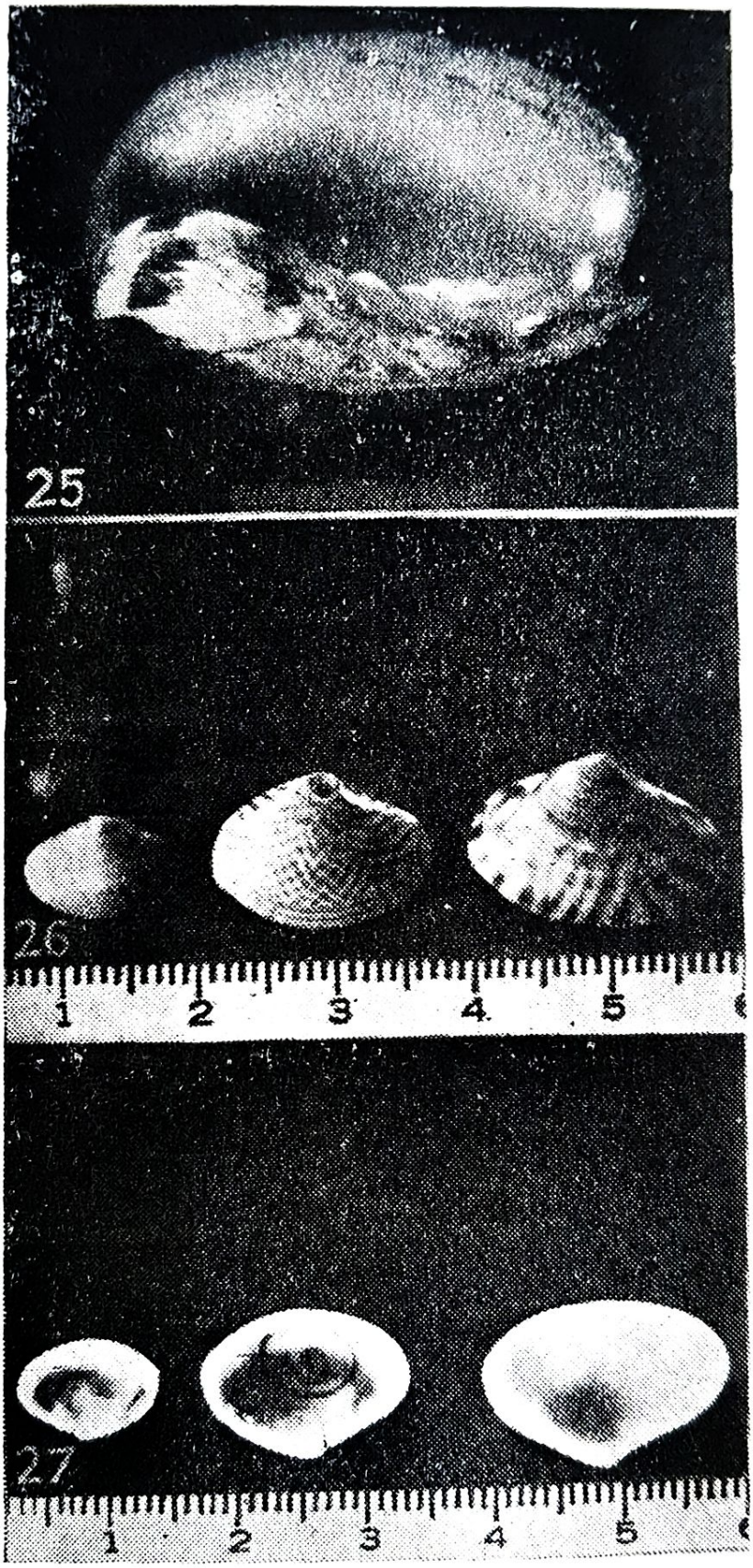
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Pranikee, 2 : 51-55 (1981)

INTER AND INTRASPECIFIC PREDATION BY *RANA TIGERINA* TADPOLES

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ABSTRACT

Rana tigerina tadpoles are predators of tadpoles of other sympatric anuran species. They turn cannibalistic if maintained at high concentrations. Therefore, they play a major role in controlling inter and intraspecific populations in the temporary rain water pools during monsoons. Although it has been reported that *Bufo* tadpoles secrete an effective retarding substance as protection against predation, *R. tigerina* tadpoles can eat *Bufo melanostictus* tadpoles repeatedly without showing any adverse effects.

INTRODUCTION

Aquatic breeding anurans are subject to predation from a number of species. Brockelman (1969) has reported that the leech *Batrachobdella picta* and odonate nymphs cause considerable damage to *Bufo americanus* tadpoles under natural conditions and recently Werschkul and Christensen (1977) have discussed the differential predation by the bluegill sunfishes *Lepomis macrochirus* on the eggs and tadpoles of *Ranā*. However, predation of larvivorous tadpoles in regulating interspecific and intraspecific tadpole population has received little attention.

During a study of the reproduction and life-history of anurans of Bhubaneswar (Mohanty-Hejmadi & Dutta 1979), it was noticed that Indian Bull frog *Rana tigerina* tadpoles with typical carnivorous mouthparts, were devouring other tadpoles under natural conditions indicating that they were a major predator in the temporary pools during the monsoons. Therefore, experiments were set up to determine the inter and intraspecific predation habits and the method of feeding of *Rana tigerina* tadpoles. Since it has been reported that *Bufo* tadpoles possess a predator retarding substance (Szarski, 1972), *Bufo melanostictus* tadpoles were also offered to *Rana tigerina* tadpoles in this study.

METERIALS AND METHODS

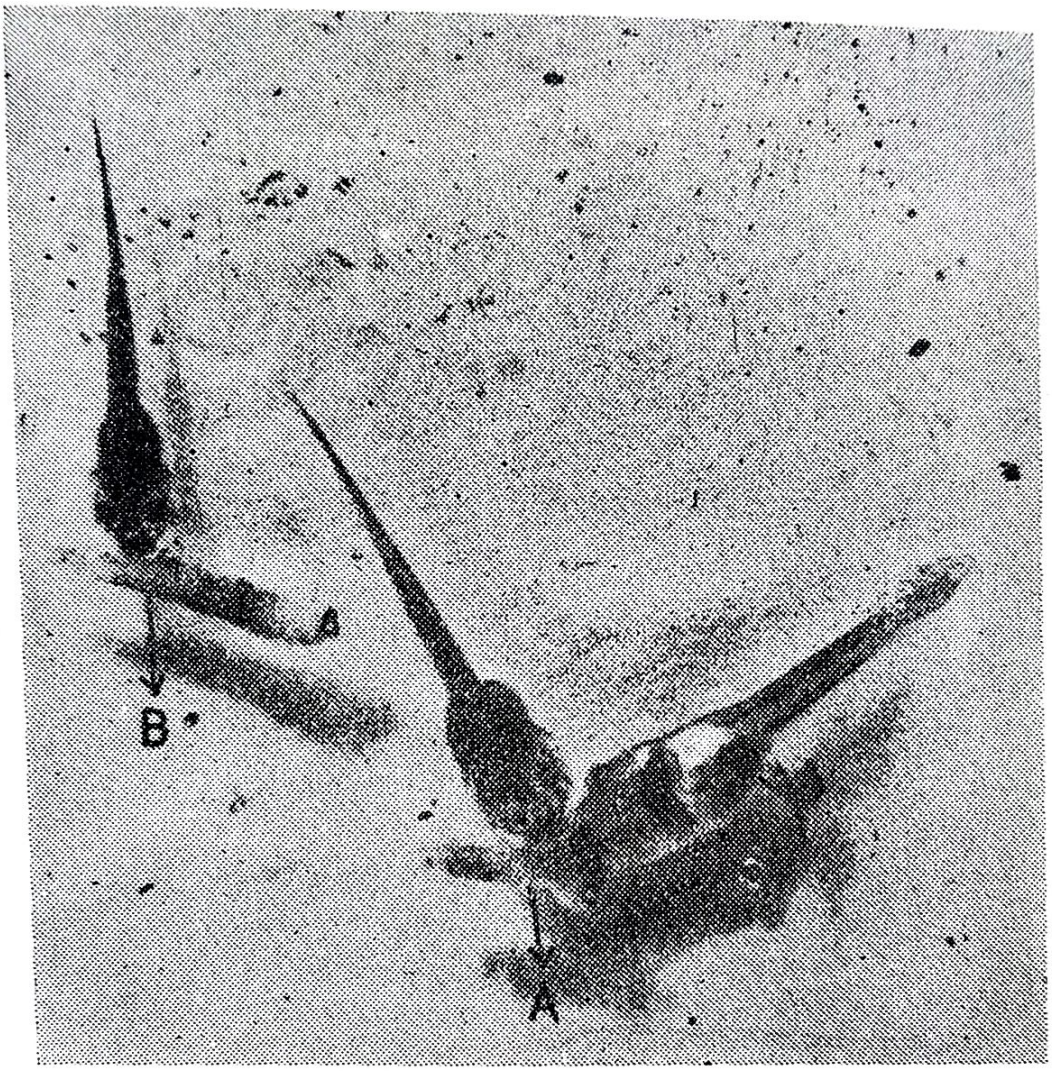
Rana tigerina egg masses obtained from nature were raised under standardized conditions in the laboratory (Mohanty-Hejmadi 1977), upto the desired stage. Two stages of the tadpoles were used as described under each experiment. Standard food was available *ad libitum* to the tadpoles throughout the experiment. Experiments were terminated when all the preys were consumed or after 36 hr whichever was earlier. The terminology of Webb and Korky (1977) was followed to determine the tooth row formula.

To determine the concentration at which cannibalism occurs, ten, twenty and thirty, 15 to 19 mm, 5 day old tadpoles with a tooth row formula 3 (2-3)/0/3(1) were set up in one litre of water each, in identical enamel coated bowls. To determine interspecific predation, ten same age tadpoles as described in the previous experiment, were set up with a combination of five 5 to 7 mm *Uperodon systoma*, five 4 to 5 mm *Microhyla ornata* and five 5 to 7 mm *Rana limnocharis* pre-limb stage tadpoles in 500 ml of water.

To determine the palatibility of *Bufo* tadpoles, five same age and size *Rana tigerina* tadpoles as in previous experiments, were set up with ten 5 to 7 mm, *Bufo melanostictus* pre-limb stage tadpoles. In addition, five 38 to 40 mm, 27 day tadpoles at metamorphic stage — X of Taylor and Kollross (Rugh, 1962) with a teeth row formula of 4(2-4)/0/4(1-2) were set up with five 5 to 7 mm *Bufo melanostictus* tadpoles. The latter had an average diameter of 1 cm around the widest part of the body.

RESULTS AND DISCUSSION

Intraspecific predation (Cannibalism) : Cannibalism was evident within four hours in the group with 30 tadpoles. One smaller tadpole was lying dead in the bottom and other living tadpoles were feeding on it occasionally. Within twenty hours two smaller tadpoles had been completely consumed by the larger tadpoles and a smaller tadpole was seen being eaten by two larger tadpoles (Fig. 1.) No cannibalism was observed in groups with 10 and 20 tadpoles. Since plenty of food was available, it was concluded that cannibalism was induced by concentration alone. This indicated that similar cannibalism must exist in nature when the concentration of the tadpoles exceeded certain limits. The method of attack was similar. The larger tadpoles with their powerful rasping apparatus, inflicted



Intraspecific predation in *Rana tigerina* tadpoles. A—two tadpoles eating one; B—one tadpole eating one.

wounds by biting the smaller ones. If the location and severity of the wound was such that the prey was not able to escape subsequent attacks, then it succumbed. In one instance a smaller tadpole had an wounded tail suggesting that it had probably survived such an attack.

Interspecific predation ; Within 24 hours all the *Microhyla* and *R. limnocharis* tadpoles were consumed. Only two of the *Uperodon* tadpoles were living. Both *Microhyla* and *Uperodon* tadpoles are filter feeders mainly staying near the surface and *R. limnocharis* tadpoles are bottom dwellers. Since tadpoles mainly stay at the bottom making occasional trips to the surface, it is possible that they cleaned up the tadpoles in the bottom first because they came in contact with them first. They must have eaten the surface dwelling *Microhyla* on their trip up. *Uperodon* tadpoles could survive longer, probably because with a muscular tail they could escape to some extent. However, both the surviving *Uperodon* tadpoles were consumed within the next 12 hr.

Predation on Bufo melanostictus tadpoles ; *Bufo* tadpoles were attacked within 30 minutes. *R. tigerina* tadpoles bit the ventral side of body or the tail of the prey. The latter was most effective in immobilizing the prey by interfering with its main propulation mechanism i. e., the base of the tail. Within two hr, two *Bufo* tadpoles have been killed. Inspite of the two dead tadpoles in the bowl, sometimes being eaten and mostly lying as a reserve, fresh *Bufo* tadpoles were killed. One *Bufo* tadpole was seen hiding under the vegetable food material, probably as an instinctive protective cover. *R. tigerina* todpoles were not seen under cover during the experiment. Within 6 hr all the *Bufo* tadpoles were consumed.

In the group with stage X, *R. tigerina* tadpoles, as long as *Bufo* tadpoles were swimming, often touching the *R. tigerina* tadpoles, there were no attacks. However, when a *Bufo* tadpole which is also a bottom dweller, came to rest close to the mouth of a *R. tigerina* tadpole, the latter bit the part nearest to its mouth. As mentioned earlier, other *Bufo* tadpoles were killed before the consumption of the first one, provided the victim touched the mouth of the predator in the following manner.

Any time a *Bufo* tadpole came to lie next to the mouth of a *R. tigerina* tadpole, the latter bit the former. In appeared that this biting reflex was triggered by certain receptors around the mouth area. These larger tadpoles cleaned up *Bufo* tadpoles at a fast rate. In one instance as soon as a *Bufo* tadpole came to rest next to the mouth area of *R. tigerina*, the former was

literally swallowed. This tadpole was fixed immediately in 10% formalin for future examination. When this tadpole was dissected out a few days later, it was observed that the *Bufo* tadpole had been swallowed and its viscera had been squeezed out like a paste out of the tube. The ghost external membrane was lying coiled in the proximal part of the gut. The diameter of the intact *Bufo* tadpoles at the widest part was 1 cm.

GENERAL CONCLUSIONS

This study showed that cannibalism is concentration induced even with other food available in the sorroundings. Thus, these tadpoles are larvivorous and must play a role in reducing their own population in nature. Since tadpoles of other species of anurans were consumed in this experiment and tadpoles of all these species are found together in the temporary pools during monsoon season, it is reasonable to believe that *Rana tigerina* tadpoles are effective predators of all sympatric species of anuran tadpoles and probably fish and insect larvae too. This larvivorous habit in addition to controlling inter and intraspecific populations, also ensures the high protein diet necessary for fast growth. The time period for completion of life history of *Rana tigerina* is shortest among the species studies so far (Mohanty-Hejmadi, 1977). It becomes even more impressive as the size and volume of growth of *tigerina* tadpoles is maximum among the local species. *Bufo melanostictus* tadpoles were eaten repeatedly without any adverse effect on the predator indicating that either the *Bufo* tadpoles do not secrete the retarding substance which has been reported for other species of *Bufo* (Szarski, 1972) or the *Rana tigerina* tadpoles are immune to these substances. The method of feeding seems to vary according to the size of the prey. If the prey is larger than the size of the clearance of its mouth they are killed by biting off large chunks and then devoured by the rasping mouth apparatus. If the size of the prey is smaller than the clearance of the beak, then it can be swallowed *in toto*. In both cases the biting or swallowing is triggered by touching the area around the mouth of the *Rana tigerina* tadpoles which probably has some special receptors.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. B. K. Behura, Head of the Dept. of Zoology for his kind encouragement throughout this study. One of us (SKD) thanks CSIR, New Delhi for a junior research followship.

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Pranikee, 2 : 56 59 (1981).

AN IMPROVED TECHNIQUE FOR THE PREPARATION OF COCCID (COCCOIDEA : HOMOPTERA) CHROMOSOMES *

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ABSTRACT

An alcoholic HCl-Carmine technique suitable for the study of scale insect (Coccoidea : Homoptera) chromosomes is described.

INTRODUCTION

The coccids (Coccoidea) popularly known as scale insects, are of considerable interest on account of the unusual modification of their body structure, and as serious pests of our nursery plants, orchards and major crops. Therefore, in recent years much attention has been paid to the systematics. biology and control of economically important scale insects in advanced countries of the world through International Biological Programme (Kosztarab, 1977). In comparision to systematics, biological control, endo-symbiosis and other sophisticated areas of coccidology, not much is known about their cytogenetics. Chromosome cytology of the species found in U.S.A. have been reported (Brown, 1963, 1965; Hughes-Schrader, 1948; Hughes-Schrader and Tremblay, 1956, Nur, 1967, 1971 and 1972). Unfortunately the cytological study of coccids has been neglected in India (Manna, 1969). Therefore, a study was undertaken to determine the karyotype of indigenous scale insects found around Bhubaneswar, Orissa State.

In this paper an improved technique (alcoholic HCl-carmine) modified after Snow (1963), is described which is very suitable for the study of coccoidea chromosomes. The advantage of using this stain is that the nucleus can be clearly differentiated and the chromosomes are brightly stained.

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* Dedicated to Dr. T. H. Yosida, Head Department of Cytogenetics, National Institute of Genetics, Misima, Japan on his 60th birthday.

MATERIALS AND METHODS

Specimens of different instars of coccids are collected from their host plants. Instars alongwith the plant material are carried to the laboratory for fixation. The gravid females are transferred with a fine needle and camel hair brush to the Bradley-Carnoy fixative (Brown and Bennet, 1957) and stored in the same. The insects are punctured with a fine needle for better penetration of the carnoy's fluid.

1. After 24 hours the fixed insects can be processed for chromosomal preparations. The specimens are thrice washed with 70% alchol at an interval of one hour. Then the specimen are transfered to alcoholic HCl-carmine stain for 48 hours. Alcoholic HCl-carmine has been reported to be the better stain for study of coccoid chromosomes (Snow, 1963).

2. After staining, the specimens are washed in 70% alchohol with two changes at an interval of one hour.

3. The embryos are dissected out under binocular microscope in 70% alcohol for chromosome preparation by employing Smith's (1974) technique. The younger embryos from the gravid females are more suitable for the purpose than older ones.

4. Three to four embryos are transferred to a drop of 45% acetic acid on a slide, A clean cover glass is placed on the embryos and heated gently over a flame for spreading of the material.

5. The slide is then inverted on an absorbent paper pressed with the thumb, sealed with paraffin wax.

The slide is now ready for permanent preparation. The procedure for permanent preparations modified by us is described.

1. The wax from the slides are removed by the help of a sharp razor blade.

2. An identical ink mark is given over the slide and coverglass.

3. The slide is inverted in a solution of 1:1:1 (Acetic acid: xylene ethanol) kept in a covered petri dish. After some time the cover glass will seperate.

4. The slides and the corresponding cover glass retransferred to a sequence of xylene-ethanol solutions (1:1; 3:1 and 9:1) for 5-7 minutes each

5. Lastly the slide alongwith the cover glass are transfered to xylene for 5 minutes.

6. Mounting is made with a drop of canada balsam.

7. The mounted slide is kept in an oven at 60°C for about one week.

8. Now the slide is permanent and ready for chromosome studies. Photographs of chromosomes of a few coccids are given for illustrations (Figs. 1—6).

ACKNOWLEDGMENT

We are thankful to Prof. B. K. Behura, Professor and Head of Zoology Department, Utkal Univ., for kindly extending laboratory facilities and to U. G. C. for a Teacher Fellowship to one of us (SM) under Faculty Improvement Programme.

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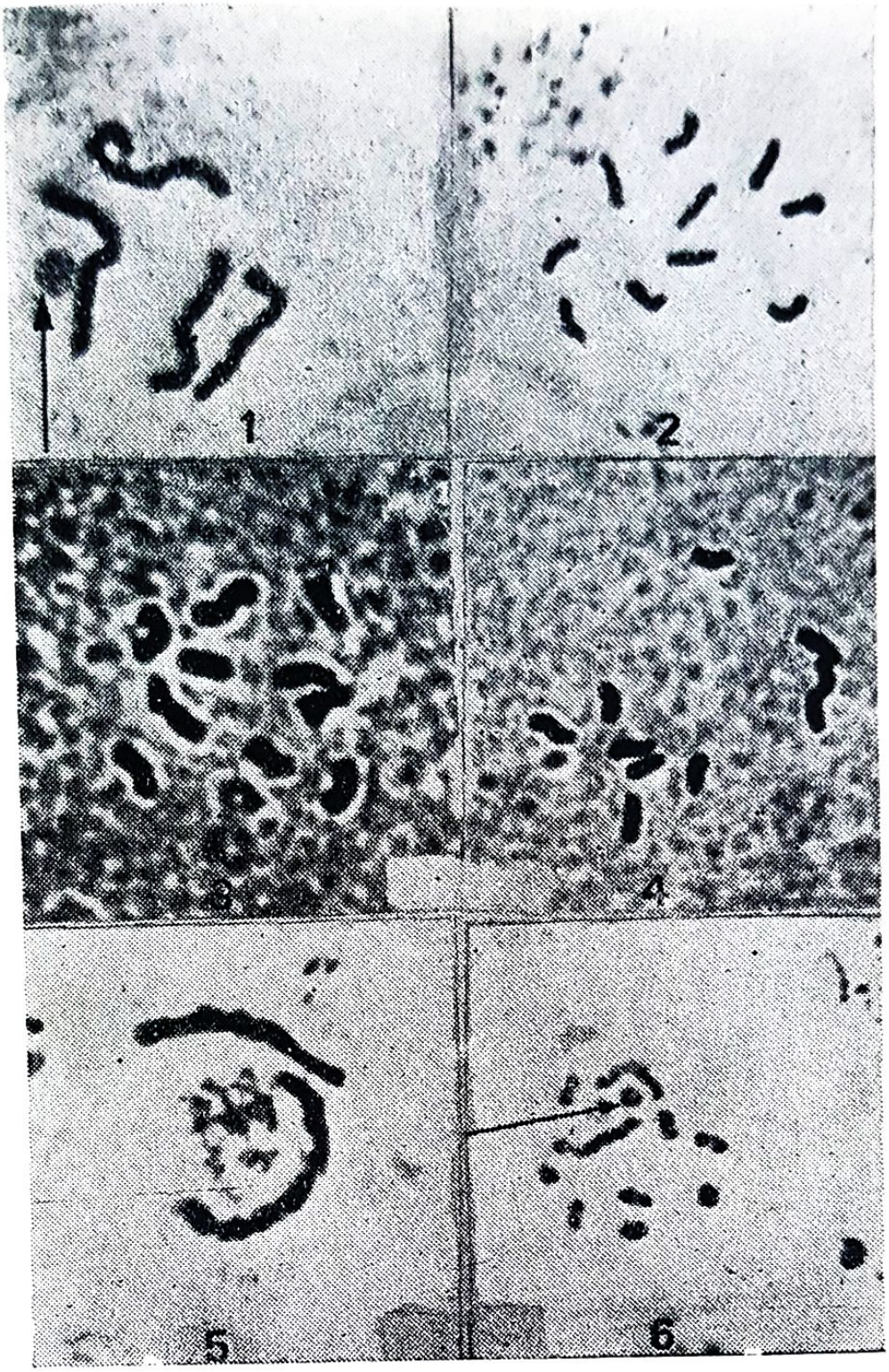

Fig. 1. *Icerya formicarum*, metaphase, 2n = 4 (Nucleous—arrow)
2. *Ferrisia virgata*, metaphase, 2n = 10
3. *Nipaecoccus viridis*, metaphase, 2n = 10
4. *Indococcus pipalae*, metaphase, 2n = 10
5. *Icerya* sp. metaphase n = 2.
6. *Dactylopius indicus*, metaphase, 2n = 10 (Nucleolus—arrow).

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Prnikee, 2 : 60-61 (1981)

SOME OBSERVATIONS ON MATING BEHAVIOUR OF TIGER (*PANTHERA TIGRIS*) *IN CAPTIVITY*

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The present report embodies some notes on mating behaviour of a compatible pair of tigers (*Panthera tigris*) observed at the Nandankanan Biological park, Orissa during the periods from 13.11-1976 to 20-11-1976 and from 3.2.1977 to 10.2.1977.

The external genitalia of the tigress in oestrus becomes moist and swollen. She frequently marks on the structures of the enclosure i. e., the walls, the fence (Chain link-mesh), the poles and the plants with her marking fluid. The tiger sniffs the places of marking (Fig. 1) followed by grimacing with the nose wrinkled and the tongue protruding out (Fig. 2). At this time droplets of saliva fall down from the hanging tongue. At times the tiger also marks on the places of marking of the tigress The behaviour of sniffing and grimacing are noticed several times during the period of mating.

Mating is always initiated by the tigress in oestrus. She displays a series of signals to intensify the partner's desire to mate. She approaches the resting male and goes on rubbing her face and head on those of the tiger till he gets up. The tigress then moves round the enclosure with the tail raised and the tiger follows her (Fig. 3). During this process the male strikes the hindlimbs of the tigress with his fore-paws. This behaviour may be an indication of readiness of the male for actual mating.

Fig. 1 The tiger sniffs at a plant, previously marked by the tigress in oestrus.
Photo—PRASANT K. PATNAIK

Fig. 2. After sniffing, the tiger grimaces with protruded tongue and wrinkled nose.

Photo—PRASANT K. PATNAIK

Fig. 3. The tiger follows the tigress in oestrus with raised tail, just before mating.

Fig. 4. Mating of tigress in progress. Mark the raised hind quarters and the position of the tail of the tigress.

Photo—PRASANT K. PATNAIK

Fig. 5. Climax of mating. Mark the extended neck condition of the tiger.

Photo—PRASANT K. PATNAIK

Fig. 6. End of mating ceremony. Mark the raised condition of the tail and exposed penis of the tiger.

Photo—PRASANT K. PATNAIK

The tigress then sits down in front of the tiger in a crouching position. The male mounts and mating takes place by friction. During mating the hind quarters of the tigress are kept in a somewhat raised position with the tail to one side, probably to facilitate proper contact of the genitals. But the tail of the tiger remains in usual position (Fig. 4).

At the climax of mating the tiger extends his neck, takes a good grip of a fold of skin on the tigress's neck (Fig. 5) and produces a peculiar guttural sound probably corresponding with the act of ejaculation.

At the end of mating, the male jumps off and the female almost turns upside down, both making a peculiar loud noise typical to the end of the mating ceremony. At this stage the male keeps its tail raised probably to maintain balance and his penis remains out for a few seconds (Fig. 6). Each mating lasts for a period of about 8 to 35 seconds (as noticed in 26 observations from 3.2.1977 to 7.2.1977.

The inter-mating period may vary from twenty minutes to several hours. On 7.2.1977, fifteen matings were observed during a period of nine hours (from 8 AM-5 PM).

Mating is more frequent during the mid 2-3 days of the oestrus period and duration of mating is longer during the last two days of the period.

Mating of tigers in this Biological Park have been observed in all the months of the year except October.

Pranikee, 2 : 62-64 (1981)

STUDIES ON THE PREPARATION OF WHOLE MOUNTS OF SCALE INSECTS (COCCOIDEA : HOMOPETRA)

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ABSTRACT

Classification of scale insects is based almost exclusively on the morphology of adult females. Thus it is necessary to prepare very good whole mounts so as to study the morphological parts in detail. A suitable technique for the preparation of whole mount of female coccids is described.

INTRODUCTION

The superfamily Coccoidea includes approximately 6,000 described and perhaps as many underscribed species (Kosztarab, 1979). Depending upon the presence or absence of abdominal spiracles, the superfamily is subdivided into two groups viz., (i) Archeococcoidea and (ii) Neococcoidea. Most coccidologists recognize 15 to 20 families, though this number is controversial. Irrespective of the family controversy, they are divided karyologically into three sections : Margaroidae, Lecanoidae and Diaspidoidae (Hughes-Schrader, 1948),

Scale insects are some of the most fascinating and unusual organisms in the Insecta. They are notorious plant pests; especially affecting nut and fruit trees, woody ornamentals, forest vegetation, and indoor plantings. Plant damage may be caused directly by feeding or by injecting toxins or plant pathogens. It is therefore necessary to know the coccoid fauna of India since we mostly depend on agriculture. However, no uptodate records of these insects are yet available (Ali, 1971).

As members of the four-winged Homoptera, male scales have only mesothoracic wings while the metathoracic wings are reduced to stubs. The adult males function in gene pool dissemination while the females are degenerate, apterous and function as reproductive factories.

As we know, historically scale classification has been based almost exclusivly on the morphology of adult females Hence it is necessary to

prepere very good whole mounts so as to study the parts in detail. A suitable technique for the preparation of slides of female coccids is described.

MATERIALS AND METHODS

The scales were collected *in situ* by detaching pieces of bark, twigs or other plant parts. Then they were numbered. The names of the host plants, localities and date of collection were noted. They were preserved in 70% alcohol.

In order to obtain different instars in the laboratory eggs were reared in a petri dish on leaves of host-plants and in some instances on potato tubers.S ufficient precaution, however, was taken by introducing absorbent papers to avoid moisture in the rearing petri dish so as to prevent growth of molds. Specimens of different instars were preserved in 70% alcohol.

MOUNTING METHODS

Different instars and adult females preserved in 70% alcohol were used for mounting on microscopic slides as detailed below.

(1) The instars were transferred to 5% KOH and heated at about 60°C until the body became transparent. In case of adults, the specimens were transferred to 10% KOH and heated at about 94°C until the body became clear.

(2) Both the instars and the adult females were transferred to water with a fine brush. The body fluid of the adult female was expelled after pressing the specimen gently in a drop of water.

(3) The transparent specimens were then passed through ascending grades of alcohol : 30%, 50% and 70% alcohol for 7-8 minutes in each.

(4) The specimens were stained in 2% aquous Eosin for 15 to 20 minutes.

(5) The stained material were transferred to 90% alcohol for 10 minutes or until the material was properly destained.

(6) The material was treated with absolute alcohol (ethanol) for 5 minutes and transferred to xylol for about 10 minutes.

(7) The specimens were then mounted in canada balsam under a cover glass and marked with appropriate code number.

(8) Slides were kept in a drying oven at 40°C for about 2 weeks (Figs. 1-4).

Precautions :

(1) In case of old, dried and fungus infected females prolonged KOH treatment may be necessary.

(2) Before boiling in KOH (Step No. 1) a small incision may be made in between two antennae so that the body fluid can escape through this aperture at the time of boiling.

ACKNOWLEDGMENT

We are thankfu to Professor B. K. Behura, Head of the Department of Zoology. for kindly providing laboratory facilities and U. G. C. for awarding a teacher fellowship to one of us (S. M.).

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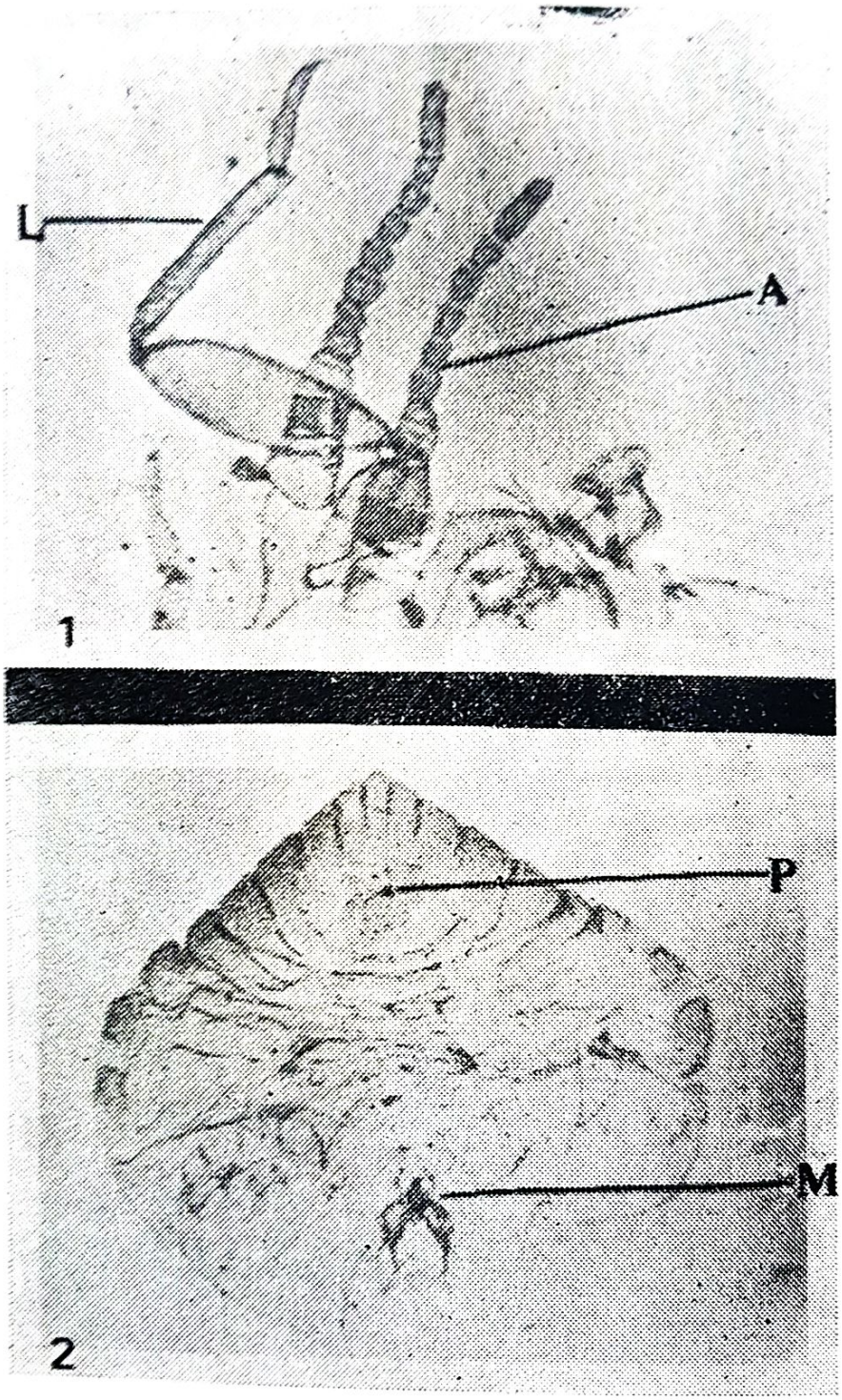

Fig. 1. Cottony-cushion scale, ***Crypticerya*** sp. showing two antennae (A) and one leg (L) (X10)

Fig. 2. Whole mount preparation of guava armored scale, *Hemiberlesia rataniae* showing anal plate (P) and mouth (M) (X10)

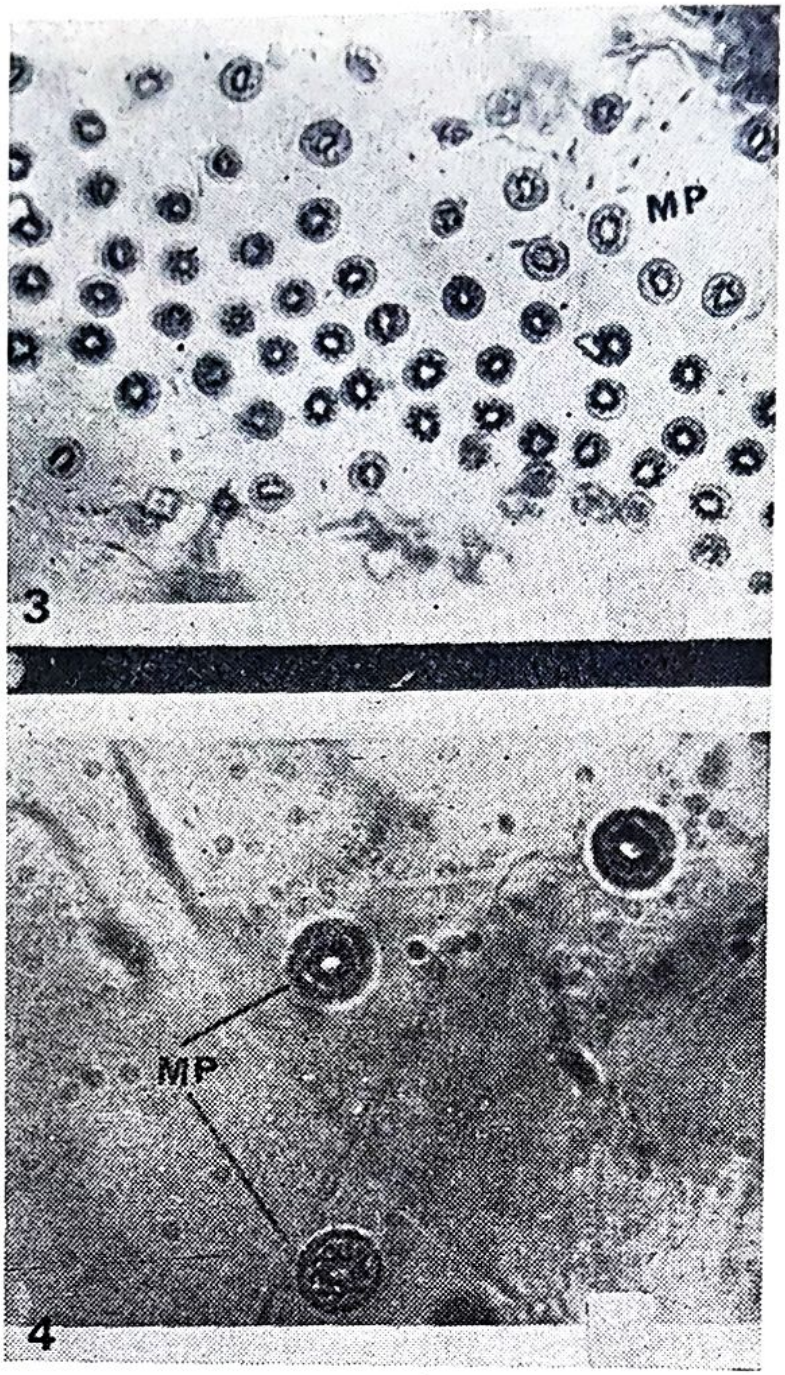

Fig. 3. Multilocular pores (MP) in the cottony-cushion scale *Crypticerya* sp. (X60)

Fig. 4. A few multilocular pores (MP) enlarged (X300).

Pranikee, 2 : 65 69 (1981)

DEVELOPMENT OF ANTENNA AND CAUDA THROUGH DIFFERENT INSTARS OF *RHOPALOSIPHUM MAIDIS* (FITCH)

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ABSTRACT

The antenna of *Rhopalosiphum maidis* (Fitch) is 4 segmented in the first instar, 5 in the second and third instars; and 6 in the fourth instars, in the adult apterous and alate viviparae. The increase in the number of segments occurs due to the division of segment III in the first and third instars. The cauda is indistinguishable and remains fused to the dorsal surface of the abdomen all through the instars until it develops into a long finger-like projection dorsally at the distal tip of the abdomen due to the posterior prolongation of the ninth tergite in the final ecdysis.

INTRODUCTION

Antenna and cauda are two important structures of aphids employed in the determination of species (Bodenheimer and Swiriski, 1957: Cott er, 1953; and Eastop, 1961). Davis (1909) studied the development of antennal segments in *Rhopalosiphum maidis* (*Aphis maidis*) and Takahasi (1924) made some observations on the development of cauda in *Aphis malvoides* v. d. Goot. However, studies on the development of these organs through different instars of this aphid species are lacking. Therefore an attempt has been made in the present investigation to study the development of antennal segments and cauda through different nymphal instars of *R. maidis*.

MATERIALS AND METHODS

Different stages of *R. maidis* were reared in the laboratory at 28°C temperature and 70% mean relative humidity on maize leaves. Specimens of the desired stage were mounted in canada balsam. More than twenty individuals of each instar were used for morphological studies of the antenna and cauda.

RESULTS AND DISCUSSION

Just after hatching, the nymph of the first instar destined to become either apterous or alate morph, has four-segmented antennae. The scape (Seg. I) and pedicel (Seg. II) are small. Seg. I is slightly longer than Seg II while Seg. IV is the longest and is differentiated into two regions—the base and the processus terminalis. Primary sensoria are present (Fig. 1) at the

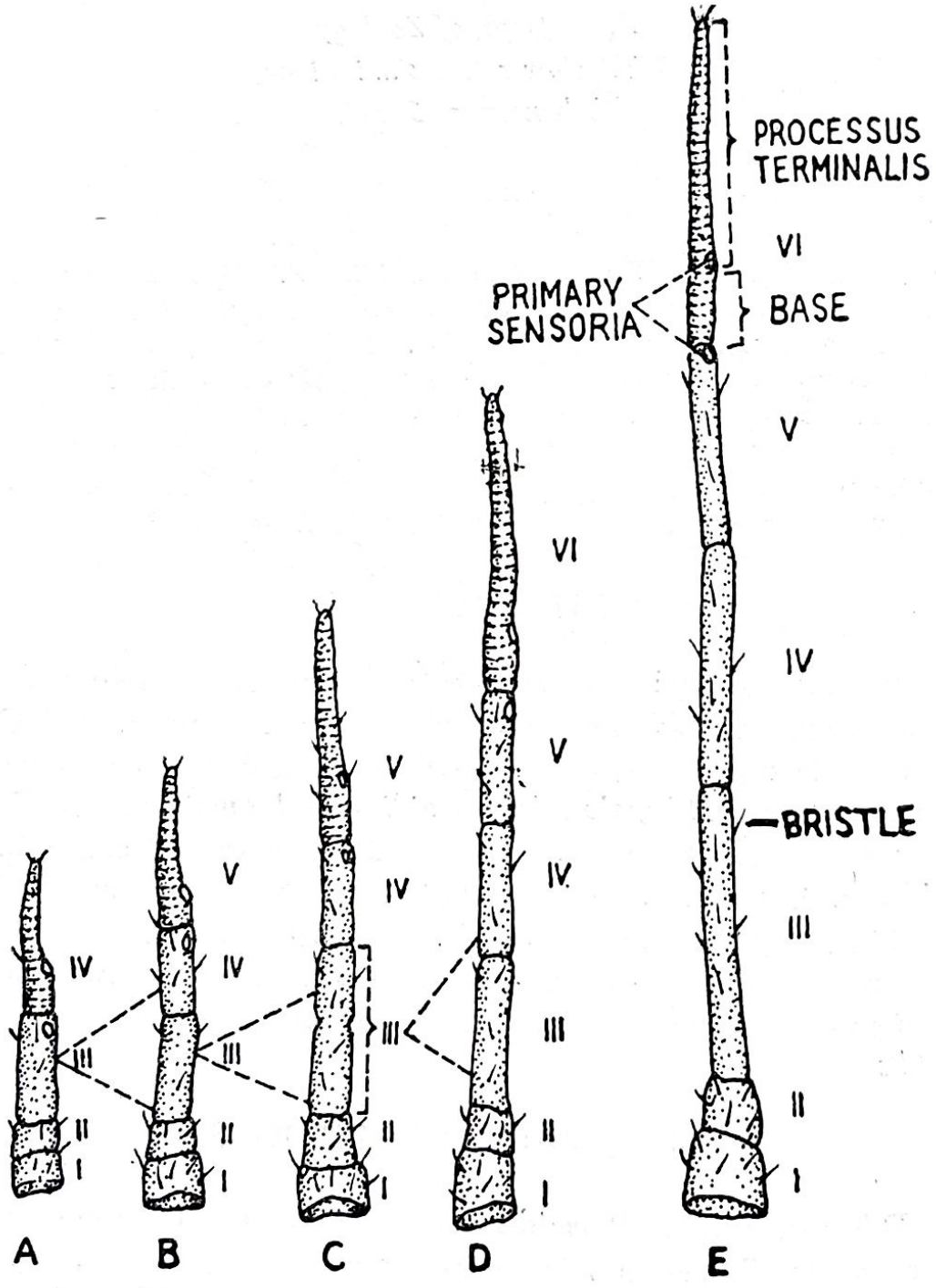

Fig. 1. Development of antenna through different instars in *Rhopalsiphum maidis* (Fitch). Antenna of A. first instar, B. second instar, C. third instar, D. fourth instar and E. adult apterous viviparae.

distal end of the 3rd segment (.i e., penultimate segment) and the distal portion of the base ot the 4th segment (i. e., ultimate segment). After the first moult the antenna becomes five-segmented due to the complete division of segment III of the first instar nymph. As a result, antennal segment IV of the Ist instar nymph now becomes segment V of the 2nd instar nymph. The primary senosoria now occur on the distal portion of the base of antennal seg nent IV and that of segment V.

In the third instar, a constriction begins to appear on the antennal segment III. In the fourth instar, the constriction which had started in segment III of the 3rd instar becomes complete during the 3rd moult. Thus, the antennae become six-segmented. The primary sensoria are now located on segments V and VI instead of IV and V of the 3rd instar. During the adult stage segmentation of the antenna remains as that of the 4th instar.

The scape and pedicel do not divide through successive nymphal instars. The post-pedicel elongates and becomes three-segmented by two successive divisions which take place in the 2nd and 4th nymphal stages. But a constriction persists during the 3rd nymphal stage before the 2nd division is completed. Thus:

1. Antennal segment I and II of the Ist instar nymph remains the same during all the nymphal stages and the adult.

2. The proximal half of antennal segment III of the 3rd instar nymph forms segment III of the 4th instar nymph and adult.

3. The distal half of antennal segment III of the 3rd instar nymph becomes antennal segment IV of the 4th instar nymph and adult.

4. Segment IV of the antenna of the 2nd instar nymph forms segment IV of the 3rd instar nymph and segment VI of the 4th instar nymph and adult (Fig. 1).

However, Davis (1909) based on specimens from U. S., reported that in *R. maidis* (*Aphis maidis*) the antennal segments in Ist, 2nd, 3rd and 4th instar nymphs and adult were 4, 4, 5, 5 and 6 respectively in viviparous female forms.

In the present study the corresponding nymphal stages and adults had 4, 5, 5, 6 and 6 respectively. This difference could be due to geographical variation.

Development of cauda :

No true cauda is present in the Ist instar or in any other nymphal stage of this aphid species. However, in the first instar nymph, the 9th tergum which is destined to become cauda of the adult is similar in shape to that of the anal plate. It remains indistinguishable and fused with the latter on the dorsal surface of the abdomen. It is broader than long, highly spinose and possesses two long bristles dorsally on its posterior edge nearer to the mid-dorsal line.

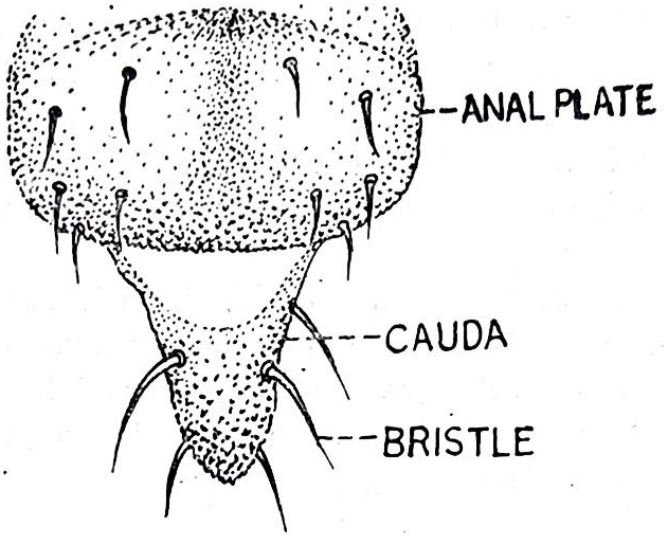

Fig. 2. Anal plate and cauda of apterous viviparae of *Rhopalosiphum maidis* (Fitch).

In 2nd, 3rd and 4th nymphal instars, the ninth tergite practically undergoes no further development in structure but increases in size corresponding to the increase of the 9th sternite which is the anal plate.

However, cauda develops into a long finger-like projection dorsally at the distal tip of the abdomen due to the posterior prolongation of the ninth tergite in the final ecdysis. In the adult, the surface of the cauda is highly spinose due to the distribution of a number of minute spinules. It is highly constricted at the middle region and bears 3-4 hairs. The anterior end of the cauda is concave with a broad base while the posterior end is narrow and bluntly rounded (Fig. 2).

Takahashi (1924) observed the presence of cauda in the first nymphal instar of *Aphis malvoides* v. d. Goot, which becomes well-defined through further development during the second nymphal instar. In sharp contrast to the above phenomenon, in *R. maidis* no true cauda is present in the first nymphal instar. The ninth tergite of the first instar nymph which is

destined to become the cauda of the adult, shows no resemblance to the latter and does not elongate remarkably during successive nymphal stages. It constantly bears a pair of hairs till the nymph attains the adult stage. Just after the final moult of the nymph, the full grown finger-like cauda is distinctly evident.

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Pranikee, 2 : 70 74 (1981).

BLOOD CELLS OF *CLARIAS BATRACHUS*

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ABSTRACT

Several types of blood cells are recognised in the blood of *Clarias batrachus*. The erthrocytes are immature and mature. The leucocytes are of several types such as, granular types including ghost cells, neutrophils, eosinophils, basophils and the non-granular leucocytes or the lymphocytes. Clumps of thromobocytes are also noticed in the blood. The immature erythrocytes are nucleated, oval, rounded and irregular in outline and the nucleus is always bigger and the cells are smaller than those of mature erythrocytes. The mature erthrocytes are nucleated, bigger cells having small nucleus and their outline is rounded or elliptical. The ghost cells are without nucleus having granules inside, and are about 11.2 microns in diameter. The neutrophils are rounded or irregularly elliptical and the nucleus is irregular, bilobed or multilobed and their size is 12.9μ in diameter. In the basophils the outline of the cell varies from oval to circular and the nucleus is elliptical, eccentric and they are about 9.1μ in diameter. The eosinophil is bigger in size than the basophil, the nucleus is oval and eccentric, and its average diameter is 10.9μ The lymphocytes are larger and circular, non-granular and their average diameter is 11.2μ. The thrombocytes appear as clumps and their nucleus is very big, almost fills up the crytoplasm and their average diameter is 4μ.

INTRODUCTION

Clarias batrachus is a common siluroid fish in the fresh and brackish waters of the plains of India (Day-1958). This fish is well-known for its accessory respiratory organ. The blood cells of vertebrates particularly those of frogs and mammals are well known (Romer, 1962 ; Weichert, 1958). But the blood cells of fishes are very poorly known. Hence it was attempted to study the blood cells of *C. batrachus*.

MATERIALS AND METHODS

Healthy specimens of *C. batrachus* were selected for this study. The specimens ranged in length from 18 to 24 cm. Several blood films were drawn on slides and were stained with Leishman's stain. Blood cells were studied under high power of the microscope. The diameter of the blood cells was determined by eyepiece micrometer after standardising it with the stage micrometer.

OBSERVATIONS

The blood cells of *C. batrachus* comprise Red blood cells or erythrocytes, White blood cells or leucocytes and thrombocytes (Fig. 1 and Table 1),

RED BLOOD CELLS OR ERYTHROCYTES

The red blood cells are nucleated. When seen under high power, they appear to be of different sizes and range from 7.5 to 12 microns. The smaller ones are circular or irregular in outline and range in between 7.5 to 8.5μ, the mean being 8.1μ. The small red blood corpuscles have bigger sized nucleus in them with comparatively little cytoplasm and they may be regarded as immature erythrocytes. The larger erythrocytes are usually elliptical or circular in shape ranging between 8.5 and 10.5μ in diameter, the average being 9.9μ. These larger ones may be termed as matured erythrocytes.

WHITE BLOOD CORPUSCLES OR LEUCOCYTES

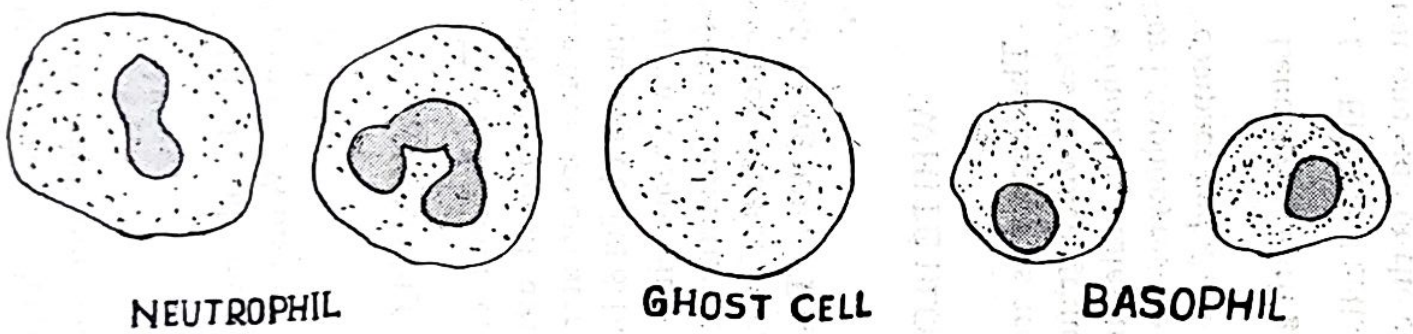
The leucocytes are few in number and are irregular in outline. The leucocytes in which granules are present may be called granulocytes and those without granules are termed as agranulocytes. The agranular leucocytes or lymphocytes are irregularly elliptical in outline. The nucleus is large, compact and almost fills up the cytoplasm.

Leucocytes with granules in their cytoplasm are of four types :

1. Elliptical cells with an irregular, bilobed or many lobed nucleus often at one side of the cell wall (Fig. 1), are the nentrophils.

2. Elliptical, oval or almost circular cells with oval nucleus in one side of the cell wall with dark red to pink granules, are the eosinophils.

3. Oval to irregularly circular cells with elliptical nucleus and gramules are the basophils.


NEUTROPHIL
GHOST CELL
BASOPHIL


EOSINOPHIL
THROMBOCYTE

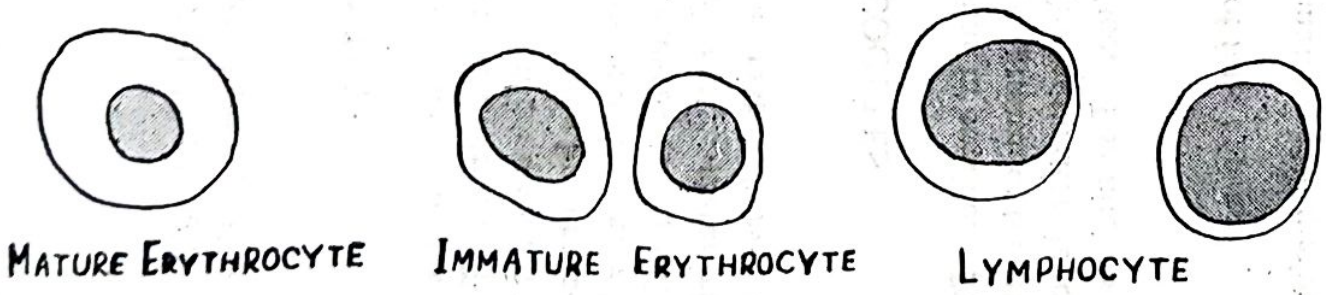

MATURE ERYTHROCYTE
IMMATURE ERYTHROCYTE
LYMPHOCYTE

TABLE-1

BLOOD CELLS OF *CLARIAS BATRACHUS*

Cell types	N	Appearance in Leishman's stain		Entire cell range in μ	Average diameter of the cell in μ
		Nucleus	Cypoplasm		
Immature erythrocyte	100	Bluish red	Circular or elliptical granules, light blue	7.5 to 9	8.1
Mature erythroycyte	100	In the centre of the cell, bluisn red.	Granules	9 to 12	9 9
Ghost cells	20	None	Granules	10.5 to 12.2	11.2
Lymphocytes	20	Takes up almost entire cell	No granule, little cytoplasm	7 to 10 5	8.0
Neutrophil	20	Lobed nucleus at one side of cell wall	Granules pale blue	12 to 13.5	12.9
Eosinophil	20	Frequently at one end of the cell	Granules red or pink	10.5 to 12	10.95
Basophil	20	Observed at one side	Granules present	9 to 10.5	9.1
Thrombocyte	10	Deep blue large nucleus	Scanty	3 to 6	4 0

4. The fourth type of granular leucocytes are without a nucleus in them. They are larger and circular and are few in number. They are the ghost cells.

Thrombocytes :

They appear in clumps and are nucleated. The nucleus occupies considerable space and the cytoplasm is very scanty. The nucleus is stained deep blue.

DISCUSSION

The red blood cells of the fish are nucleated and are usually oval in shape (Mott, 1957). The leucocytes of the fish blood are amoeboid. The heterophilic (neutrophilic) leucocytes are abundant in all vertebrates except reptiles. The acidophils (eosinophils) are rare in individuals and are widely seen in the vertebrates. The basophils are fewer in number and are seldom seen in fishes (Romer, 1952).

In the present investigation erythrocytes, various leucocytes and thrombocytes have been identified in *C. batrachus*. Amongst the blood cells of *C. batrachus*, the neutrophils are the largest in size and their average diameter is 12.9μ. The ghost cells are next in size and are 11.2μ in diameter. The thrombocytes are the smallest being 4 microns in diameter, The blood cells are fairly typical as reported by Romer (1952).

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Pranikee 2 : 75-79 (1981)

ON THE EGG LAYING BEHAVIOUR OF *POECILOCERUS PICTUS* (FABR.) (ORTHOPTERA, PYRGOMORPHIDÆ)

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ABSTRACT

The egg laying behaviour of *Poecilocerus pictus* (Fabr.) was studied in an insect rearing glass chamber filled with dry sand, moist sand and moist sand covered with dry sand. It prefers moist sand covered with dry sand, finally digs a hole, secretes a fluid which immediately on exposure to air turns into a frothy mass. The eggs numbering 130 to 155 are laid one by one into the frothy mass, the whole process lasting 2 to 5 hours.

INTRODUCTION

A number of workers have studied the egg laying behaviour in Orthoptera. Turner (1916) gave an account of the breeding habits of blatids, mantids, phasmids, acridids, locustids and gryllids. Fedorov (1927) described the egg laying behaviour of *Anacridium aegyptium* L. An analysis of oviposition behaviour of *Locusta migratoria migratorioides* R & F., in relation to moisture has been given by Kennedy (1949). Roonwal (1945) and Srivastava (1956) have described the process of oviposition in *Hieroglyphus nigrorepletus* Bol. Studies on the selection of oviposition site by locusts have been made by Johnston and Maxwell-Darling (1931), Faur (1932), Hussain *et al* (1941), Popov (1958), Magor (1962) and Bhatia & Harjai (1968).

The present study deals with the egg laying behaviour of *Poecilocerus pictus* (Fabr.)

METERIALS AND METHODS

A special glass breeding chamber (35 cm × 35 cm × 60 cm) was chosen to study the egg laying behaviour of *P. pictus* (Fig. 1). Sand; sieved and washed repeatedly in water to remove debris, was dried inside an oven. Eighteen glass tubes 10.5 cm high and 3.5 cm in diameter were used in the experiment. Six were filled with dry sand, six with moist sand and six with

moist sand covered with a layer of dry sand, 1.25 cm thick at the top. Ten gravid female grasshoppers were introduced into the breeding chamber for

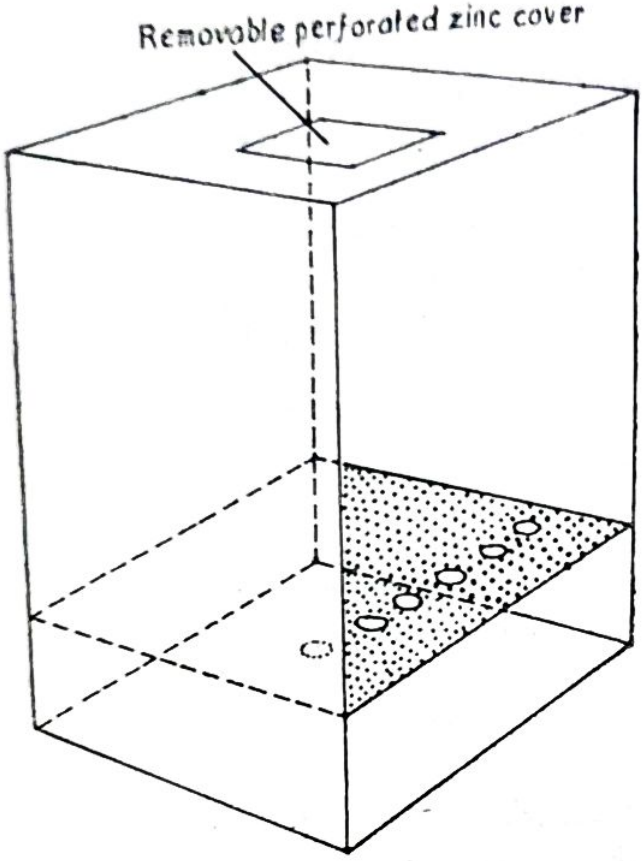

Fig.1- Grasshopper breeding cage

Fig. 1

the study of egg-laying behaviour. The temperature inside the breeding chamber was 29±1°C and relative humidity 62±2%.

OBSERVATIONS AND DISCUSSION

Before egg laying, the female grosshopper walks on the sandy stratum and feels the surface of the sand with the antennae and palpi. When moist surface is found she raises her fore legs, the abdomen bends slowly and strikes the surface of sand gently with the valves of the ovipositor. The abdomen is then fully arched and while the hind legs support the body, the ovipositor digs into the sand almost at right angles. The upper and lower valves of the ovipositor move rhythmically as the ovipositor penetrates deeper and deeper into the sand. Due to the elasticity of the intersegmental sclerites, the normal abdomen of 3.7 cm is distended upto

8.0 cm. To give the hole thus dug in the sand a regular round shape, the female often contracts and twists the abdomen inside the hole. The body is lowered into the bore right upto the thorax and is firmly pressed against the sand surface while the wings remain fully streched out.

The female in her endeavour to locate a suitable site for egg laying performed exploratory trial boring in all the three types of strata viz., dry sand, moist sand and moist sand with dry sand on top. Digging in dry sand is very superficial, the surface sand being slightly scratched by the valves of the ovipositor whereas in other two conditions true digging was noticed. The largest number of trial bores were noticed in moist sand and lesser number in moist sand with a layer of dry sand on the top. In several cases the female dug "complete" holes and discarded them without depositing eggs inside them. It is interesting to note that although complete holes suitable for egg laying were to be found in moist sand, the number of holes with egg pods was more in moist sand with a layer of dry sand on top.

TABLE I

FREQUENCY OF OVIPOSITION IN *P. PICTUS*

Type of sand	Number of trial bores	Number with egg pods
1. Moist sand throughout	30	6
2. Moist sand with a layer of dry sand on top	21	17

It thus appears that moist sand with a layer of dry sand above is more suitable for oviposition.

When digging is completed the female interrupts her work for a short while and then lifts up the abdominal tip from the bottom of the hole and closing the valves, secretes a fluid which immediately on contact with air turns into a frothy mass. It is deposited at the bottom of the hole into which eggs are dropped one by one in a spiral manner so as to form a compact mass. The hole almost gets filled up with eggs. At the end of laying, the opening of the hole is sealed with froth to cover the entire egg mass. The process takes about 2-5 hours by the end of which the abdomen retracts to its original shape; the legs which are kept pressed against the surface of the sand are raised. She remains inactive for a short while after which she starts feeding on the leaves.

The froth when fresh, is yellowish white and gradually turns brownish as it hardens with the egg mass to form an egg pod A freshly laid egg pod is very delicate and soft and is difficult to take out of the hole, but after 1-2 days, it is quite hard to dig out. It is cylindrical, about 10-12 cm long, 1.5 cm wide and usually bow shaped. The froth even covers individual eggs and thus preserves them against infection The eggs are elongated and yellow in colour and turn brown within 1-2 hr In the laboratory, a female laid one or two pods. The number of eggs in a pod varied from 130 to 175 with a mean of 145.

Uvarov (1928) states that most Acrididae lay eggs in the ground, the choice of the soil being dependent upon its physical properties Lal (1941) records a swarm of *Schistecerca gregaria* Forskal "dropping eggs on a tract of waste land" without boring any hole and according to him it was due to extreme dryness of the soil and occurred only where a hole could not be dug for oviposition. Choudhuri (1956) has shown that under laboratory conditions soil temperature has some influence over oviposition in locusts. Dry soil is a bad conductor of heat whereas moist soil is relatively a good conductor. The rate of evaporation is high in the latter case leading to loss of energy and this loss of energy is unfavourable for the development of the egg (Bhatia and Harjai, 1968).

Singh (1952) and Popov (1958) observed that desert locusts prefer warmer sites for oviposition. Omar (1965) states that the female locust always seeks moist soil with a layer of dry soil on top for egg laying, dry soil being a bad conductor of heat, restricts evaporation from the moist soil below and lowers the loss of energy, which is perhaps the reason why *P. Pictus* prefers moist sand with a layer of dry sand on top for egg laying.

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*Not seen in original

SHORT COMMUNICATION

INCOMPLETE POSTERIOR TWINING IN A GUINEA PIG (*CAVIA PORCELLUS*)

This communication records a case of incomplete posterior twining in a guineapig (*Cavia porcellus*). Out of 354 young guineapigs so far born at the Nandankanan Biological Park, Orissa, one out of two guineapigs born in one litter on June 13, 1972 was born dead. On close examination of the dead young one, it was found to have an extra ill developed hind quarters. The skin was continuous behind the axillary region. The pair of exta hind limbs were much smaller in size and was facing the well developed pair of hind limbs. The pelvic girdle was not, however, developed but there was an extra anal opening. At birth, the dead young weighed 95 gms whereas the living one weighed 74 grams.

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Incomplete posterior twining in a Guineapig (*Cavia porcellus*)

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