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Brief history :

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Membership and subscription :

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PRANIKEE

EDITOR'S NOTE

Midway through the printing of this volume unexpected tragedy struck us. The press changed hands without any warning hence we are still trying to recovar half of the papers, galleys and blocks etc. The rest of the papers find place in this volume. Therefore, we apologise for the fewer number of pages of this volume.

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THE EMBLEM

On the cover page is the emblem of "NABAGUNJARA" a chimeric animal peculiar to Orissan art and literature. Literally meaning "Nineform" it is a common motif in Orissan 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 from of a serpent, waist of the lion, hump of the bull and the head of a cock, to fool his friend Arjuna. The chimera was holding a lotus flower in a human hand. Arjuna had never seen such a creature in his life and guessed that this cannot be a real animal and mus be a form assumed by Lord Krishna and bowed downt at its feet. It is said that the human hand with the lotus provided the clue. In the paintings and sculptures however, the lotus is often replaced by the "Chakra" or the "stylized discuss" of Lord Krishna.

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

—P. Mohanty-Hejmadi
President

We are happy to place in the hands of our readers volume 7 for 1986 of PRANIKEE, Journal of the Scciety. Various forces including paucity of funds did stand on the way of its publication resulting in delay by almost a year. It is hoped that the next volume will appear in time.

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

B. K. Behura
Editor

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Abbreviation : *Pranikee*

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Pranikee, 7 : 1-9 (1986)

ANATOMICAL CHANGES IN THE VENTRAL NERVE CORD OF *CORCYRA CEPHALONICA* (STAINTON) LEPIDOPTERA; PYRALIDAE; GALLERIINAE) DURING METAMORPHOSIS.

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ABSTRACT

In *Corcyra cephalonica* (Stainton), the larval nerve cord consists of twelve ganglia namely, the suboesophageal ganglion, three thoracic ganglia and eight abdominal ganglia connected with each other through paired connectives during metamorphosis, only six ganglia remain out of which two are thoracic and four abdominal. The pterothoracic ganglionic mass represents fused mesothoracic, metathoracic and first two abdominal ganglia. The sixth, seventh, and eighth abdominal ganglia also fuse to form a complex ganglion.

Key words : *Metamorphosis, nerve cord, Corcyra cephalonica. Pyralidae*

INTRODUCTION

Workers like Singh & Srivastava (1973), Pipa (1978) and Tsajimura (1983) have studied the aspect of ganglionic fusion during metamorphosis in certain species of Lepidoptera. Keeping in view the scope of these studies, *Corcyra cephalonica* a representative of the family Galleriinae of family Pyralidae was selected for the present studies.

MATERIALS AND METHODS

C. cephalonica is a pest of a variety of stored products. It was cultured on sorghum grain in the laboratory at a constant temperature of $28 \pm 2^{0}C$ and relative humidity 60 to 70%. For anatomical studies, the larvae, pupae and adults were collected from the stock culture. Dissections were

made under the stereoscopic binocular microscope. The diagrams were drawn with the help of a graph eye piece on graph paper.

RESULTS

The ventral nerve cord in all the larval stages (i.e. Ist to 7th) of *C Cephalonica* consists of twelve ganglia (Fig. 1). Besides brain (BR), the suboesophageal ganglion (SOG) also lies in the head region and is connected with the brain by circum-oesophageal connectives (COC), while the three ganglia i. e., prothoracic (TG_1), mesothoracic (TG_2) and matathoracic (TG_3) belong to the thoracic region and eight ganglia (AG_{1-8}) lie in the abdominal region. All these ganglia are separated from each other by paired connectives. In the pre-pupa. all the three thoracic ganglia show an increase in their sizes and the interganglionic connectives running between them are clearly double (Fig. 2). In twelve-hour old pupa (Fig. 3), the prothoracic ganglion shifts slightly backwards. Meanwhile, the metathoracic ganglion also shifts and tends to lie in close proximity to the first abdominal ganglion. After another twelve hours of pupal duration (Fig.4), the metathoracic ganglion joins with the first abdominal ganglion. This happens because of the forward shifting of the first abdominal ganglion right into the thoracic region. Their fusion is completed by the time the pupa becomes three-day old (Fig.5). At this stage, the suboesophageal ganglion also gets fused with the brain. The second abdominal ganglion shifts forward in order to fuse with the already fused metathoracic and first abdominal ganglia. Their fusion is completed after four days of pupation (Fig. 6), and this too happens because of the shifting into the thoracic region of the second abdominal ganglion. At this stage, this ganglionic complex shifts forward to occupy a place in close vicinity of the meso-thoracic ganglion with which it has to fuse ultimately. Their complete fusion is traceable by the time the pupa becomes five-day old (Fig. 7). The compound pterothoracic ganglionic mass which occupies the meso-thoracic space now represents a complex of four ganglia which are; the mesothoracic ganglion, the metathoracic ganglion and the first and second abdominal ganglia. The fusion between the sixth abdominal ganglion and the posteriormost ganglionic mass, already representing seventh and eighth abdominal ganglia becomes complete when the pupa becomes one-day old (Fig. 4). As a result of this, the nerve cord also gets shortened and terminates in the sixth abdominal segment as seen in the seven-day old pupa (Fig. 8).

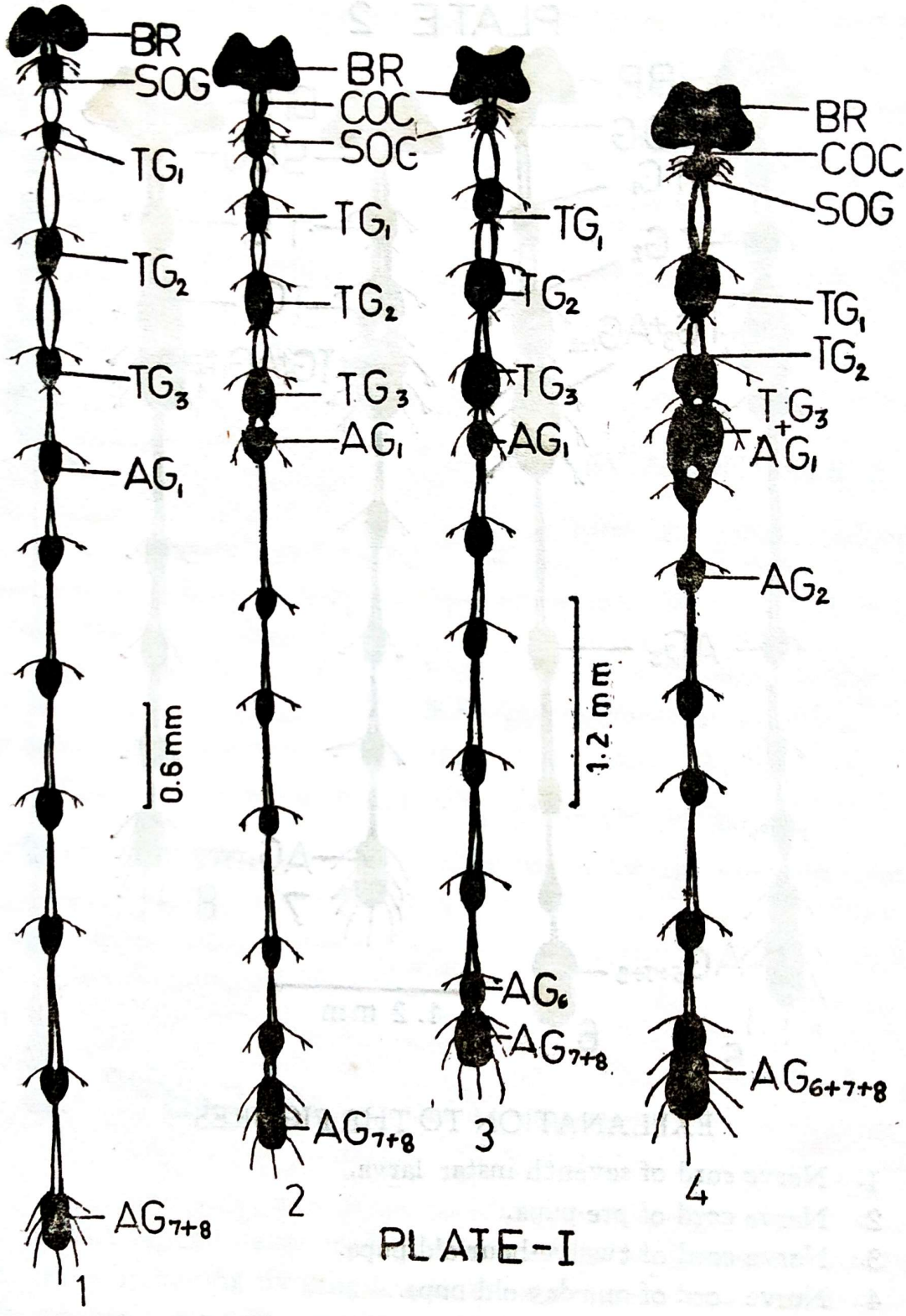
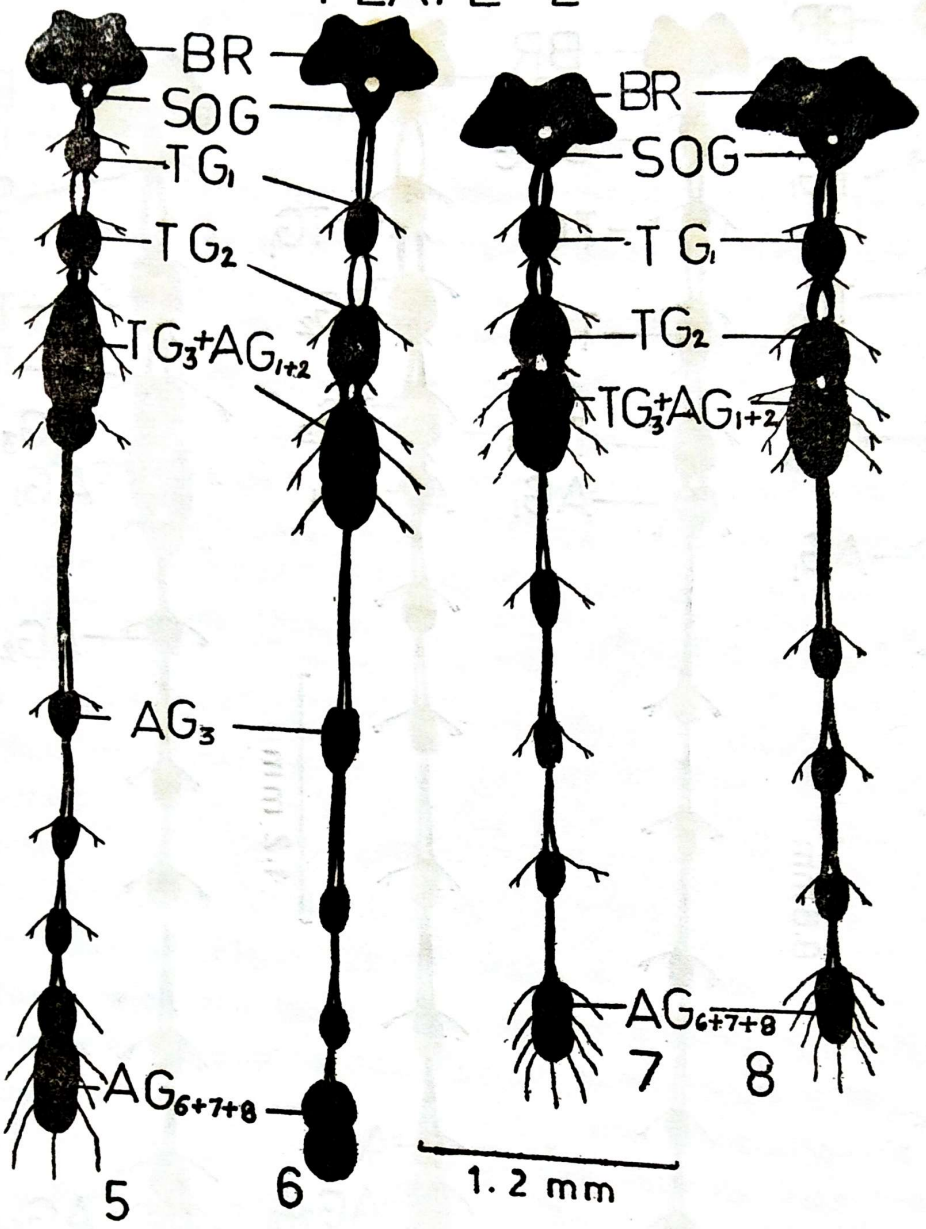

BR
SOG
TG1
TG2
TG3
AG1
0.6 mm
AG7+8
1
BR
COC
SOG
TG1
TG2
TG3
AG1
AG7+8
2
BR
COC
SOG
TG1
TG2
TG3
AG1
1.2 mm
AG6
AG7+8
3
BR
COC
SOG
TG1
TG2
TG3+AG1
AG2
AG6+7+8
4

PLATE-I

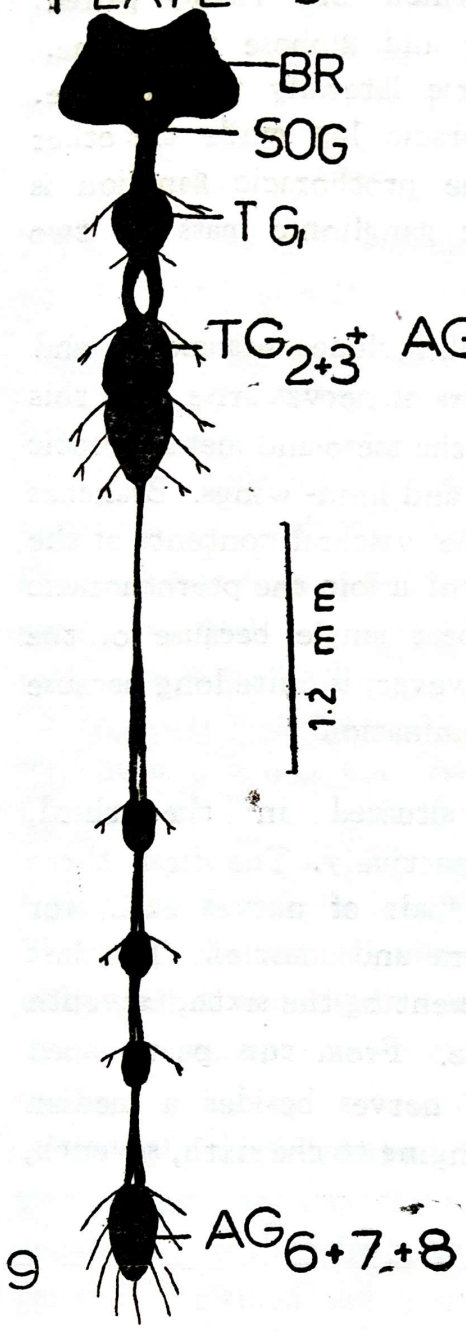
PLATE 2



EXPLANATION TO THE FIGURES

1. Nerve cord of seventh instar larva.
2. Nerve cord of pre-pupa.
3. Nerve cord of twelve-hour old pupa.
4. Nerve cord of one-day old pupa.
5. Nerve cord of three-day old pupa.
6. Nerve cord of four-day old pupa.
7. Nerve cord of five-day old pupa.
8. Nerve cord of seven-day old pupa.
9. Nerve cord of adult.

PLATE 3



ABBREVIATIONS USEDS

AG ($_{1-8}$) First to eight abdominal ganglia.
BR Brain
COC Circum-oeosphageal connective
SOG Sub-oesophageal ganglion
TG_1 Prothoracic ganglion
TG_2 Mesothoracic ganglion
TG_3 Metathoracic ganglion.

The ventral nerve cord of the adult (Fig. 9) differs from that of the larva by having six ganglia and their connectives. Moreover, the suboesophageal ganglion in the adult is completely fused with the tritocerebral part of the brain. Out of these six ganglia, two lie within the thoracic region and four in the abdomen. All these ganglia are interconnected by paired connectives but appear single because of the close approximation of the two counterparts. The only exception

to this is provided by the connectives running between the prothoracic ganglion and pterothoracic ganglionic mass, which are visibly paired. The prothoracic ganglion in the adult is simple and globose in outline. It antero-ventrally gives out nerves which traverse laterally to bifurcate. One of the two branches goes to the prothoracic leg while the other climbs up to supply the fore-wing muscles. The prothoracic ganglion is posteriorly connected with the pterothoracic ganglionic mass by two distinct connectives.

The pterothoracic ganglionic mass as such includes mesometa-, and first and second abdominal ganglia. Four pairs of nerves arise from this oval ganglionic mass, out of which two supply the meso-and meta-thoracic legs and two to the muscles of the fore-wings and hind- wings. Branches come out from these nerves which supply the visceral contents of the respective thoracic segments. The connectives which join the pterothoracic mass with the third abdominal ganglion appear single because of the proximity of the two connectives, which however, is quite long because it has to traverse three segments before its termination.

All the four abdominal ganglia are situated in the third, fourth, fifth and sixth abdominal segments, respectively. The first three abdominal ganglia are simple and give out a pair of nerves each, for innervation of the respective segmental viscera and muscles. The last abdominal ganglion is a complex structure representing the sixth, seventh and eighth abdominal ganglia in a fused state. From this pear-shaped composite ganglionic mass arise four pairs of nerves besides a median nerve which supply the muscles and viscera belonging to the sixth, seventh, eighth and ninth abdominal segments.

DISCUSSION

Singh and Srivastava (1973) have recognized three main conditions on the basis of number of ganglia in the adult nerve cord of the lepidopterans. In the first condition, there are two cephalic, two thoracic and four abdominal ganglia. In the second, there are two cephalic, three thoracic and four abdominal ganglia and in the third (e. g. *Hepialus* sp., Brandt, 1879), there are two cephalic, two thoracic and five abdominal ganglia. According to these authors, the first condition is further distinguishable into two sub-types on the basis of the participation

of various ganglia in the formation of pterothoracic ganglionic mass. The first sub-type is represented in *Vanessa* sp., *Sphinx* sp. and *Pieris* sp. (Brandt, 1879), *Galleria* sp. (Ashhurst and Richards, 1964) and *Philosamia* sp. (Singh & Srivastava, 1973), where the pterothoracic ganglionic mass is formed by the last two thoracic and the first two abdominal ganglia. The second sub-type is reported in *Ephestia* sp. (Pyle, 1941), where even the third abdominal ganglion also moves forward to take part in the formation of pterothoracic ganglionic mass.

Subsequently, Tsujimura (1983) modified this division by introducing more elaborate system of grouping the insects into three types, on the basis of the fate of third and sixth abdominal ganglia. In the first type, the pterothoracic ganglionic mass is formed by two thoracic and first two abdominal ganglia, whereas, the last abdominal ganglionic mass results after the fusion of the sixth, seventh and eighth abdominal ganglia. This condition is represented in *Vanessa urticae* and *Sphinx lingustri* (Brandt, 1879); *Pieris brassicae* (Brandt, 1879, Heywood, 1965; Ali, 1973); *Galleria mellonella* (Pipa, 1963; Ashhurst and Richards, 1964); *Manduca sexta* (Taylor and Truman. 1974) and *Hypsa alcifron* (Singh and Singh, 1982). In the second type, the pterothoracic ganglionic mass results after the fusion of five ganglia i. e., two thoracic and first three abdominal ganglia. However, the last abdominal ganglionic mass is formed by the fusion of only seventh and eighth abdominai ganglia. Such conditions are represented in *Sphinx* sp. (Newport, 1832) and *Ephestia* sp. (Pyle, 1941).

In the third type, the pterothoracic ganglionic mass is formed by two thoracic and first two abdominal ganglia, while the last abdominal ganglionic mass results from the fusion of the seventh and eighth abdominal ganglia. The sixth abdominal ganglion maintains its identity, while the third abdominal ganglion degenerates and as such is not traceable. This type is represented in *Philosamia ricini* (Singh & Srivastava, 1973). If this grouping of lepidopterans is considered, *Corcyra cephalonica* falls in the category represented by the first type. In fact, most of the lepidopterans, studied so far, for their nervous system fall in this category (Tsujimura, 1983).

In general terms, it can be stated that ganglionic fusion in insects, tends to occur either in the posteriormost part of the abdomen where

genitalia are located or in the central portion of the thorax which happens to be the locomotory centre of the insect body. According to Obara *at al.*, (1975) and Suguwara (1981), the fused pterothoracic ganglionic mass partially controls flight and the last abdominal ganglion innervates copulation and oviposition apparatus.

ACKNOWLEDGEMENTS

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POTENTIALITY OF FISH PRODUCTION FROM ESTUARIES OF INDIA

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ABSTRACT

India has extensive estuarine systems. Estuarine waters include brackish water areas such as shallow bays, tidal marshes and bodies of water behind barrier beaches. If one million hectare of estuarine area out of the 1.42 million hectare available in the country can be used for aquaculture, then one million tonnes of brackishwater fishes can be produced. If 25% of this fish production is prawns, then the export of marine prawns can be trebled and India can earn foreign exchange worth Rs, 1500 crores from the export of marine products excluding the production of 7.5 lakh tonnes of brackishwater fish for internal consumption. Also considerable employment will generate in the rural areas of the coast.

Key words : *Fish production, India.*

INTRODUCTION

Estuary is the part of the mouth or lower course of a river in which the river current meets the sea's tide. Hence, estuary is an arm or inlet of the sea at the lower end of the river. *Aestus* means tide and so an estuary is a river mouth where tide meets the current of the river and there is mixing of salt and fresh water. Variations of salinity is widely seen in the estuary. The salinity is high near the sea and it gradually decreases as one proceeds to the upper reaches of the river. Estuarine waters are called brackish waters and include siallow bays, tidal marshes and bodies of water behind barrier beaches (Odum, 1959).

Brackish water areas are mixohaline where salinity is mixed and varies fresh water condition (<0.5% salinity), to sea condition (35% salinity). Day (1951) while discussing the ecology of South African estuaries described the conditions seen in various estuaries in relation to salinity and tide. The tide, river flow and wind are the important factors which produce currents in the estuary. In the estuaries, the less dense river water lies above the sea water. The sea water moves upstream along the bottom. The river water which is laden with particles mixes with the clearer sea water and forms the brackish water zone. Sometimes the mixing is high due to wind action and so the particulate matter and muddy sediments are stirred up and muddy cloudiness is produced in the brackish water.

Fluctuations of temperature occurs in the estuary but such fluctuations are widely seen in temperate climate (Moore, 1958). The silt suspension in the estuaries is an important factor which plays, vital role in the ecology of estuarine organisms and it affects the food, substratum, and illumination etc, in the estuaries (Moore, 1958). The physiography of the coast, the subtrate and amplitude of the tides play significant role in the productivity of the estuaries. The estuaries are more productive than the adjacent fresh water or sea water due to the mixing of the waters.

Estuarine waters of India.

In India, sand bars are generally seen in the estuaries and the estuaries receive a lot of fresh water from July to October due to the South-west monsoon and the water becomes almost freshwater. From November to February due to less incoming of freshwater the salinity fluctuates. From February to June there is no discharge of fresh water and so the salinity increases in the estuaries (Jhingran, 1983), Estuaries are important for us as they are utilised for the production of fish, shrimps, and oysters, etc. The estuaries are the nursery grounds for shrimps, mullets, and milkfish etc., as these organisms come to the estuaries for feeding purposes and than move to the sea for growth and breeding.

The estuarine waters of India are very productive. Many rivers have made extensive estuarine systems in the country. Hoogly Mathah estuary of West Bengal forms a deltatic region of about 2340 sq Km called Sunderbans. River Mahanadi makes also a wide and large estuarine system

in Orissa. Godavari and Krishna have formed a large estuarine system in Andhra Pradesh. River Cauvery has created in Tamilnadu a large area of brackishwater. So also rivers Narmada and Tapti have formed large brackishwater areas in Gujarat. Zuari and Mandovi have made large estuarine waters in Goa. There are several back waters in the country which enhibit estuarine conditions as well. Chilika Lake, the largest brackishwater lagoon in the Country is about 906 sp km in summer and 1165-sq km in the rainy serson (Misra, 1979). The Pulicat lake in Andhra Pradesh and Tamilnadu offers a brackish water area of about 77, 700 ha. The Vemband back water in Kerala is about 256 sq km in area and the northern part of the Cochin back waters is called the Varapuzha lake and the southern part the Vembonad lake.

Present Fish Production from the Estuaries af India.

The annual fish production of Hooghly—Mathah estuary varies from 10,000 to 13,000 tonnes as revealed from the studies of the Central Inland Fisheries Research Institute, Barrackpore. Prawns contribute about 1800 tonnes and the other fishes comprsie *Harpodon nehereus, Hilsa ilisha, Setininna, Tachgsurus, Mugil, Polynemus, Pampus, Lates, Sciaenoides and Trichiurus* etc. The Mahanadi estuarine system produces annually about 800 to 1000 tonnes of fish and the main constitutents are prawns, mullets and clupeoids as studied by Central Inland Fisheries Research Institute, Barrackpore. The annual fish production from Godavari estuary is about 4000 to 5000 tonnes and the main constitutents are the clupeoids, Mugil, Pomfrets, Trichiwens, and Arins etc. The fish production from Cauvery estuary is about 100 tonnnes annually. The annual fish landing from Nirmada estuary is about 800 to 1000 tonnes. The annual fish production from several small estuarine systems like Zuari, Mandovi have not been reported. Chilka Lake produces annually fish of about 3000 to 4000 tonnes and the main catches consist of *Crabs, Mugil cephalus, Mugil macrolepis, Polynemus, Hilsa, Nematalosa, Lates, Gerres, Mystus, Pseudosciaena and Etropdos etc.* The annual fish landings from Pulicat Lake varies from 1000 to 1400 tonnes and the main items are prawns, crabs, mullats, clupeids, catfishes, perches, and Sciaenids. The annual fish landings from back waters of Kerala including the Vembanad Lake is about 14,000 to 17,000 tonnes per year (George and Sebastian, 1970). Thus the annual fish landing from the estuarien waters of India varies from 45,000 to 50,000 tonnes.

Potentiality of Fish Production from Estuaries of India :

It has been reported that the coastal swamps available near the estuaries is about 1.42 million hectare in the country. Experiments on brackishwater fish culture have shown that about one tonne of fish and prawns can be produced from one hectare. So, if one million hectare can be used for pisciculture, then about one million tonnes of brackishwater fish and prawns can be produced. If 25% of the fish production is prawn, then about 2.5 lakh tonnes of prawns can be produced. If 50 percent of the expected prawn production will be processed prawns, then about 1.25 lakh tonnes of processed prawns can be available for export purposes. India in 1982 exported about 75, 136 tonnes of fish worth Rs.342 crores, (MPEDA 1982). In the total export frozen shrimp formed 54,625 tonnes of the value of about Rs. 301 crores. Hence, India by properly exploiting the estuarine areas can increase the prawn production two times more and can alone earn a foreign exchange of Rs. 1000 crores from the export of prawns. Besides, 7.5 lakh tonnes of commercially important brackishwater fish can be produced which will be available for internal consumption.

Socio-economic considerations.

Fish culture in estuarine areas will not only earn foreign exchange but will as well supply more fish for internal consumption and generate employment in the rural areas of the country. In India, the population in 1981 was about 70 crores and will reach about 100 crores in 2000 A D In each year the Indian populrtion is increasing by 2 crores and in every two seconds a baby is born in our country. If 17 grams of protein will be supplied from fish per person per day which will come from 100 grams of fish, then the fish requirement in 2000 A.D., will be about 10 million tonnes per annum assuming that fish will be eaten for 200 days by 50% of the population. India can produce about 10 million tonnes of fish annually. From marine resources of the Indian ocean about five million tonnes of fish can be produced. From the estuarine waters sbout one million tonnes of fish can be produced. From about 1.5 million hectare of tanks, 3.0 million hectares of reservoirs, there will be no difficulty in raising anther 4 million tonnnes of freshwater fish. Thus, India can meet its protein demand and can export marine products to earn valuable foregn exchange of about Rs. 1500 crores.

Out of the total 180 million loabour force of the country, about 148 million labourers live in rural areas. Many of the rural labourers are unemployed. Aquaculture in estuarine areas and aquaculture in inland areas can provide employment in the rural areas. Thus planned estuarine aquaculture will help to improve the socio-economic conditions of the poor people.

Clean water is essential for all life including fish life. Demestic waters and industrial effluents are discharged in to rivers, lakes, estuaries, bay and sea without treatment Such waste materials pollute the water and make the environment unfit for fish life. Hence. such areas should be khpt free from pollution for fish culture programme,

In the estuarine waters and adjacent areas it is possible to grow prawns, mullets, and milk fish etc. and so intensive efforts should be laid on seed collection, artificial feed, engineering aspects of pond construction and hydro-biological conditions in the estuarine areas for maximum utilisation.

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COMPARATIVE NOTES ON THE REPRODUCTION AND ECOLOGY OF *BUFO STOMATICUS* AND *BUFO MELANOSTICTUS* IN WESTERN ORISSA, INDIA

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(COMMUNICATED BY DR. S. K. DUTTA)

ABSTRACT

At Barpali, Sambalpur district, Orissa, *Bufo stomaticus* and *B. melanostictus* occupy similar type of habitat and also exhibit similar behavioral adaptation. Main food of both the species consists of ants and beetles. During breeding season, both toads aggregate near permanent or temporary rain water pools for egg laying. In nature, metamorphosed froglets of *B. melanostictus* were observed 32 days after first egg laying. The greatest niche separation in these two species is in breeding habitat and season. *Bufo melanostictus* breeds early in the monsoon, whereas *B. stomaticus* breeds for an extended period. Both the species also differ in their mating calls. Eggs collected from an amplecting pair (*B. melanostictus* × *B. stomaticus*) did not develop at all. Tadpoles were abtained from reciprocal crosses but the tadpoles died within three weeks of development.

Key words : *Bufo melanostictus* ; *Bufo stomaticus* ; *Niche separation.*

From February, 1955 to October, 1957, while working in a Village development project near the village of Barpali, Sambalpur District, Orissa, India, I studied the ecological relationships and breeding habits of two sympatric species of toads, *Bufo stomaticus* and *Bufo melanostictus*. Barpali is situated in the level Bargarh plain in western Orissa, approximately 200 miles from the eastern coast of India. The climate is continental monsoon with a hot dry season lasting from March to June. The only sources of water for man and animals during this season are artificial ponds and wells, as rivers and streams are dry. The monsoon rains begin in June and last until

the middle of October, bringing approximately 60 inches of precipitation. Much of the land is flooded to grow rice during the rainy season.

Bufo stomaticus is the most common toad near Barpali. It is a medium-sized gray toad. The range of this species extends throughout northern India and Pakistan to Arabia (Daniel, 1956 : 55). It has been reported from Coorg in South India (Rao, 1920:120), and there are reports of recent immigration into Bombay (Daniel, 1956 : 51) and Ceylon (Kirtisinghe, 1957). *B. melanostictus* is a larger brown toad. It has a wide distribution in the Oriental Region, from India to Malaysia and China.

B. melanostictus and *stomaticus* are similar in general habitat requirements. During the rains they are found together on the uplands but not in the lowland rice fields. During the dry season they are found in the same fields or gathered together at pools or ponds.

Stomach contents revealed little difference in the food habits of these two toads. Stomachs of eight *B. melanostictus* taken during the months of February and June to September were examined. Stomachs of 19 B. *stomaticus* were examined, representing the months of March and July to September. The principal food items for both species were ants and beetles. Ants were found in appreciable quantities in five of eight *B. melanostictus* stomachs and ten of nineteen *B. stomaticus* stomachs. The Beetles were in seven of eight *B. melanostictus* and thirteen of nineteen *B stomaticus* stomachs. The beetles were ground-dwelling types of the families Scarabeidae, Carabidae, and Tenebrionidae. Termites were found in only one *B. melanostictus* stomach, but they constituted the total contents of this stomach. Termites were found in appreciable quantities in three of the B. *stomaticus* stomachs. Other food items taken by *B. melanostictus*, but represented in only one stomach each, were grasshoppers, caterpillars, earwigs and centipedes. Other food items taken by *B. stomaticus* were wasps, earwigs, caterpillars, earthworms, and flies. However, these two species, as adults, probably compete little for food since the two major food items, scarabeid beetsles and ants, are two of the most abundant groups of arthropods at all season of the year near Barpali. Neither species is capable of fully utilizing this food niche. Berry and Bullock (1962 : 739-40) studied the food habits of *B. melanostictus* in Malaya and found that this toad feeds unselectively on small invertebrates within the size range of five to

twenty mm. Differences in food habits between to different populations of *B. melanostictus* correlated with invertebrate faunistic differences. Species taking such a broad range of food are not likely to compete.

Both toads have a similar behavioral adaptation for remaning active during the dry season. They spend the day under rocks or in burrows. In the evening they collect in mixed groups at small pools of water near wells or houses or at artificial ponds. They remain sitting in the shallow water until 11.00 p. m. or later, when their bodies have become firm and filled with water. The rest of the night is spent in search of food. These toads were not observed to aestivate. Rao (1923) reported an aestivating specimen of *B. stomaticus* from Warziristan. All other toads and frogs in the Barpali area either aestivate during the dry season or are almost entirely aquatic in permanent ponds.

During the breeding season both toads collect in breeding aggregations. *B. melanostictus* collect at large permanent ponds, locally called "tanks" or "bandhs", and breeding occurs early in the rainy season. The breeding of *B. melanostictus* was observd only during 1957. The first heavy monsoon rain fell on June 5. On the evening of June 6, *B. melanostictus* males began to call around a large pond near the village of Barpali, and on the night of June 7, eggs were laid in this pond. On June 27, *B. melanostictus* males began collecting near another pond at 9 00 p. m. At 8 00 the next morning, egg-laying was in progress. The pairs in amplexus were floating in the water. Unmated males remained on the shoreline and voiced the breeding call or went into the water and attempted to mount amplexed pairs. When unmated males attempted to mount other males, they were repulsed by a chattering purr. As the egg-laying subsided at 10.00 a m, groups of three to five toads were seen hanging together and floating in the water. At 1.00 p. m, approximately 50 toads were gathered under the shelving bank of the pond where they spent the rast of the day. Egg laying was not witnessed at any later date, but *B melanostictus* males continued to call sporadically at various ponds until the end of August. The first metamorphosed youngs were observed on July 19, thirty two days after the first eggs were laid.

Bufo stomaticus were observed breeding in all three years. *B stomaticus* aggregations gather at small temporary pools Daniel (1956 : 52 reported that in Bombay *B. stomaticus* also breeds in shallow rainwater pools. The

breeding of *B. stomaticus* occurs after heavy rains for an extended period during the middle of the monsoon season when these pools are abundant. In 1955 and 1956, *B. stomaticus* males were first heard calling in early August and continued calling until late September or early October. In 1957, a few males were heard calling after the heavy rains at the end of June and some joined the *B. melanostictus* aggregations. The first B. *stomaticus* breeding aggregations were found on July 14. Egg-laying was recorded as late as September 13. The male toads begin to gather and call at approximately 9:00 p. m. Calling is interspersed with movement around the pool. The males attempt to mount any approaching toad. It the second toad is a male, it will fight off the mounting attempts, often even turning over on its back. The females do not come to the pools until later, and most egg-laying occurs in the morning. If egg-laying is finished before dawn they leave the pools to spend the day under rocks or in burrows. However, if egg-laying does not cease until after daylight they spend the day in the pool. Metamorphosed B. *stomaticus* youngs were not seen commonly until late August.

The strictness with which breeding aggregations of *B. stomaticus* and B. *melanostictus* usually keep to their separate habitats was indicated by the situation on July 14. 1957 at the ponds. At 9:30 p. m. *B. melanostictus* were the dominant calling toads and they were gathered around the larger pond. At 2:30 a. m. the next morning, *B stomaticus* had become the dominant call but the twelve males were calling from the small temporary pool in the foreground.

Related species often have broad similarities in ecological niche requirements. In sympatric species this is particularly true of requirements that are in plentiful supply and therefore not limiting to the populations. Niche separation in sympatric species will usually be most distinct for requirements in short supply or limiting to the populations.

Of the ecological factors studied, the greatest niche separation in these two spscies is in breeding habitat and season. *B. melanostictus* breeds early in the rains in large permanent ponds while *B stomaticus* breeds for an extended period during the middle of the rainy season in small temporary pools. Breeding habitat may be the ecological factor in greatest scarcity for these two species. It is probably one of the critical factors in population limitation During the rains there are many flooded fields but all are thickly planted to

rice. Neither of the toads was found breeding in these fields. The upland pools and ponds are a more limited habitat for breeding. The large populaof tadpoles in some of these pools must compete heavily for ecological necessities. The tadpoles of these two species of toads do not enter into serious competition because of separate breeding habitats and separate breeding seasons. The population dynamics of the two species would be affected differently by the climatic factors of any one season. For instance, a "break in the rains" often causes the loss of one set of *B stomaticus* eggs if the small pools dry up, but has little effect on *B. melanostictus* reproduction. Although predation was not studied, predation factors would probably be somewhat different for the tadpoles and newly metamorphosed young because of the seasonal and habitat differences.

Difference in breeding habitat and season are important premating factors in reproductive isolation between these two species. Ecological differences have been reported to be the most important isolating factors between other species of the genus *Bufo* (Bogert, 1960 : 261; Meacham, 1962 : 303). Other premating factors are less important in B. *melanostictus* and *B stomaticus*. The breeding calls of the males are different in dominant frequency, trill rate and trill pattern. They sound very different in the field and can easily be identified. However, sexually advanced *B. stomaticus* are attracted to B. *melanostictus* breeding aggregations before *B. stomaticus* breeding aggregations are forming in some years. This supports the suggestion of Bogert (1960 263) that the breeding call in the genus *Bufo* may be primarily for distance orientation to the breeding aggregation rather than for species discrimination.

On June 28, 1957, some *B. stomaticus* were breeding in a large pond along with B. *melanostictus*. Four *B. stomaticus* and nine cross-fertilizing pairs were seen. Three crosses involved a *B. stomaticus* male and a *B melanostictus* female and six involved the reciprocal cross. Bi-species pairs in amplexus were seen at other times. Some eggs were collected directly from hybrid crosses and from normal matings on June 28. The eggs from normal B. *melanostictus* matings hatched in 26 hours and developed normally. The eggs from a cross between a *B. melanostictus* male and a *B stomaticus* female failed to hatch. Some of the eggs from a cross between a *B.stomaticus* male and a *B. melanostictus* female hatched but development was slow and abnormal. At one week many tadpoles had died and those remaining could only swim in close counterclokwise circles. All of the hybrid tadpoles had died by

three weeks of age. No toad showing intermediate characters were eve observed. This evidence of genetic incompatibility along with morphologica differences suggests that these two species of *Bufo* are not closely related.

Premating isolation by habitat and seasonal differences is a commor pattern among toads. Such mechanisms prevent wastage of gametes. Th relatively frequent breakdown of these premating isolation mechanisms ir *B. stomaticus* and *B melanostictus* may indicate that these two toads have only become sympatric in this area since the spread of artificial ponds and wells in the area made water more available during the dry season.

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Notes on the manuscript by. Dr. S. K. Dutta, P. G. Department of Zoology, Utkal University, Bhubaneswar 751004, Orissa, India.

As is evident from the contents of the manuscript, Dr. Platt carried out his studies in Orissa during February, 1955-October, 1957 But, for some reason, he did not communicate the manuscript to any journal for publication. During my PhD studies at the University of Kansas, USA I had an opportunity in meeting Dr. Platt during 1983 and there I could know that, he made extensive collection of amphibians at Barpali, Sambalpur district, Orissa. Furthermore, he also handedover the present manuscript and other data to me for my personal use and for possible publication. He also handed over me all the specimens that were kept with him since 1957 and now all those specimens have been deposited at KU (University of Kansas, Museum of Natural History).

After reading the present manuscript, I found it of immence importance to the studies on biology of amphibians of Orissa. So far, we do not have any published record on the comparative reproductive ecology of these two species of *Bufo*. I thought, it would be appropriate, if the manuscript be published as such without any modification and this might be an useful information to those, who want to carry further studies on these animals.

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ANIMALS OF ECONOMIC IMPORTANCE OF ORISSA

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ABSTRACT

The list of economic animals pertaining to sericulture, lac culture, cantharidin, apiculture, fisheries including prawn fishery; animal husbandry, frog culture, turtle and lizard, and wild animals for prospective conservation are given.

Key words : ***Economic animals*** ; ***Orissa state***.

Orissa, one of the backward States of the Union, with 42 8% of the population below the poverty line (estimates, 1984), is rich in animal resources of economic importance which are yet to be properly exploited.

Sericulture : India stands second with regard to *tasar* silk production in the world, the first position going to China. India produces about 464 tonnes of *tasar* raw silk per year. It is grown in Bihar, Madhya Pradesh, Orissa, Andhra Pradesh and Uttar Pradesh. The first three States raise over 90% of the total production. Tasar silk cultivation is mostly confined to about 30,000 *adivasis* in the districts of Mayurbhanj, Keonjhar, and Sundergarh (Panda, 1963). The sericigenous tasar producing caterpillar, *Antheraea paphia* Linn., is not fully domesticated and is reared traditionally by *Khadia* and *Budha* tribes in the jungle on Sal (*Shores robusta*), Arjuna (*Terminalis arjuna*) and Asana (*Terminalia tomentosa*). The Eri silk moth (*Attacus ricini*) is domesticated, the caterpillar feeds on castor (*Ricinus communis*) leaves and silk by this moth is produced in small quantities. The Mulberry silk moth (*Bombyx mori*) is fully domesticated and is reared on mulberry leaves (*Morus alba*).

Production of this silk in the State is very recent and is raised in very small quantities. The production of Tasar, Eri and Mulberry silk in 1985-86 in Orissa, is estimated to be 63, 8 and 2 metric tons, respectively.

Lac culture : Lac is the resinous encrustation produced by the tiny sap sucking insect *Tachardia lacca* (Kerr) on the branches of its principal host plants viz.. Kusuma (*Schleichera trijuga*), Palasa (*Butea frondosa*), Babul (*Acacia arabica*), Barakoli (*Zizyphus jujuba*), Khaira (*Acacia catechu*) and Harada (*Cajanus indicus*).

India is the foremost lac producing country in the world and the State of Bihar contributes about 55.5% of the total production of stick lac in the country. The next in rank are Madhya Pradesh, West Bengal, Maharashtra, Gujarat, Uttar Pradesh and Assam. Orissa stands last in in the list contributing about 0.1%, all through the natural food plants of the insect occur in abundance in the State and the climatic conditions are congenial for the production of the resin.

Cantharidin : Cantharidin, a crystalline solid is extracted from the dried bodies of 'blister beerles' (Meliodae). The blister beetle *Mylabris pustulata* is quite common in Orissa. It is a large, black and red striped beetle, about 2.5 cm long. It feeds on pollen grains and tender petals, usually of yellow flowers, and is commonly found on pumpkin and bittergourd. Cantharidin in used as an aphrodisiac, vesicant or diuretic. Collection of these bettles and production of this drug is yet to be undertaken in Orissa.

Apiculture : In Orissa, honey is obtained through two sources. The Khadi and Village Industries Board encourages people to cultivate honey, as a result of which some 3000 villages produce honey by bee-keeping. The other source of honey is collection of natural honey produced by *Apis dorsata* in huge hives constructed in the hollow of trees, on precipitous rocks and on branches of large trees by "Khadia" and "Malhara" tribes in the districts of Mayurbhanj, Dhenkanal and Koraput.

Honey obtained by bee-keeping of the domesticated Indian bee *Apis indica* varies in variety according to the flowers visited by the honey bees. Orissa abounds in large number of cultivated plants visited by honey bee workers and there is great scope for the development of apiculture in the State.

Fisheries : Orissa's coast line runs for 480 km on the Bay of Bengal, and a large number of rivers like Mahanadi, Baitarani and Subarnarekha together with their tributaries, flow through the State. A natural lagoon, the Chilka lake, covering an area of about 1000 sq km is a source of large haulage of prawns and brackish water fishers. The fishery resources of the State is therefore extensive and the figures of fish production set in Table 1 indicate progressive development of the industry. The principal freshwater species of fish commonly preferred are listed in Table 2.

TABLE 1

Fish production in Orissa (in metric tons)

Year	Inland	Marine
1982 83	40.200	41.400
1983 84	50.560	47.065
1984-85	51.440	46.070
1985-86	55,127	51.456

TABLE 2

Common freshwater fishes in use as food in Orissa.

	Scientific name	Local name in Oriya
Cerps	*Catla catla*	Bhakura
	Labeo rohita	Rohi
	Labeo calbasu	Kala bainshi
	Cirrhina mrigala	Mirikali
	Barbus sarana	Pitta-kerandi
Catfish	*Wallago attu*	Balia
	Eutropiichthys vacha	Bacha
	Macrones vittatus	Kantia
Sheat fish	*Notopterus chitala*	Chitala
Featherbacks	*Notopterus notopterus*	Pulli
	Clarias betrachus	Magura
	Heteropneustis fossilis	Singi
Live fish	*Anabas testudineus*	Kau
	Channa striatus	Seula
	Channa gachua	Chenga
	Channa punctatus	Gadisha
Herring	*Hilsa ilisha*	Elishi
Fel	*Mastacembalus armatus*	Bami

Prawn Fishery : Lake Chilka provides one of the rich sources for prawn fisheries of the State. Although as many as 21 species of prawns have been recorded from the lake, the two most important prawns of commercial value are ***Penaeus monondon*** and ***Penaeus indicus***. The average yearly yield of the two species is 246 and 661.34 tonnes, respectively (based on figures for 1957-1965). The other prawn species of commercial importance are *Penaeus semisulcatus*, ***Metapenaeus monoceros*** and ***Metapenaeus dobsoni***.

Some amount of the non-penaeid marine prawn, ***Palaemon tenuipes*** in hauled from the coastal waters of the State. Lake Chilka also yields some quantity of crabs.

Animal Husbandry : In 1979-80, the population of major domestic animals of economic importance in the state was as follows :

Cattle	13,479,218
Goats	3,416,395
Sheep	1,432,218
Poultry	8,309,787

The yield of milk from the cattle population was estimated at 250,000 metric tonnes. The average milk yield per cow per day is 0.518 litres. Although there is no recognised breed of cattle in Orissa, there are a number of established types, such as, cattle-Binjharpuri, Ghumsuri, Motto and Khariar. In addition, there are buffalo Sambalpuri and Paralakhemundi; goat and sheep-Ganjam type in Southern Orissa and black Bengal goats of Northern Orissa.

There is great scope for greater production milk, mutton, meat and egg production by introducing improved breeds and techniques. There is also room for improvement in the processing and utilization of hide and live-stock wastes.

Wild animal farming for profit, development of tourism and conservation

One of the most effective ways of conserving the fast vanishing wild life resulting from destruction of the forest ecosystem and dwindling forests, is wild life farming in smaller units of area constituting 1 to 2000 hectres or in larger area of 130 sq km. The Sambar, ***Rusa unicolor*** is the largest of Asiatic deer with the finest horns and once roamed in wooded

areas of India, Burma, Sri Lanka, Malay peninsula, Philipines and beyond. The Chital or Spotted deer, ***Axis axis*** is truely Indian being no where found except in Peninsular India and Sri Lanka. These two species, once common in all thirteen districts of the state, are now fighting for survival. Both the species of deer are highly adaptive to varied conditions. Farming of the two species imported from India into Australia and U.S.A., have proved to be highly successful in ranches attracting a large number of tourists, naturalists and sportsmen. Some of the potential animals suitable for farming in the state for meat, hide and horn, tourism as well as conservation are Chital, Black buck, Sambar and Pheasants.

Snake Park : Orissa abounds in various species of poisonous and non-poisonous snakes, such as, king cobra, cobra, Russell's viper, banded krait, common krait, green pit viper, Indian rock python, dhaman, vine snake, checkered keelblack, etc. The price of cobra venum now is Rs 400 and that of krait Rs. 2500 per gm, whereas the cost of gold per 10 gms is about Rs. 3000. A snake farm covering an area of one acre can house 2000-3000 snakes. A poisonous snake can be milked once a week yielding about 1/10 gm. There is great scope for the establihment of a Snake park in the State for attracting tourists, educating public and school children, contributing to the requirement of venum in the country for the production of polyvalent anti-snake venom serum and other experimental uses.

Frog culture : Orissa has two of the three edible bull frogs, namely the Jerdon's bull frog ***Rana crassa*** and the Indian bull frog ***Rana tigerina***. The climate is extermely suitable for frog culture and already the techniques for culture has been standardised (Mohanty-Hejmadi, 1986).

Sea turtle farm : Sea turtle are endangered as a whole. Orissa has the largest rookery for the olive ridley sea turtle ***Lepidochelys olivacea*** (Mohanty-Hejmadi, 1987). The techniques are available for farming this sea turtle which are of much commercial value for their flesh and other products.

Moniter Lizards : Three species of monitor lizards namely, the common Indian monitor ***Varanus bergalensis***, the water monitor ***Varanus salvator*** and the yellow monitor ***Varanus flavescens*** are of much economic importance as their skin is highly prized for its durability and suppleness.

Laboratory Animal Production : Research in almost all fields of biological science requires experimentation on laboratory animals for which various kinds of animals from monkey to albino rat of standard age maintained under healthy conditions are in great demand. There is ample scope for a Laboratory animals production centre in the State on cmmercial lines.

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SHORT COMMUNICATION

WILD ANIMALS OF THE BALIMELA AREA, DISTRICT KORAPUT, ORISSA.

Machkund is the most important river in the Balimela area of district Koraput. It originates in the Madgal Hills high up in the Eastern Ghats in Andhra Pradesh and for the most part travels along the Orissa-Andhra boundary in a South-easterly direction. After taking in its main tributary Guru Priyo in the Kondakamberu Reserve, it is known by the name Sileru and ultimately joins river Saberi near Motu at the extreme South of the district of Koraput in the state of Orissa. The confluence marks the inter-state boundary of Orissa, Madhya Pradesh and Andhra Pradesh. Both Machkund and Guru Priyo are perennial and flow through wild remote country and the valley is held between two folds of the Eastern Ghats for the most part. As such, the course is swift, rocky and treacherous. The 267 m (500ft) Dumduma fall near Machkund on the same river is the site of the 102,000 KW power station and a dam with its reservoiris located at Jolaput. Further down-stream at Chitrakonda, the Balimela Dam has been constructed. On the east of Godavari-Koraput boundary two other dams are located, on the same river in Andhra Prrdesh before it joins Saberi. Out of its total length of 295 km, it flows 61 km through the Koraput district and 192 km along the interstate boundary. The river due to its swift flow through hilly regions has immensely contributed to the economic growth of the district through power projects. The river flows through grassy hills and dense forest, and offers rare charm and scenic beauty. It abounds in the Mahseer (*Tor mosal*), the turtle ***Trionyx leithi*** Gray, and the Mugger or Marsh Crocodile ***Crocodilus palustris.***

Nearly 1500 sq km of miscellaneous forests occur in the Reserve lands of Machkund basin and on the extensive low country in Malkangiri and Balimela ranges. The forests of Machkund basin receive an annual rainfall of about 200 cms and abound in southern moist mixed deciduous forests with dry and moist bambo thickets. Much of the forests of the

valley are being submerged by the Balimela and upper Sileru raservoirs where *Teak. Bija, Haldu* and *Sahaj* trees of over 80 cms in diameter and 30 mts in height were once common.

The typical vegetation of the area consists of ***Terminalia tomentosa, Adina cordifolia, Pterocarous marsupium, Bridelis retusa, Dalbergia latifolia, Xylia xylocarana, Bombax ceiba, Albizzia chinensis*** and ***Schleichera oleosa*** with ***Emblica officinalis*** and ***Careva arborea*** forming the lower storey. ***Dendrocalamus strictus*** is present throughout Teak is now rarely seen as a result of changes in the soil structure due to continuous shifting cultivation over generations.

MAMMALS

1. The wild buffalo (***Bubalus bubalis***) is found in small numbers in the vicinity of Balimela and Kondakamberu. Hardly fifteen years back they were seen roaming in the whole of Malkangiri Sub-division. But with large-scale deforestation due to the Dandakaranya project most of them have crossed over into Andhra Pradesh, Only a small number has survived in the Kondakamberu forest but their pasture and breeding has been much affected by the construction of the Balimela Dam. The total number was estimated to be about 50 heads in 1981.

2. The Gaur (***Bos gaurus***) has suffered a lot due to the Balimela Dam project and is now found in small herds in Kondakamberu and in limited numbers in Dharamagad block.

3. Chital (***Axis axis***) is seen in small herds in Kondakamberu and further down along Sileru.

4-5. Sambar (***Cervus unicolour***) and Barking deer (***Muntiacus muntjak***) are not particulaaly abundant in Kondakambaru although still found in small to large herds.

6. Nilgai (***Boselaphus tragocamelus***) is rarely seen in Motu, Balimela and Malkangiri zones.

7. The 4-horned antelope (***Tetacerus quadricornis***) and the swamp deer (***Cervus duvauceli***) are extremely scarce.

8. The Chinkara (***Gazella gazella***) has been sighted in the past but now appears to be extinct.

9. The mouse deer (*Tragulus meminna*) is met with in small numbers throuhout the area but qu te often in Kondakambaru.

10. Tiger (*Panthera tigris*) is widely distributed but is particulrly found in Ramagiri, Malkangiri and Kondakambaru areas. During recent times their number has greately dwindled due to poaching.

11. Leopard (*Panthera pardus*)

12. Leopard cat (*Felis chaus*)

13. Hyaena (*Hyaena hyaena hyaena*)

14. Wild dog (*Cuon alpinus dukheunenssis*)

15. Sloth bear (*Melursus ursinus*)

16. Jackal (*Canis aureus*)

17. Indian fox (*Vulpes bengalensis*)

18. Wild boar (*Sus scrofa cristatus*)

19. Wolf (*Canis lupus pallipes*) occasionally seen in Ramagiri and Malkangiri.

20. Giant Indian Squirrel (*Ratufa indica*)

21. Brown flying Squirrel (*Petaurista petaurista phillinensis*)

22. Porcupine (*Hystrix indica indica*)

23. Hare (*Lepas nigricollis*)

24. Common langur (*Semnopithecus entellus*)

25. Rhesus macaque (*Macaca mulatta*)

26. Bonnet macaque (*Macaca radiata*) is found in good number.

BIRDS

1. Pea-fowl (*Pavo cristatus*) very common in Balimela Kondakamberu zone.

2. Red Jungle fowl (*Gallus gallus*)

3. Grey partridges (*Francelinus pondicerianus*)

4. Quail (*Cortunix* sp.)

5. Common Grey Horn-bill (*Tockus birostris*)

6. Hill myna (*Gracula religiosa*)

7. Orioles (*Oriolus* sp.)

8. Malbar pied hornbill (*Anthracoceros coronatus*)

9. Bulbus (*Pycnonotus* sp.)
10. Parakeets (*Psttacula* sp.)
11. Racket tailed Drongo (*Dicrurus paradiseus*), is common.

SNAKES

1. Indian Python (*Python molurus*)
2. King cobra (*Naja hannah*)
3. Cobra (*Naja naja*)
4. Russel's viper (*Vipera russelli*) : common.
5. The green pit viper (*Trimeresurus* sp.) : abundant

Excepting the submerged area of Kondakamberu reserve affected by the Balimela Dam. where the Orirsa Forest Corporation extracted marketable timber, the rest of the coops in this vast tract could not be sold, as these coops are uneconomical to work out due to their considerable distance from the nearest rail head. Further, most of the valuable forests of Kondakamberu reserve have been submerged by the Balemela Reservoir and the rest are on high country and are under shifting cultivation. The following sanctuaries have been established for the protection of wild life in the area.

1. Balimela Sanctuary 160 sq kms (approx.)
2. Kondakamberu Sanctuary 430 sq kms (approx.)

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EMINENT ZOOLOGIST

PROFESSOR GOBINDA KISOR MANNA

Dr. GOBINDA KISOR MANNA, M.Sc. (Calcutta), D. Phil, P.R.S., (Calcutta), D. Sc. (Calcutta) , F.N.A., F.N.A.Sc., F.A.Sc , F.A.Z., Professor of Zoology, Kalyani University, Kalyani, West Bengal, is widely known nationally and internationally as an eminent cytogeneticist, reputed teacher, researcher and scientific organizer. Born in Multi, 24 Parganas, West Bengal on the 10th October, 1926, he graduated from the Calcutta University with first class honours in Zoology in 1946, and obtained his M. Sc. degree in Zoology in 1948 with a first class and several proficiency prizes of Calcutta University. He obtained his D. Phil from Calcutta

University under the supervision of Prof. S. P. Raychoudhuri, in 1952. He enjoyed the prestigious Premchand Research Scholarship of the University in 1954 to work on human cancer cytology. In 1962, he was awarded the D. Sc. degree of the University on his work on mammalian and insect cytology. He was awarded Mount Gold Medal by Calcutta University on completion of P.R.S. in 1956.

Dr Manna joined as a Lecturer in Zoology in Bangabasi College, in 1949, Reader and Head in Zoology in Kalyani University in 1961 and became Professor of Zoology, University of Kalyani in 1968, which post he presently holds.

Professor Manna is internationally acclaimed to an authority in different fields of Cytology and in particular Cytotaxonomy and chromosomes in evolution in Heteroptera, Homoptera, Orthoptera and Coleoptera, Pisces, Amphibia and Mammalia, Chromosome breaking activity induced by various antibiotics, chemosterilants and other chemicals like nucleic acid analogues, components, metallic salts etc. He is pioneer to put microbes as a new class of mutagens, termed by him as " Living Mutagens " from the sustained works of himself and his group using dozens of bacterial species, fungal spores, culture of parasite protoza etc. He is now the acknowledged authority on mutagenesis specially showing microbes as mutagens to some species as of laboratory mammals, man and fishes as models. He worked on cancer cytogenetics from 1951-56, at a time when hardly human chromosomes was at infancy but his contributions are cited even in recent books of cancer cytogenetics. His works are often cited in many research papers and quoted over fifty standard books and other publications.

Dr. Manna has to his credit over 230 research pablications in national and international journals and more than 30 students working under his guidance were awarded the Ph. D Degree of the University of Kalyani. Some of his students have established themselves in setting up research school of their own in different Universities, Research Institutions in India. He is in the editorial board more than a dozen of research Journals published in India and a standing collaborator of Cytologia, Japan. Professor Manna has widely travelled and lectured in various Universities and research institutes in Japan, Canada, U.K., U S.A., Italy, Czechos-

lovakia, Israel and U.S.S.R. He had been to Czechoslovakia as INDO—CZEC exchange Professor in 1978, Indian National Science Academy and Japanes Science Council Exchange visitor Programme in 1983.

Dr. Manna is a great organizer and has successfully organised six All India Congress of Cytology and Genetics at Chandigarh (1971), Udaipur (1975), Hisar (1978), Bhagalpur (1981), Bhubaneswar (1984) and Jammu (1987), editor of the Proceedings under the cover Perspectives in Cytology and Genetics Vol. I-VI of which, through his efforts each volume running several hundred pages. He is the Secretary-Convener, All India Congress of Cytology and Genetics, Secretary and now the President, Zoological Society, Calcutta and past Secretary to the Society of Cytologists and Gentists, India.

Professor Manna is associated with various scientific organisations in and outside the country. He has delivered special lecture and/or chaired many national and international Conferences, and to name some are section of Cancer Cytology, Inter Xth Int. Fnt. Cong. Canada 1956, Xth Int. Genetics Cong. Canada 1958, Genetics Symposium, Tokyo and Kyoto, 1956; Genetics and Cancer, Texas 1959; XII Internatioual Congress of Genetics, Tokyo, Japan, 1968, Jerusalem Chromosome Conference 1976, XIV Int. Genet. Cong. Moscow 1978; XV Int. Genet Cong. Delhi 1983; International Seminar on management of Environment, BARC, Bombay, 1980; International Satellite Symposium on Chromosome research, Calcutta 1983; Section of Zoology, 56th Indian Science Congress, Bombay 1959, and Section Biological Science, 53rd Annual session, National Academy of Science, Jodhpur 1973; Indo US International Symp. on genetic toxicology, Calcutta 1987. Special lecture to 70th ,71st, 72nd, 73rd, 74th session of Indian Science Congress in different parts of India etc. In fact he has been lecturing almost in all Symposia/Seminar etc. in the field of Cytogenetics and environmental genotoxicity in our country.

Dr. Manna was awarded the Fellowship of the National Science Academy (FNA) in 1976, National Academy of Sciences, India (FNASc.) in 1967, Indian Academy of Science (FASc.) in 1978, Academy of Zoology (FAZ) in 1982. He also served for differeet periods: a member of the executive councial to Indian Academy of Sciences, Indian National Science, India, Indian Science Congress Association etc. Outside India he worked

on Cancer Cytogy in the University of Hokkaido, Sapporo, Japan in 1956 as a Sir Rash Behari Ghosh Travelling Fellow of the Calcutta University, worked for 2 years at the Forest Insect Laboratory, Canada on insect Cytogenestics from 1956-68 as a post-Doctorate Fellow of the National Research Council of Canada, Research Associate to M.D. Andrian Hosp tal U.S.A. for four months in 1959 after which he established his school of research in the Departmsnt of Zoology, University of Kalyani in 1962 to which he is still devoted and made the Institution internationally known visited by dozen of foreign scientists.

For his outstanding contributions in the field of cell biology he was awarded the Sir J. C. Bose award instituted by the Hari Om Trust, Naidad through the University Grants Commission in 1976. He was made a National Fellow by the U.G.C. from 1979-82.

Dr. Manna has settled permanently at Kalyani and his postal address is P 10/250 Kalyani 741 235, West Bengal.

Professor Manna has been associated with funding agencies like CSIR, UGC etc. In public life, he has been the Chairman, Kalyani Notified Area Authority, Kalyani Civil Association, member, Governing Body of Educational Institutions; Expert, in Union Public Service Commision, Chancellor Nominee to the West Bengal College Service Commission, External member to the Academic Council of some University and other University Bodies.

The ZOOLOGICAL SOCIETY OF ORISSA and PRANIKEE offer Professor Manna all good wishes on his 60th Birth day and also wish all success in his future activities.

INSTRUCTIONS TO AUTHORS

Manuscripts should be typewritten, double spaced, in English. Tables should be typed on separate pages. Illustratrions should not be larger than 22 × 28 cms (8½ × 11 inches). Reference to literature should be alphabetically arranged under author's name in the following format.

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

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

Pierce, B.A. and H. M. Smith, 1979—Neoteny or pnelogenesis ? J. Herpetol. 13 : 119 121.

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

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