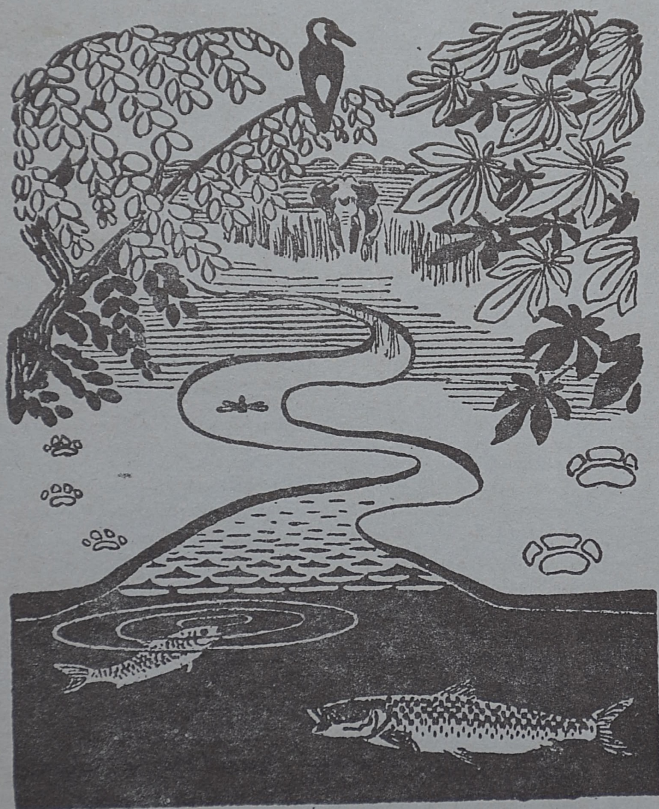


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JULY, 1969

NO. 2

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JOURNAL
OF THE
BENGAL NATURAL HISTORY SOCIETY

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JULY, 1969

No. 2

BIRDS OF THE DUARS

BY

C. M. INGLIS

(Continued from page 5, Vol. 35. No. 1.)

Suborder—*Cuculi*

Family—*Cuculidae*

Subfamily—*Cuculinae*

Cuckoos are divided into two groups, those which are parasitic on other birds and those which are non-parasitic, making their own nests and bringing up their own young. We will first deal with the parasitic ones.

Four Cuckoos occur in the Duars which have very similar plumage. They can be distinguished as follows—

No subterminal black band on the tail—

- (a) Edge of shoulder of wing and below the wing, narrowly barred blackish brown and white; lower plumage with narrow blackish-brown bars.....
.....The Asiatic Cuckoo
- (b) Edge of shoulder of wing pure white, lower plumage bars broader, bolder and further apart.....The Himalayan Cuckoo

(c) Edge of wing ashy, bars on lower plumage broader and bolder. Small sizeThe Small Cuckoo

A broad black, sub-terminal band on the tail, a white tip to the feathers.....The Indian Cuckoo

325. The Asiatic Cuckoo

Cuculus canorus telephonus, Heine.

Fauna B. I. 2nd. ed. No. 1452.

Description :— Length 13 inches. *Male* :—Upper plumage ashy-grey; wings browner and with a certain amount of gloss; tail ashy-black tipped with white and with small white spots at intervals along each side of the shaft, there is more white on the outer than on the central feathers; wings have the quills barred with white on the inner webs; sides of head and neck and from chin to upper breast pale ashy-grey; the rest of the lower plumage white, narrowly barred with black.

Female :—Browner and with a rufous tinge on the upper breast and sometimes, on the sides of the neck. It also has a hepatic phase in which the whole upper plumage is barred chestnut and blackish-brown and also the lower plumage is similarly barred, only paler, from the chin to the upper breast.

Bill horny-brown, paler and yellowish at base and orange-yellow on the gape; iris yellow; legs wax-yellow.

Distribution and habits :— The Asiatic Cuckoo occurs in the plains during the winter but is seldom heard calling; the call is like that of the European bird, *cuck-oo* so familiar to one in the spring at home; it is uttered by the male. It frequents open country rather than forest and may be seen on shade-trees in the tea or in groves and patches of trees. In appearance, and in flight, it is very hawk-like and it is fast on the wing. Its food consists of grubs, caterpillars and other soft-bodied insects.

It breeds in the Himalayas and other hill-ranges, and is parasitic on Shrikes, Forktails, Bush-chats etc.

326. The Himalayan Cuckoo.

Cuculus optatus Gould.

Fauna B. I. 2nd. ed. No. 1454.

Description :— Length 12 inches. Very similar to the last bird but the edge of the shoulder of the wing is pure white instead of being barred and the black bands on the lower plumage are broader, bolder and further apart. The *female* has usually more of a rufous tinge on the breast and the patch below the tail is fulvous barred with black. The hepatic plumage is like that of the last bird.

Bill dark horny-green, most of lower mandible yellowish, gape bright yellow; iris and eyelids yellow; legs wax-yellow.

Distribution and habits :— O'Donel recorded that this cuckoo occurred in the plains in September and October. I secured a specimen at Hasimara in April. Its habits are the same as those of the Asiatic Cuckoo but its call is very different. Whistler calls it "a dull booming note *hud-hud-hud-hud*".

It breeds in the Himalayas laying its eggs in the nests of Willow-warblers etc.

327. The Small Cuckoo.

Cuculus poliocephalus poliocephalus Latham.

Fauna B. I. 2nd. ed. No. 1455.

Description :— Length 10 inches. Sexes alike. The adult colouration is very like that of the Asiatic Cuckoo but the lower plumage is usually tinged with buff and the barring on it is bolder and further apart.

The young has a hepatic plumage; upper plumage chestnut barred with black, but the barring is sometimes absent on the head and neck; lower plumage white, the chin and throat tinged with chestnut, all barred with black.

Bill blackish-horny, base of both mandibles yellow; iris brown, eyelids yellow; legs wax-yellow.

The small size of this cuckoo should be sufficient to identify it. More material of this and other cuckoos is required for study of plumage changes.

Distribution and habits :— A female, in the young hepatic plumage, was obtained by O'Donel at Haldibari on the 13th September 1930; it was identified by Whistler. I have never come across it in the district. Its habits are like those of other members of the genus. I found it and many other cuckoos busy feeding on the caterpillars of the Red Slug moth which were swarming on the tea-bushes of the Mornai Tea Estate in Goalpara, Assam, a very serious pest to the tea. It frequents both open and forest country. Whistler says the Small Cuckoo has "a loud screaming note" and Stevens describes it as "a loud call, somewhat resembling the syllables *quik* four times rapidly uttered."

It breeds in the Himalayas laying its eggs in the nests of Bush-Warblers, Willow-Warblers etc.

328. The Indian Cuckoo.

Cuculus micropterus micropterus Gould.

Fauna B. I. 2nd. ed. No. 1456.

Description :— Length 13 inches. *Male* :—Head and neck above and at the sides dark ashy-grey; remainder of upper plumage rich brown; tail with a broad black subterminal band, the feathers tipped with white, with alternate white and black marks along the shafts; quills barred with white on the inner

webs; chin and upper breast light grey; rest of lower plumage creamy white barred with black.

Female:—Like the male but with, generally, a rufous tinge on the breast.

Bill horny-black above, patch under nostrils and lower mandible horny-green; gape yellow; iris dark brown; eyelids plumbeous-green; legs wax-yellow to orange-yellow.

Distribution and habits:— A very common Cuckoo which, according to O'Donel, arrives at the end of March, the male is usually heard calling about the 28th of that month. The adult birds leave in August and September followed by the young ones in October and by November all have left. He goes on "Only once in many years have I noticed a definite migratory movement, this was when out shooting on the 25th March, 1925. Numbers of birds were met with that morning, all were tired and restless, perching for a short time and then hurrying on again". It is found both in forest and open country and its well-known call *make more-pekoe*, is often heard on the tea-gardens and elsewhere. Its habits are like those of the rest of the genus.

It breeds in the district. H. Storrs, while on the Tasati Tea Estate, discovered it laid its eggs in the nest of the Himalayan Black Drongo. It, probably, starts laying in April as he found young in May and June. He shot a specimen for the Darjeeling Museum and wrote about the concern the Drongos had for the safety of the young bird, uttering cries of alarm and warning and, when the young Cuckoo fell, they flew down to the spot. Very little is recorded about the nesting of this Cuckoo but it, apparently, lays both blue eggs and eggs with pale or deep salmon ground colour, blotched with deep red-brown. The blue eggs are laid in the nests of Bush-Chats, Golden Bush-Robins, Streaked Laughing-Thrushes etc and the others in the nests of different species of Drongos and in those of the Indian

Paradise Fly-catcher. Much more information about the nesting and eggs of this common Cuckoo is desirable, especially oviduct eggs but the only way to obtain those is by shooting females during the breeding-season; they do not utter the well-known call.

329. The Indian Large Cuckoo.

Hierococcyx (Cuculus) sparveroides sparveroides (Vigors)

Fauna B. I. 2nd. ed. No. 1457.

Description :— Length 15 inches. Sexes alike. Head and neck dark ashy-grey, passing into the glossy purplish-brown of the upper plumage; tail banded with dark brown bands, the last the broadest; the feathers are tipped with white or rufous-white; wing-quills banded with white on the inner webs; a whitish moustachial-streak; chin dark ashy; throat white streaked with dark ashy; upper breast mixed rufous and ashy, the rufous predominating and streaked with dark ashy; rest of lower plumage white, suffused with rufous, and barred with blackish-brown.

Bill dark brown, lower mandible, except at tip, greenish-horny; gape bright yellow; iris yellow to orange; legs bright yellow and orange-yellow.

The Hawk-Cuckoos are even more Hawk-like than those of the last genus.

Distribution and habits :— This is a rare Cuckoo in the district, the only record is one secured at Hasimara on the 2nd March 1939. This fine Cuckoo is a forest loving bird, being found in evergreen, open mixed-deciduous forest and secondary-growth. Its call is similar to that of the better known Brain-Fever bird and its food consists largely of caterpillars and grubs.

It breeds in the Himalayas and in some other hill-ranges, and lays two types of eggs, a blue one and a brown one, the former in nests of Laughing-Thrushes which lay blue eggs and the

other in the nests of the large Streaked Spider-Hunter which lays brown eggs.

330. The Common Hawk-Cuckoo or Brain-fever Bird

Hierococcyx (Cuculus) varius Vahl.

Fauna B. 1. 2nd. ed. No. 1858.

Description :— Length 13 inches. Sexes alike. *Adult* :— Upper plumage ashy-grey; tail grey, broadly barred and tipped with rufescent, the terminal bar is the broadest; wing-quills ashy-brown barred with white on the inner webs; chin and throat white tinged with ashy; fore-neck and breast pale rufous mixed with ashy; abdomen and flanks white anteriorly tinged with rufous and barred with grey. *Young* birds are brown above barred with rufous; lower plumage white tinged with rufous and marked with bold, longitudinal, blackish-brown drops.

Bill greenish-horny, top of upper mandible and tip, blackish; iris yellow; legs wax-yellow.

Distribution and habits :— This very common Cuckoo is fond of groves and, unfortunately, freely enters gardens. It is arboreal in habits. It is most familiar through its voice of which, judging by its volume, it must be exceedingly proud; it is ear-splitting and nerve-racking and is uttered, continually, *ad nauseum*. Besides calling through the hottest hours of the day, it keeps on during the night as well. It is a very penetrating sound and can be heard from a considerable distance; its most vociferous period is from about February until the rains break. A good rendering of the sound is, "Oh lor! how very hot its getting—we feel it, *we feel it*, WE FEEL IT". Sometimes only the *we feel it* is uttered a number of times in succession. In flight it much resembles a hawk, but when perched on a branch it has a slouching attitude. It has a mixed diet of insects, fruit and birds but mostly the former such as crickets, hairy and other caterpillars, cockchafers and ants; the fruit

eaten is *Ficus*. Mason examined the stomachs of 17 birds in Bihar and of the 300 insects they contained 1 was beneficial, 46 neutral and 253 injurious, so it is a beneficial bird even if it does keep one awake at night.

The breeding season is from the middle of March to June and it lays its eggs largely in the nests of the Jungle Babbler (Seven Sisters) and allied species. Its eggs so closely resemble those of the fosterers that it is difficult to distinguish them but, on an average, they are rather bigger, stouter in texture and heavier. In colour they are the same deep blue as the Bblers' eggs but less glossy. As many as 6 Cuckoo eggs have been found in one nest. The young Cuckoo ejects the young or other eggs of the foster-parents and if there are several young Cuckoos in the same nest the stronger bird gets most of the food and survives. The eggs measure about 1.00 by 0.8 inches.

331. The Indian Plaintive Cuckoo.

Cacomantis merulinus passerinus (Vahl).

Fauna B. 1. 2nd. ed. No. 1462.

Description :— Length 9 inches. *Male* :— Upper plumage dark ashy-grey; tail black tipped with white and the inner webs of the outer feathers barred with white; wings brown glossed with bronze, the edge and a patch under the flight-feathers white; chin and throat grey paling to white under the tail.

Female :—Upper plumage bright chestnut barred with black on the back and wings; the tail has some black marks along the shafts and white tips to the feathers; chin to breast white suffused with chestnut, rest of lower plumage white, all lightly barred with black.

Nestling :—In the *Fauna B. I.* it is said that the upper plumage is "dark brown, each feather broadly edged with rufous; the tail black, barred and mottled with rufous and white; under

plumage white, more or less suffused with chestnut on chin, throat and breast and banded throughout with dark brown". I received several nestlings in the flesh, one of which was alive, collected by W. H. Mathews in the Darjeeling district. He also saw others and they were *all* as described here. Upper plumage dark ashy-grey like the male; tail dark ashy-grey, nearly black, tipped with white; chin, throat and upper breast dark ashy-grey; the chin and throat feathers edged with white; rest of lower plumage light ashy-grey. Not a single one had a vestige of chestnut in the plumage.

Bill dark brown; iris reddish-brown; legs dingy yellow or yellowish-brown.

Distribution and habits:— O'Donel recorded this as an uncommon Cuckoo. I have never seen it in the district. It is a bird of open forest, gardens, scrub-jungle etc and is oftener heard than seen. It has a very plaintive note syllabalized, by Stevens, as *pe-peah* followed by *tay-ta-tay* in an ascending scale. Jones describes a note as *how-few, how-few*. It calls both by day and by night. It is a restless bird with a swift flight.

It lays its eggs in the nests of Fantail-Warblers, Hill-Warblers, Wren Warblers and Tailor-birds.

332. The Burmese Plaintive Cuckoo.

Cacomantis merulinus querulus, Heine.

Fauna B.I. 2nd. ed. No. 1463.

Description:— Length 9 inches. *Male*:—Paler grey than the last species and the lower plumage ashy-grey on the throat, the upper-breast and the rest of the lower plumage rufous or rufous-buff instead of white.

Female:—Differs from the last species in having the whole of the upper plumage barred.

Bill brownish-black; iris brownish-black; iris brown; legs yellowish-brown.

The female might be confused with the next species but the bill of the latter is much heavier, the forehead is white with some brown bars and the middle tail-feathers have the centres black forming incomplete bars on to either web.

Distribution and habits:— This Cuckoo is not as uncommon as it was, formerly, believed to be. I have specimens collected at Binaguri, Haldibari and in the Moraghat forest during December, January and February. Its habits are the same as those of the last species but its call is said to be less plaintive.

I do not know whether either of the Plaintive Cuckoos breeds in the district. This race also lays its eggs in the nests of the Brown Hill-Warbler, Tailor-birds and Wren-Warblers.

333. The Indian Banded Bay Cuckoo.

Penthoceryx sonneratii sonneratii Latham.

Fauna B. I. 2nd. ed. No. 1464.

Description:— Length $9\frac{1}{2}$ inches. Sexes alike. Upper plumage barred with rufous and blackish-brown, except the forehead which is white with brown bars; tail rufous, the centre of the middle feathers black, forming incomplete bars on to either web—the black decreases on the other feathers and on the outer pair these are merely narrow bars; a rufous band behind the eye, with a white one above it; on the sides of the crown speckled and barred with brown; rest of head, and lower plumage white or buffy-white with fine blackish-brown wavy bars.

Bill brownish-black above, lower mandible horny-green; its much heavier bill easily distinguishes it from the Burmese Plaintive Cuckoo.

Iris brown with a red outer circle; legs greenish-slate.

Distribution and habits:— O'Donel considered it a very rare, resident Cuckoo. I have collected half a dozen specimens at Hasimara, Chilapata, the Rehti forest and Chupramari, one in February and the rest in January. It frequents forest, especially deciduous, but is also found in more open country where there are trees and undergrowth. Deignan says that in North Thailand it is fond of fruit gardens and copses and loves to perch upon telephone wires.

It is known to cuckold Bulbuls, Ioras, various small Babbler etc. Its breeding season varies much in different parts of India and is apparently from April to August on this side of India.

334. The Emerald Cuckoo.

Chalcites maculatus (Gmelin).

Fauna B. I. 2nd. ed. No. 1468.

Description:— Length 7 inches. *Male:*—Whole upper plumage from chin to breast, brilliant metallic green with golden-bronze reflections on the back and wings, blue on the wing-quills; tail tipped with white and with three white bars on the outer pair; lower plumage, below the breast, barred with metallic bronzed-green.

Female:— Crown and nape rufous, changing to light copper-green on the rest of the upper plumage; outer tail-feathers barred with white and black and the next pair with broad subterminal bands and patches of black; lower plumage white tinged with rufous from chin to upper breast and the whole barred with coppery-brown.

Bill orange-yellow tipped with black; iris brown to crimson; eyelids coral-red; legs brownish-green or slaty.

This genus contains two beautiful Indian Cuckoos with brilliant plumage; the tail is short and much graduated; the wings long and pointed and the legs feathered throughout.

Distribution and habits:— This is the most beautiful of the Cuckoos found in the district and is, I believe, resident as a pair were shot by E.G.L. Webb in June. I have secured about half a dozen specimens, in the Moraghat forest, in February and March. It is, essentially, a forest bird and generally keeps high up in trees, its plumage harmonizing with the leaves and making it rather difficult to observe. Stuart Baker describes its call as "a shrill but not unmusical succession of three notes in an ascending scale", this often gives it away and the above-mentioned author secured specimens on several occasions by shooting at moving leaves, whence he thought the whistles came. It, sometimes, calls at night as well as during the day. The food of this handsome little Cuckoo consists, especially, of caterpillars, cicadae, grubs but other insects and spiders, are also eaten.

The breeding season is from mid-April to the end of July. A.M. Primrose and myself, found a number of eggs of this Cuckoo, in the nests of the Eastern Himalayan Scarlet-Breasted Sunbird, in Goalpara, Assam. The nests were mostly situated under the overhanging banks of small streams in heavy forest. We only found single Cuckoos' eggs in the nests and they much resemble those of the Sunbird but are considerably larger. On the opposite side of the Sankos river, in the Goalpara district, Assam, Primrose and I found a very beautiful little Cuckoo, the Violet Cuckoo (*Chalcitis x. xanthorhynchus*), which may, some day, cross the river and turn up in the Duars. It is about half an inch smaller than the Emerald Cuckoo, the *male* has the whole of the upper plumage, throat and breast shining violet-purple and the lower plumage banded with white and violet, the latter glossed with metallic green. The *female* is similar to that of the Emerald Cuckoo on the lower plumage and the upper plumage is pale bronze-green tinged with copper.

335. The Indian Drongo Cuckoo.

Surniculus lugubris dicruroides (Hodgson).

Fauna B. I. 2nd. ed. No. 1470.

Description :— Length 10 inches. Sexes alike. Black throughout with a steel-blue gloss, especially on the upper plumage; there are, usually, some white feathers on the nape and part of the things are also white: outermost tail-feathers narrowly barred with white, the next ones with a few white spots; a white patch on the inner webs of the flight feathers; the patch below the tail is narrowly banded with white.

Bill and legs black; iris brown.

This Cuckoo has a striking resemblance to a Drongo, the tail is long, and forked, the lateral feathers curving outwards.

Distribution and habits :—O'Donel recorded this Cuckoo as very common in the plains but that it was overlooked on account of its remarkable resemblance to a Drongo. I have only secured one specimen in the Moraghat forest in March. It has not got the sprightly appearance of that bird. It frequents forest, bamboos, scrub-jungle and open wooded country and is not shy, allowing close observation. Its flight is dipping, rather like that of a Drongo and its call is a whistle of six notes in an ascending scale. Its food consists of caterpillars and other soft insects, also beetles.

It breeds from April to June but there is still nothing authentic recorded about its eggs.

336. The Pied Crested Cuckoo.

Clamator jacobinus pica (F. W. Hemprich & C. G. Ehrenberg)

Fauna B. I. 2nd. ed. No. 1472 part.

Description :— Length 13 inches. Sexes alike. Upper plumage, including crest, black glossed with green; tail tipped with

white, broadly on the outer feathers and less on the others; wing brown with a broad white band across the quills; lower plumage white or greyish-white.

Bill black; iris brown; legs leaden-blue.

This genus is distinguished by its long pointed crest; the upper part of the leg is feathered and the tail is long and much graduated.

Distribution and habits:— This Cuckoo is common from April to November, our Museum specimens were obtained in May, June and July. It frequents gardens, open wooded country, bamboos, and light forest and is an exceedingly noisy bird during the breeding season. It has a number of calls, some shrill and metallic, others harsh, the commonest of which sounds like *ple-ue*. The Pied Crested Cuckoo is not a shy bird. I have often watched it at close quarters in my garden in Bihar where it used to sit on some exposed position. Its flight is rather slow and its food wholly insects, grasshoppers, crickets, caterpillars, mantids etc. Mason recorded that out of 140 insects taken from the stomachs of 4 birds, 3 were beneficial, 131 injurious and 16 neutral; a certain amount of its food is obtained on the ground. Stuart Baker mentions wild blackberries and raspberries being eaten.

June, July and August are the principal breeding months. It lays its eggs in the nests of Jungle and Striated Babblers, and they very closely resemble those of those birds, being blue in colour, varying in tint, the gloss is less than in the fosterers' eggs. Several Cuckoos, sometimes, use the same nest in which to deposit their eggs. The young Babblers are ejected from the nest by the young Cuckoo. The eggs measure about 0.94 by 0.73 inches.

337. The Red-winged Crested Cuckoo.

Clamator coromandus (Linnaeus).

Fauna B.I. 2nd. ed. No. 1474.

Description:— Length $18\frac{1}{2}$ inches. Sexes alike. Head, crest, and nape black glossed with steel-blue; a narrow white half-collar on hind-neck; rest of upper plumage glossed with steel-green, with steel-blue from rump to tail; wings chestnut; chin to upper breast pale ferruginous; lower breast and abdomen white, ashy-grey on the flanks and vent; patch below the tail black with a steel-blue gloss.

Bill black, base of lower mandible yellowish, gape salmon pink; iris reddish-brown; legs plumbeous.

Distribution and habits:— According to O'Donel this is a very common Cuckoo in the forests of the foothills wandering well into the plains. I secured specimens at Rajabhatkhawa and near Binaguri. It frequents forest, bamboo and scrub-jungle and is, usually, seen singly or in pairs, but, it also collects in small parties when there is a plague of caterpillars, like the Red Slug one I saw in Goalpara or any other abundance of food. Its note is a harsh scream.

It lays its eggs in the nests of the Black-gorgeted and Necklaced Laughing Thrushes any time between April and August. The eggs are blue like those of their fosterers.

(To be continued)

FLOWERING OF CALCUTTA TREES

S. C. DUTTA AND JAYANTI BHATTACHARYA.

Department of Botany, University of Calcutta, Calcutta-19.

INTRODUCTION

Trees form a conspicuous part of any landscape. Their ornamental value cannot be minimised. They produce flowers of various shades of colour. Their flowering takes place at different times of the year, even if some of them belong to the same genus or same family. All these features are common to trees for any region and certainly Calcutta and vicinity cannot claim any exception to the general trend.

According to Benthall (1942), 54 families of angiosperms are represented in the trees of Calcutta and vicinity. They make up 276 plants, out of which 69 are native or naturalised to the area. Among the remaining 207 species, 91 are endemic to other parts of India, 50 are endemic elsewhere in Asia (though not natives of India), 14 are natives of Africa, 42 natives of America, 9 of Australia and 1 of South Sea Islands. It will be worthwhile to find out how the exotics have adapted to the new environment in conjunction with the indigenous ones. This can be done by recording their flowering time in every month and season and by correlating them with the climatic factors of the locality in question.

MATERIALS AND METHODS

Extensive trips to the different streets, roads, avenues and parks of the city of Calcutta and vicinity, where the trees are seen growing, were organised four or five times every month throughout the year from 1959 to 1964. Specimens from those trees in bloom were collected and brought to the laboratory where they were identified by matching with the herbarium spe-

cimens kept at the Botany Department, Calcutta University, and by referring to the works of Prain (1963), Benthall (1942) and Datta and Majumdar (1966). After they were identified, the names were entered in stout cards along with their date of collection. This information was checked all through the year by going to the spots wherefrom the collections were made. In order to correlate the flowering time with climatic factors, weather data for the four seasons (Table I) were collected from the Regional Meteorological Office, Alipur, Calcutta. The number of trees that flowered at every month and every season were estimated and their percentage calculated (Table II).

RESULTS

The flowering time for each species of trees was noted against each month and each season. One can notice 11 categories with respect to the monthly flowering and 15 categories with respect to the seasonal flowering.

Monthly flowering :— 1. Neither *Eucalyptus citriodora* nor *Euphorbia nivulia* flowered in any month of the year.

2. No trees flowered exclusively in January, August, November and December.

3. *Adenantha pavonina*, *Guazuma ulmifolia* and *Leucaena glauca* flowered twice in a year—once in March and April and another time from September to November.

4. Those flowering only in February included *Ailanthus excelsa*, *Filicium decipiens*, *Glircidia maculata* and *Jacaranda mimosaeifolia*.

5. Those flowering only in March comprised *Cochlospermum religiosum* and *Firmiana colorata*.

6. Those flowering only in April embraced *Cassia fistula*, *C. javanica*, *Chrysalidocarpus madagascariensis* and *Mammea longifolia*.

7. *Dalbergia lanceolaria*, *Lansea coromandelica* and *Peltophorum brasiliense* flowered only in the month of May.

8. *Flacourtia jangomas* flowered only in June.

9. *Livistona rotundifolia* and *Pandanus tectorius* flowered only in July.

10. Those flowering in September were represented by *Albizzia richardiana*, *Cassia surattensis* and *Tamarix troupii*.

11. *Bauhinia purpurea* flowered only in October.

Seasonal flowering :— 1. Those flowered during the winter included *Ailanthus excelsa*, *Bombax ceiba*, *Caesalpinia cacalaco*, *Cinnamomum camphora*, *C. tamala*, *Dalbergia sissou*, *Ehretia serrata*, *Filicium decipiens*, *Glircidia maculata*, *Jacaranda filicifolia*, *Schizolabium excelsum* and *Trewia nudiflora*.

2. Those flowered in the summer or pre-monsoon time comprised *Adenanthera pavonina*, *Aegle marmelos*, *Areca catechu*, *Antidesma ghaesembilla*, *Azadirachta indica*, *Barringtonia acutangula*, *Blighia sapida*, *Borassus flavellifer*, *Brya ebenus*, *Careya arborea*, *Cassia fistula*, *C. javanica*, *C. nodosa*, *C. renigera*, *Castanospermum australe*, *Casuarina equisetifolia*, *Chrysalidocarpus lutescens*, *C. maodagascariensis*, *Cicca acida*, *Citrus aurantium*, *C. medica*, *C. sinensis*, *Cochlospermum religiosum*, *Cordia dichotoma*, *Couroupita guianensis*, *Corypha elata*, *C. taliera*, *C. umbraculifera*, *Dalbergia lanceolaria*, *Diospyros cordifolia*, *D. discolor*, *D. peregrina*, *Dolichandrone spathacea*, *Embllica officinalis*, *Firmiana colorata*, *Euphoria longana*, *Excoecaria agallocha*, *Galphimia elegans*, *Garcinia cowa*, *Garuga pinnata*, *Grevillea*

robusta, *Guazuma ulmifolia*, *Ixora arborea*, *Jacaranda mimosaefolia*, *Jatropha curcas*, *Kigelia pinnata*, *Lannea coromandelica*, *Lepisanthes teraphylla*, *Leucaena leucocephala*, *Magnolia grandiflora*, *M. pterocarpa*, *Mammea longifolia*, *Milleitia ovalifolia*, *Nauclea orientalis*, *Peltophorum brasiliense*, *Phoenix sylvestris*, *Polyalthia cerasoides*, *P. suberosa*, *Pterocarpus indicus*, *Putranjiva roxburghii*, *Ravenala madagascariensis*, *Spondias dulcis*, *Strychnos nux-vomica*, *Swietenia macrophylla*, *S. mahagoni*, *Tamarindus indicus*, *Terminalia arjuna*, *T. belerica*, *Vitex negundo*, *V. trifolia* and *Wrightia coccinea*.

3. Those flowering in the monsoon time were represented by *Albizzia richardiana*, *Alstonia macrophylla*, *Anogeissus pendula*, *Anthocephalus cadamba*, *Cassia marginata*, *C. surattensis*, *Citharexylum quadrangulare*, *Colvillea racemosa*, *Cratoxylon quadrangulare*, *Dillenia indica*, *Diospyros chloroxylon*, *Euphorbia tirucalli*, *Flacourtia jangomas*, *Haplophragma adenophyllum*, *Hiptage benghalensis*, *Livistona rotundifolia*, *Pandanus tectorius*, *Tamarix aphylla*, *T. troupii* and *Tectona grandis*.

4. Those flowered in the post-monsoon period embraced *Bauhinia purpurea*, *Bixa orellana*, *Crataeva roxburghii* and *Thespesia populnea*.

5. Those flowered from the winter to summer covered *Acrocarpus fraxinifolius*, *Alangium salvifolium*, *Amherstia nobilis*, *Artocarpus heterophyllus*, *Azadirachta indica*, *Bauhinia variegata*, *Bischofia javanica*, *Broussonetia papyrifera*, *Brownea coccinea*, *Butea monosperma*, *Casearia tomentosa*, *Cassia grandis*, *Cedrela toona*, *Ceiba pentandra*, *Citrus maxima*, *Croton oblongifolius*, *Cynometra polyandra*, *Erythrina ovalifolia*, *E. variegata* var. *orientalis*, *Euphorbia antiquorum*, *Feronia limonia*, *Flacourtia indica*, *Gmelina arborea*, *Grewia sapida*, *G. subinequalis*, *Haematoxylon campechianum*, *Hemitelia littoralis*, *Hibiscus tiliaceus*, *Jacquinia ruscifolia*, *Litchi*

chinensis, *Litsea monopetala*, *Malphigia glabra*, *Mangifera indica*, *Moringa oleifera*, *Morus australis*, *Ochna squarrosa*, *Pithecolobium dulce*, *Pterospermum acerifolium*, *Pterygota alata*, *Schleichera oleosa*, *Spathodea campanulata*, *Spondias pinnata*, *Sterculia foetida* and *Streblus asper*.

6. Those flowering from the pre-monsoon to the monsoon period included *Adansonia digitata*, *Albizzia lebbek*, *A. procera*, *Annona squamosa*, *Anogeissus acuminata*, *Artocarpus lakoocha*, *Barringtonia racemosa*, *Caryota urens*, *Cocos nucifera*, *Delonix regia*, *Desmos chinensis*, *Elaeodendron glaucum*, *Elaeis guinensis*, *Gustavia angusta*, *Holarrhena antidysenterica*, *Kleinhovia hospita*, *Lagerstroemia speciosa*, *Lawsonia inermis*, *Litsea glutinosa*, *Livistona chinensis*, *Melaleuca leucadendron*, *Michelia champaka*, *Mimusops elengi*, *Oroxylum indicum*, *Parmentiera cerifera*, *Peltophorum pterocarpum*, *Polyalthia longifolia*, *Pongamia pinnata*, *Psidium gujava*, *Pterospermum lanceaefolium*, *Ptychosperma macarthuri*, *Pouteria mammosa*, *Roystonea oleracea*, *R. regia*, *Sapindus mukorossi*, *Syzygium jambos*, *S. malaccensis*, *S. samarangense*, *Tecoma stans*, *Terminalia catappa*, *T. chebula*, *Wrightia tinctoria* and *W. tomentosa*.

7. Those flowered from the monsoon to the post-monsoon period included *Averrhoa carambola*, *Calophyllum inophyllum*, *Cassia multijuga*, *Eriobotrya japonica*, *Lagerstroemia thorelli*, *Leucaena leucocephala*, *Nyctanthes arbor-tristis*, *Sesbania grandiflora*, *Syzygium cumini* and *Zizyphus mauritiana*.

8. The flowering of *Sesbania sesban* extended from the winter to the monsoon period.

9. The flowering time of *Acacia nilotica* ranged from the monsoon to the winter.

10. The flowering of *Alstonia scholaris*, *Annona reticulata*, *Aphanamixis polystachya*, *Millingtonia hortensis* and *Sapindus laurifolia* covered the time from the post-monsoon to the winter.

11. For *Aleurites mollucana*, *Crescentia cujete*, *Saraca indica* and *Trema orientalis*, the flowering period ranged from the winter to the monsoon through the summer.

12. For *Acacia suma*, *Gardenia jasminoides*, *Plumeria rubra* forma *acutifolia*, *Sapium sebiferum*, *Siaminea saman* and *Solanum maeranthum*, the flowering time extended from the summer to the post-monsoon period via the monsoon regime.

13. The flowering time of *Solanum verbascifolium* extended from the monsoon to the winter season through the post-monsoon period.

14. The flowering of *Gelonium multiflorum* took place in the winter, summer and post-monsoon period.

15. *Acacia auriculiformis*, *A. farnesiana*, *Ardisia solanacea*, *Callistemon lanceolatus*, *Calotropis gigantea*, *Carica papaya*, *Cordia sebestena*, *Ervatamia coronaria*, *Morinda citrifolia*, *Parkinsonia aculeata* and *Thevetia peruviana* flowered in all seasons.

DISCUSSION

In course of this study, it is seen that *Eucalyptus citriodora* and *Euphorbia nivulia* remain vegetative throughout the year and do not produce any flower. The months of January, August, November and December do not influence the flowering of any tree species in particular. There are 3 species which bloom twice in the course of a year. Thus, out of a total of 234 species investigated, the flowering of 21 species follows the monthly pattern. Of those flowering in other months of the year, 4 take place exclusively in February, 2

in March, 4 in April, 3 in May, 1 in June, 2 in July, 3 in September and 1 in October.

TABLE I

Metrological data from 1959 to 1964
Station—Calcutta (Alipore)

Season	Month	Temperature (°C.)		Relative humidity (%) at		Total pre- cipitation (mm.)
		Max.	Min.	8-30 hrs.	17-30 hrs.	
Winter	December to February	28.3	15.4	68	51	8.2
Summer or Pre-monsoon	March to May	35.7	24.6	68	54	61.6
Monsoon	June to September	32.7	26.4	82	80	375.0
Post monsoon	October to November	30.5	21.3	69	67	94.9

For the seasonal flowering, 71 species or 31.7 per cent of the trees are favoured by summer or pre-monsoon when maximum temperature is 35.7°C. and total precipitation 61.6 mm. There are 44 species whose flowering extends from the winter to the summer and 43 species whose flowering time ranges from the pre-monsoon to the monsoon. In the monsoon regime, the flowering of 20 species or 8.9 per cent of the trees are stimulated by the maximum temperature of 32.7°C. and total precipitation of 375.0 mm. During the winter when maximum temperature is 28.3 and total precipitation 8.2 mm., 12 species or 5.3 per cent of the trees bear flowers. There are 10 species whose flowering time covers the monsoon and post-monsoon and 11 species which form flowers

in all seasons. In the post-monsoon season when maximum temperature is 30.5 and the total precipitation is 94.9 mm., only 4 species or 1.8 per cent of the trees form flowers.

TABLE—II

Seasonal categories in flowering

Seasons	Categories	No of trees flowered	Percentage of trees flowering
Winter ...	A	12	5.3
Summer or premonsoon ...	B	71	31.7
Monsoon ...	C	20	8.9
Post-monsoon ...	D	4	1.8
Winter + summer ...	A+B	44	19.6
Premonsoon + monsoon ...	B+C	43	19.2
Monsoon + post - monsoon ...	C+D	10	4.5
Winter + monsoon ...	A+C	1	0.4
Monsoon + winter ...	C+A	1	0.4
Post - monsoon + winter ...	D+A	5	2.2
Winter + summer + monsoon ...	A+B+C	4	1.8
Summer + monsoon + post-monsoon ...	B+C+D	6	2.7
Monsoon + post-monsoon + winter ...	C+D+A	1	0.4
Winter + summer + post-monsoon ...	A+B+D	1	0.4
Winter + summer + monsoon + post-monsoon ...	A+B+C+D	11	4.9

The first four categories (A,B,C,D) in Table II make up less than 50 per cent of the tree species and conform strictly to the seasonal pattern, while A+B, B+C, C+D, A+B+C+D and other surpass the exclusive pattern.

From the above findings, it may be stated that 31.7 per cent of the tree species constitute the category which has the highest rate of flowering. As this category blooms in the summer or pre-monsoon, the prevailing climatic conditions are conducive to the reproductive phase. The climatic conditions during the monsoon induce flowering of 20 species (8.9 per cent); this is followed by the winter and post-monsoon in

which period 12 species (5.3 per cent) and 4 species (1.8 per cent) respectively bring about flower formation. Almost all the exotics have become accliamatised to the new environment, since they are found in flowering condition in every season of the year. This proves that it is possible to increase the natural resources of Calcutta or of any other similar area in India by introducing plants from different countries.

REFERENCES

- Benthall, A. P. 1942. Trees of Calcutta and Neighbourhood. Thacker Spink & Co., Calcutta.
- Datta, S. C. and Majumdar, N. C. 1966. Flora of Calcutta and vicinity. Bull. Bot. Soc. Bengal, 20 (2), 16.
- Prain, D. 1963. Bengal Plants, Botanical Survey of India, Calcutta (reprinted. ed).

EARTHWORM HUNTING IN DARJEELING

BY

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In the third week of July, 1968 with monsoonic climate well set to favour the lush growth of plants and marked activity of invertebrate animals, I entered into the garden of Mount Hermon School of Darjeeling at an altitude of about 1900 metres from sea level. I came across a few earthworms in one part of the garden. Instantly, I felt fascinated at these "natural tillers", specially bearing in mind the altitudinal location of the garden.

Subsequently, on July 31 that I thought was a favourable day for 'earthworm hunting,' I went to the garden again. I was lucky to encounter the worms that time in different parts of the garden, and quite abundantly. In a heap of black leaf-mould manure, I found two types of earthworms. The diameter of such a mound was about 50 centimetres and coupled with size, the surface area worked out roughly at 65 square centimetres and on the average, the mound harboured about 20 earthworms of both the types. Most of these worms were mature with showy clitellum, but individuals of one type were consistently shorter and fatter and wore a darker grey hue compared to those of the other type which were longer and narrower all along the body-axis. Both types, however, resembled in their ventral surfaces which were quite pale.

The above specimens were brought by me to our Department in the Darjeeling Government College and with the help of my professors, I examined the external and internal aspects of the specimens. I could conclude that the shorter earth-

worm which measured 11.4-12.3 centimetres in length were *Pheretima alexandri*, having about 87 segments in the body. The longer ones, measuring 14.9—16.2 centimetres in length and having about 117 body segments, belonged to *Pheretima houletii*.

During my third visit to the garden, on August 3, I removed mound of the rotting leaves which harboured adults of *alexandri* and *houletii* earthworms. This was done in order to study more critically the nesting habit of these worms. I found, to my surprise, that there were a few burrows in the soil, each about of 1.27 centimetres' width and harbouring one or two 'mini-earthworms'. Those were the 'babies' of *alexandri* and *houletii*; clitellum in them was not at all perceptible, and internal reproductive structures could not be traced in them. Apparently, the adults of two species stay outdoors and within the loose interspaces of the mound, leaving the more protected burrows in the soil at the disposal of their developing forms.

While searching 'soil-burrows' of earthworms in different parts of the garden, I spotted a few pink-coloured and extendedly long earthworms. Each of them measured about 24 centimetres in length and was composed of some 290 body segments. Those belonged to *Pheretima taprobane*. Both adults and developing forms were obtained from inside the burrows which were always found in uncovered, open spaces of the garden. Stray adults were also found strolling outside the burrows and but did not form a 'school of earthworms' for that end as was the case with *alexandri* and *houletii*. Apparently, the two last-named species exhibited a trace of 'community life' in their adult state while *taprobane* adults hardly had that habit.

Then I timed the locomotion of the live adults in their natural spaces. *P. alexandri* and *P. houletii* moved at a rate

of 1.83 metres in 4.5 minutes while *P. taprobane* covered that distance in 20 minutes. Skin samples from these 'runners' were examined under microscope to note the differences in respect of "setae"—the patent locomotor organs of all earthworms. The setae in all cases were found arranged on a "perichaetine" plan—so characteristic for the genus *Pheretima*. Those were large and well developed in *alexandri* and *houletti*—the mound-dwelling, fast-moving earthworm species but small and weak in *taprobane*—the soil-dwelling, slow-moving one. Another interesting point that I observed for all specimens of earthworms in the garden was that these worms were all photophobic, and *taprobane* adults were so intensely that they used to outrun the adults of *alexandri* and *houletti* under experimental conditions with a strong light source in the vicinity.

It appears that there is no standard work on the earthworm species of Darjeeling. Present determinations were made on the basis of Bahl (1960) and it was possible that the specific diagnoses were not sufficiently critical. Nevertheless, the generic diagnosis of all earthworms encountered now was easy. This study, therefore, showed that the commonly available Darjeeling earthworms belonged to *Pheretima*, and were represented at least by three species. Further studies are required to cover other species, if any, within the area as well as the various aspects of ecology and bionomics of these earthworms including the methods they adopt in order to tide over the harsh winter.

I am obliged to Dr. B. Dasgupta, Head and Professor of Zoology Dept., Darjeeling Government College, for permission and facilities to complete this study, and to other teachers of the Department, Dr. S. K. Das Gupta and Mr. R. Guin, for various courtesies.

REFERENCE

- Bahl, K. N. 1960. The Indian Zoological Memoirs on Indian Animal Types, I. *Pheretima*. 84 pp., 4th reprinted edn., Lucknow Publishing House.

A SURVEY OF DARJEELING INSECTS BY PERIODIC
LIGHT-TRAPPINGS

BY

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INTRODUCTION

The present study furnishes the preliminary data on the abundance and the nocturnal periodicity of the phototropic insect populations including the prevailing blood-sucking forms of Darjeeling, a hill station in the northern side of the West Bengal State (India) at an approximate altitude of 1666 metres from sea level and having average atmospheric temperature varying between 9°C. and 19°C. in summer and between 15°C. and 13.5°C. in winter while the annual precipitation averages at 321 cms.

Sampling of insect populations by light-trap is a standard method (Beck, 1958) and of a few previous studies made in India in this respect, mention may be made of Sen and Das Gupta (1959) who found that in Calcutta area the peak catch of *Culicoides* insects (Diptera) occurred in the first part of the night, of Das Gupta (1961) who pursuing the light-trapping method of Bancrjee and Basu (1956) found that in the Gangetic West Bengal the peak catch in a season was obtained in September, and of Kundu *et al.* (1964) who on the basis of light-trappings of four species of Coleoptera and three species of Orthoptera, Lepidoptera and Hymenoptera in Pilani (Rajasthan) suggested that the frequency of precipitation was more important than its quantity to favour a higher incidence of the night-flying

insects. However, these studies were all made in the Indian plains.

PROCEDURE

The light-trap device used now consists of a rectangular tray, $30 \times 25 \times 4$ cms. size, filled with liquid paraffin to form the collecting bed in the device (Murphy, 1960) or filled with glycerine or even with 2% to 3% acetic acid solution in water for the same end. A plain electric bulb of 150 wattage is fixed above the tray at its centre in such a way as to almost touch the liquid layer in the tray. The bulb is fitted with a parabolic reflector so as to throw its light stream directly on the tray and outwards by the upper edges of the tray. The trap location is selected within a residential backyard at the Mall area of Darjeeling and the trap is set at 1.82 metres away from the ground level. The backyard is at an altitude of 2135 metres from sea level and the patterns of topography, vegetation, hill stream and human habitation in its vicinity are sketchily plotted in figure 1. Besides the perennial vegetation and streams of the area, local pockets of garbage, garden refuse, refuse from animal sheds and open drains form good breeding centres of insects specially the dipterons in the area.

Each of 23 nights of light-trappings of the present study were completed within a ten-hour duration, from 7 p.m. to 5 a.m. To record the hourly trappings, collections were made in two ways—either at the interval of every two hours in a night or at the interval of every five hours in a night. Thus the collections in the first way of a fully operational night were referred in the text as of I shift covering 7 p.m. to 9 p.m., II shift covering 9 p.m. to 11 p.m. etc., till of the last or V shift of the night covering 3 a.m. to 5 a.m. The collections in the second way were referred as of I shift covering 7 p.m. to 12 midnight and of II shift covering 12 midnight to 5 a.m. The number of individuals of different categories of insects was

ascertained by direct counting of the individuals in the collections.

The categories of insects admitted now in the text was a matter of convenience. However, the order taxon of the collected insects was determined after due scrutiny and while population of other orders was not further analysed in this preliminary study, those of the Diptera were broken down to all available nematoceran families, the Brachycera and the Cyclorrhapha, with one nematoceran family, the Ceratopogonidae, broken down further to all available genera.

RESULTS

It was seen in course of the present study that the specimens collected on watery bed with traces of acetic acid were more suitable for storage and microscopic study than those collected using liquid paraffin or glycerine. In the latter cases, the specimens were found saturated with the medium of the collecting bed and this could not be removed even by rinsing them with kerosene as suggested by Murphy (1960). Permanent slide mounts of the specimens having even a trace of liquid paraffin or glycerine turned foggy after some time. But those of specimens collected in watery medium with a trace of acetic acid were good even after a long time and catch-efficacy of this medium was not found lower in any way.

In 23 nightly collections, 17586 insects of the study area were collected and as: 719 Coleoptera, 11234 Diptera, 1186 Hemiptera, 272 Hymenoptera, 1644 Lepidoptera, 2531 Psocoptera. Stray samples of Orthoptera, Neuroptera and Thysanoptera were also collected, either from the trap or while those were hovering at trap vicinity.

The Diptera is composed of 20 Anisopodidae, 10 Bibionidae, 317 Cecidomyiidae, 467 Ceratopogonidae, 3763 Chironomidae, 5 Dixidae, 13 Mycetophilidae, 3126 Psychodidae, 1267

Sciaridae, 255 Simuliidae, 520 Tipulidae, 63 Brachycera, and 1408 Cyclorrhapha. The Ceratopogonidae was composed of 74 *Atrichopogon*, 182 *Culicoides*, 206 *Forcipomyia* and 5 *Stilobezzia*.

The Hemiptera was mainly composed of leaf-hoppers (Jassidae) and the Hymenoptera was mainly composed of winged ants (Formicidae). The Psychodidae was totally composed of the Psychodinae.

Of 23 nights covered during the present study, collections in all envisaged shifts could be made only in 17 nights. The nightly catch rate on basis of these 17 nights stands at, average (range): 31.4(1-73) for Coleoptera, 529.5(54-1268) for Diptera, 51.7(12-139) for Hemiptera, 12.4(2-39) for Hymenoptera, 72.8(16-167) for Lepidoptera and 109.3(2-286) for Psocoptera.

The hourly appearance of different insect groups is found to vary throughout a night. The per hour catch-rates calculated for the various insect groups are as, average (range): 3.5(0-13.2) for Coleoptera, 54.8(4-100) for Diptera, 5.78(2-17.5) for Hemiptera, 1.32(0-3.9) for Hymenoptera, 8.02(1.6-25) for Lepidoptera, 12.34(0-79.1) for Psocoptera and for the various dipterons as, Cecidomyidae 1.4(0-6.7), Ceratopogonidae 2.28(0-8.4), Chironomidae 18.35(2-79), Psychodidae 15.25(0.2-33.8), Sciaridae 6.18(0.5-17.1), Simuliidae 1.24(0-5.6), Tipulidae 2.53(0.1-7.3), Brachycera 0.31(0-1.8) and Cyclorrhapha 6.87(0-35.3). However, the pattern of maximum to minimum appearance encountered for the different insect groups in the night of two-hour-interval collection system if be examined shiftwise, the following are noted :

Coleoptera pattern—III,I,II,IV,V shift,

Diptera pattern—III,IV,II,V,I shift,

Hemiptera pattern—III,II,IV,I,V shift,

Hymenoptera pattern—III,IV,II,V,I shift,

Lepidoptera pattern—III,IV,II,I,V shift,
 Psocoptera pattern—III,II,I,IV,V shift,
 Cecidomyidae pattern—III,IV,II,V,I shift,
 Ceratopogonidae pattern—III,IV,V,I,II shift,
 Chironomidae pattern—III,IV,II,V,I shift,
 Psychodidae pattern—III,IV,V,I,II shift,
 Sciaridae pattern—III,V,IV,II,I shift,
 Simuliidae pattern—II,III,IV,I,V shift,
 Tipulidae pattern—III,IV,II,V,I shift,
 and Cyclorrhapha pattern III,II,IV,V,I shift.

In the five-hour-interval collection system, all insect populations of the study area taken as a whole show the maximum appearance during the second shift in a night. The Diptera and its such families as Cecidomyidae, Ceratopogonidae, Psychodidae, Sciaridae and Tipulidae also show the same. The Coleoptera, Cyclorrhapha, Hemiptera, Hymenoptera, Lepidoptera, Psocoptera and Simuliidae, however, show the maximum appearance during the first shift.

DISCUSSION

In 23 nights of May-June, 1968, 17586 insects were collected by light-trappings in a residential area of Darjeeling, at an altitude of 2135 metres from sea level.

The collected insect groups showed an abundance ratio as Diptera 63.9%, Psocoptera 14.4%, Lepidoptera 9.3%, Hemiptera 6.8%, Coleoptera 4.08% and Hymenoptera 1.4%. There is no standard previous work showing the extant insect groups of Darjeeling and therefore a comparative contention cannot be advanced now about the pattern of prevalence of these groups as reflected in the present study. It can only be pointed out that the study area abounds in phototropic dipterons and a good prevalence of psocids in the area is noteworthy. Phototropic species of Orthoptera, Neuroptera and Thysano-

ptera also prevail in the area as samples of these groups came in light-trap occasionally.

In a similar study as above, Frost (1963) finds that in Florida (U.S.A.), according to the abundance, the collected insect groups could be listed as, Hemiptera, Coleoptera, Lepidoptera, Hymenoptera, Diptera and Psocoptera while elsewhere, in West Virginia (U.S.A.), this was as, Diptera, Lepidoptera, Hymenoptera, Hemiptera, Coleoptera and Psocoptera (Messersmith, 1966).

About 85% of the dipterous populations in the present study were as, Chironomidae 33.48%, Psychodidae 28%, Brachycera and Cyclorrhapha 13.06%, and Sciaridae 11.31%. The remainder was composed of Tipulidae 4.6%, Ceratopogonidae 4.15%, Cecidomyidae 2.83%, Simulidae 2.37% and with Anisopodidae, Bibionidae, Dixidae and Mycetophilidae each less than 1%. The comparable study in Florida and West Virginia, mentioned before, noted a different ratio. In case of the former, the Nematocera including the Cecidomyidae, Ceratopogonidae, Chironomidae, Psychodidae, Tipulidae, Bibionidae and Simuliidae were found as far more numerous than the Brachycera and Cyclorrhapha while in case of the latter, the abundance ratio worked out as, Cecidomyidae 52.53%, Ceratopogonidae 15.68%, Psychodidae 13.15%, Chironomidae 9.81%, Brachycera and Cyclorrhapha 3.72%, Mycetophilidae 2.72%, Sciaridae 2.07%, Tipulidae 1.54%, Culicidae 0.21%, Anisopodidae 0.11%, Dixidae 0.11% and Scatopsidae 0.02%. Absence of Culicidae in the collections made now is noteworthy and this may be either due to a differential timing in the incidence of the group or the area being sparsely populated by these insects having exclusively the weakly phototropic species.

In the nights with collections made at the end of every two hours during the present study, the third shift period from 11

p.m. to 1 a.m. is seen consistently as the period when maximum number of insects per shift turned up in the trap. At the other end, the first shift period from 7p.m. to 9 p.m. and the fifth shift period from 3 a.m. to 5 a.m. have been the periods of a very low turn up of insects per shift. The Simuliidae seems most abundant in the second shift period from 9 p.m. to 11 p.m. and this falls steadily as the night advances. Such a steady pattern is not seen for other sections of Diptera or for other insect groups each of which registers its own peculiar appearance pattern.

In the nights with collections made at the end of every five hours of the present study, some insect groups are most abundant in the first shift from 7p.m. to 12 midnight while others are so in the second shift from 12 midnight to 5 a.m.

Combining the appearance patterns of the insect groups of the present study, as explained above, three distinct timings for the peak appearance can be pinpointed and as, those showing the peak appearance during 11 p.m. to 1 a.m. in the two-hour-interval collection system and during 7 p.m. to 12 midnight in the five-hour-interval collection system, those showing the peak appearance during 11p.m. to 1 a.m. in the two-hour-interval collection system and during 12 midnight to 5 a.m. in the five-hour-interval collection system, and those showing the peak appearance during 9 p.m. to 11 p.m. in the two-hour-interval collection system and during 7 p.m. to 12 midnight in the five-hour-interval collection system. The Coleoptera, Cyclorhapha, Hemiptera, Hymenoptera, Lepidoptera and Psocoptera fall under the first category with average peak appearance before midnight. The Simuliidae belongs to the third category with average peak appearance well before midnight. The remaining dipterons belong to the second category with average peak appearance in the second part of the night. Timing of peak appearance, however, has been variously reported in literature and the variation was due to differences in insect

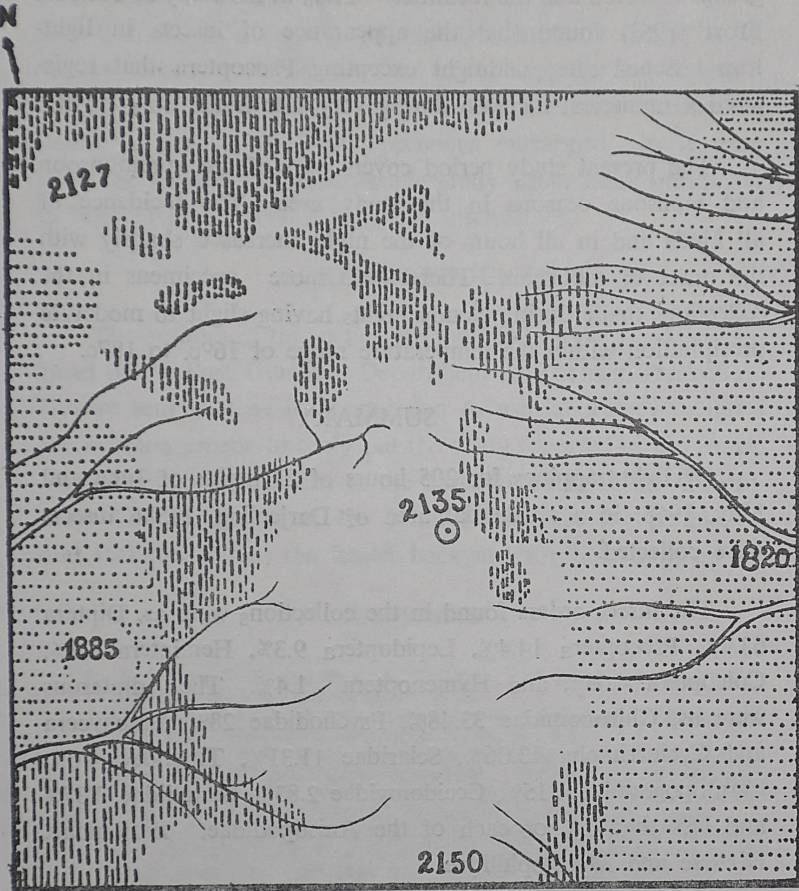


Figure 1: Symbol-sketch of topography, vegetational area and residential pockets in about one square mile around the light-trap location in the Mall area of Darjeeling (encircled area at middle shows the trap location, figure; inside show the altitude of the respective sectors from sea level in meter unit, dotted portion shows the tea gardens, dash-marked portion indicates the area having abundance in timber and shade trees, blank space stands for the residential pockets and other lines represent the hill streams).

appearance before midnight while *Stenobothrus* is maximum in the early part of the night. Other diptera of the present study show the same trend appearance in the second part of a night. More specimens are collected in cloudy nights having slight to moderate precipitation within a temperature range between

groups involved and the localities. Thus in his study in Florida, Frost (1963) found that the appearance of insects in light-trap lessened after midnight excepting Psocoptera that registered a numerical increase during very late hours of a night.

The present study period covers part of the premonsoon and monsoon seasons in the study area. The incidence of all kinds and in all hours of the night increased sharply with the onset of monsoon. There were more specimens in the collections made during cloudy nights having slight to moderate precipitation within the temperature range of 16°C. to 18°C.

SUMMARY

By light-trappings for 205 hours of 23 nights of June and May, 1968, in a residential area of Darjeeling, 17586 insects were collected.

The insect orders found in the collections were as, Diptera 63.9%, Psocoptera 14.4%, Lepidoptera 9.3%, Hemiptera 6.8%, Coleoptera 4.08% and Hymenoptera 1.4%. The dipterons were as, Chironomidae 33.48%, Psychodidae 28%, Brachycera and Cyclorrhapha 13.06%, Sciaridae 11.31%, Tipulidae 4.6%, Ceratopogonidae 4.15%, Cecidomyidae 2.83%, Simuliidae 2.37% and less than 1% of each of the Anisopodidae, Bibionidae, Dixidae and Mycetophilidae.

The periodical collections from the light-trap in the present study during a night, at the interval of every two hours or five hours, show that the Coleoptera, Cyclorrhapha, Hemiptera, Hymenoptera, Lepidoptera and Psocoptera have an average peak appearance before midnight while Simuliidae is maximum in the early part of the night. Other dipterons of the present study show the average peak appearance in the second part of a night. More specimens are collected in cloudy nights having slight to moderate precipitation within a temperature range between 16°C. and 18°C.

As the collecting bed in the light-trap, it was experienced now that 2% to 3% acetic acid solution in water could be an effective medium in the bed for insect-trapping and it has a distinct advantage over such previously reported medium as liquid paraffin in that the specimens entrapped in it were good for storage and microscopic study while those entrapped in liquid paraffin turned foggy on microslides.

ACKNOWLEDGEMENTS

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REFERENCES

1. Banerjee, S. N. and Basu, A. C. 1956. The Chinsura light trap. Proc. Zool. Soc. (Calcutta), 9 : 27-32.
2. Beck, E. C. 1958. A population study of the *Culicoides* of Florida (Diptera : Heleidae), Mosquito News, 18 : 6-11.
3. Das Gupta, S. K. 1961. Studies on the incidence of some Indian *Culicoides* (Diptera : Ceratopogonidae). Indian Agric., 5 : 190-206.
4. Frost, S. W. 1963. Winter, insect-light trapping at the Archbold Biological Station, Florida. Florida Entomologist, 46 : 24-43.
5. Kundu, H. L., Datta Gupta, A. K. and Gupta, B. B. 1964. A study of the abundance of certain insects of Pilani with the help of a light trap. Proc. Rajasthan Acad. Sci., 8 : 79-87.
6. Messersmith, D. H. 1966. Report of a collection of *Culicoides* (Diptera : Ceratopogonidae). Virginia J. Sci., 17 : 83-104.
7. Murphy, D. H. 1960. A note on collection of Heleidae and other biting Diptera in suitable condition for dissection. Mosquito News, 20 : 191.
8. Sen, P. and Das Gupta, S. K. 1959. Nocturnal periodicity of biting midges (Diptera : Ceratopogonidae). Science and Culture, 25 : 374-375.

SYSTEMATIC STUDIES ON *MYSTUS* SPP. (PISCES:
BAGRIDAE) OF WEST BENGAL.

By

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INTRODUCTION

After Day (1878) very few attempts were made to make a detailed systematic study of the common fresh water fish groups like *Mystus* spp. from West Bengal. In places like West Bengal and Orissa, where there is good scope for improvement of freshwater fisheries, there is a need for a detailed systematic study of as many groups as possible. This preliminary study on the systematics of *Mystus* spp. from West Bengal will form the basis for fishery workers in their applied study. Jayaram (1952) made a general systematic study of siluroid fishes from India in which he gave an account of *Mystus* spp. Brief description of a few *Mystus* spp. were also given by Shaw and Shebbeare (1932) in their account on freshwater fishes of Northern Bengal.

In this paper a detailed description of the species of the genus *Mystus* Scopoli obtained from Calcutta markets and places around Calcutta, (Canning, Diamond Harbour and Lakshmikantapur) and a key to these species are given. The classification in the present account is adopted from Berg (1947).

We are grateful to the Director, Zoological Survey of India, for facilities to carry out this investigation.

MATERIAL AND METHODS

Mystus spp. were collected from Calcutta markets (1.8.67) and adjoining places. Specimens were from mixed catches

of Hoogly river and ponds. Measurements were from preserved specimens, with a divider and were expressed in standard lengths except eye diameter, snout length, interorbital space, maximum head width and width of the gape of mouth which are expressed in head length. The length of the occipital process is the distance between the origin of the median prolongation to the maximum width of the occipital process at its origin. Following the previous descriptions the caudal fin ray counts were taken for those rays between and including the longest rays. The total counts of caudal fin rays (including the small rays lying outside the longest rays) were also expressed within parenthesis.

SYSTEMATIC ACCOUNT

Order—Cypriniformes

Division—Siluri

Suborder—Siluroidei

Super family Siluroidei

Family—Bagridae

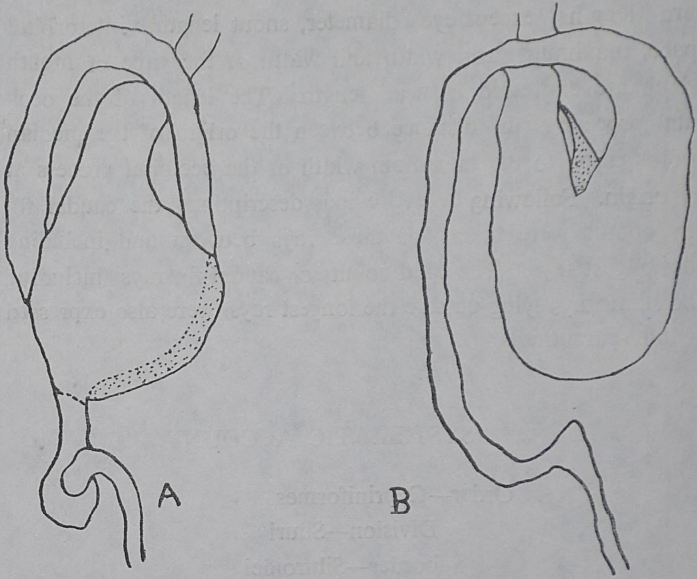
Genus—*Mystus* Scopoli, 1777.

Mystus cavasias (Hamilton):

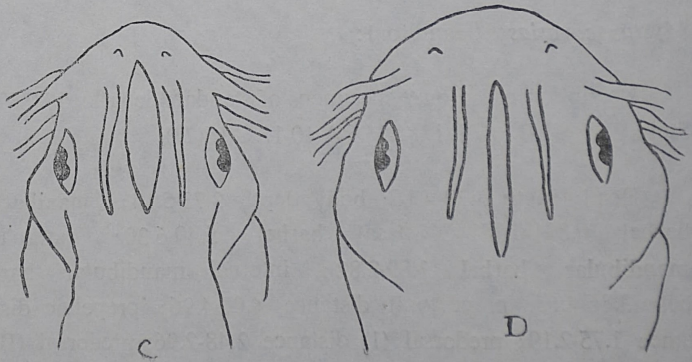
Description based on 7 specimens of standard lengths 56.0-87.5mm. B. VI.D.1/7,P.1/8, V.6 A.10-11.C.16(23),

Head length 3.20-4.16; body depth 3.73-5.14; maxillary barbel 0.821-0.981; nasal barbel 5.40-6.30; external mandibular barbel 1.89-2.82; internal mandibular barbel 3.86-4.65; prepectoral distance 4.00-4.96; prepelvic distance 1.75-2.19; predorsal (I) distance 2.48-2.96; predorsal (II) distance 1.64-2.02; preanal distance 1.23-1.47; pectoral fin length 4.20-5.33; pelvic fin length 4.90-5.85; base of 1st dorsal 5.33-7.45; base of IIInd dorsal 2.30-2.73; anal fin base 7.46-9.72; interdorsal distance 48.66-87.50 in standard length. Eye diameter

PLATE I



(A) Alimentary canal of *M. armatus*. (B) Alimentary canal of *M. vittatus*.
(C) Head region showing median longitudinal groove in *M. gullo*. (D) Head region showing median longitudinal groove in *M. malabaricus*, (After Jayaram, 1954).



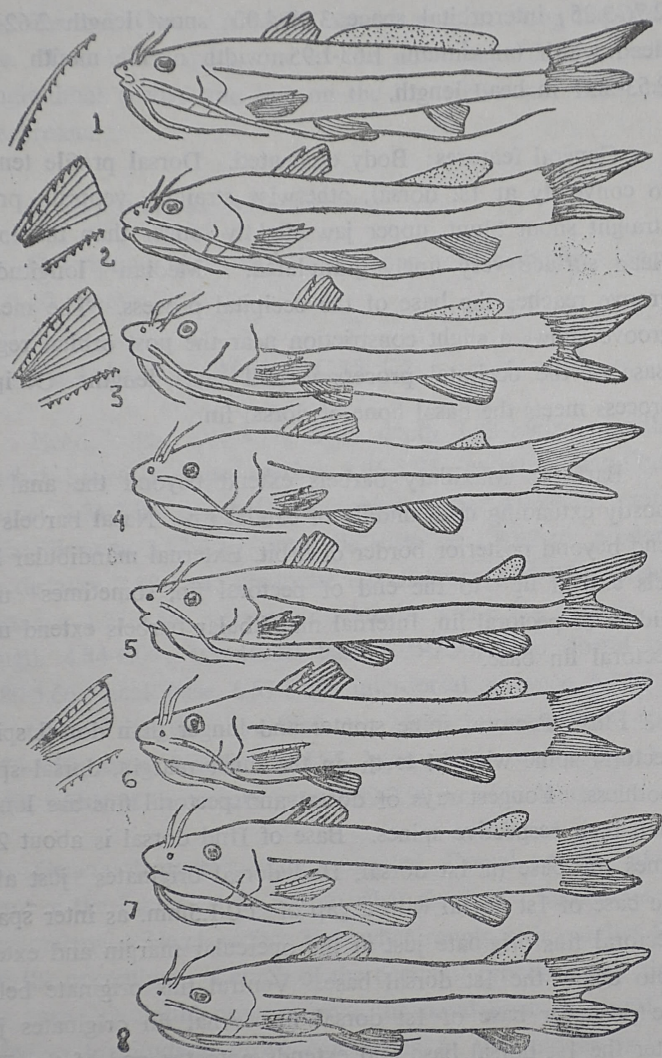


Plate II : 1. *M. cavasius* (Hamilton); pectoral spine showing teeth, 2. *M. oculatus* (Val.); pectoral fin showing teeth on pectoral spine and rays; dorsal spine showing teeth. 3. *M. keletius* (Val.); pectoral fin showing teeth on pectoral spine and rays; dorsal spine showing teeth. 4. *M. armatus* (Day), 5. *M. vittatus* (Block). 6. *M. punctatus* (Jerdon); pectoral fin showing teeth on pectoral spine and rays : dorsal spine showing teeth. 7. *M. gullio* (Ham.) head region showing median longitudinal groove is shown in Plate I. 8. *M. malabaricus* (Jerdon); head region showing median longitudinal groove is shown in Plate I.

2.76-3.25; interorbital space 3.18-4.00; snout length 2.62-3.25; head width (maximum) 1.63-1.95; width of the mouth gape 2.53-2.91 in head length.

General features: Body elongated. Dorsal profile tending to convexity at 1st dorsal, otherwise straight; ventral profile straight snout blunt, upper jaw slightly longer than the lower. Head surface very finely granulated. Median longitudinal groove reaches the base of the occipital process. The median groove shows a slight constriction near the post orbital region. Base of the occipital process is half its length. Occipital process meets the basal bone of dorsal fin.

Barbels: Maxillary barbels extend beyond the anal fin, mostly extending upto middle of caudal fin. Nasal barbels extend beyond posterior border of orbit. External mandibular barbels extend up to the end of pectoral fin, sometimes upto middle of pectoral fin. Internal mandibular barbels extend upto pectoral fin base.

Fins: Pectoral spine stouter and longer than dorsal spine. Pectoral spine with 14 teeth on the inner margin, dorsal spine toothless. Longest rays of dorsal and pectoral fins are longer than their respective spines. Base of IInd dorsal is about $2\frac{1}{2}$ -3 times the base of 1st dorsal, IInd dorsal originates just after the base of 1st dorsal, with a gap of 1.0-1.5mm. as inter space. Pectoral fins originate just at the opercular margin and extend upto below the 1st dorsal base. Ventral fins originate below the posterior base of 1st dorsal fin. Anal fin originates just after the 1st dorsal base and extends upto the end of the IInd dorsal base. Caudal fin is deeply forked and the upper caudal lobe is longer than the lower.

Colour: Dorsally lead colour, abdominal region dull yellowish white. Maxillary barbels dusky, other barbels dull white. 1st and IInd dorsal and caudal fins dusky; pectoral, ventral and

anal fins dull white. A bluish band is present along the lateral line. Two black spots, one at the posterior end of median longitudinal groove and one on the basal bone of dorsal fin, are present.

Mystus oculatus (Valenciennes):

Description based on 7 specimens of standard lengths 42.0-69.5 mm.

B.X.D.1/7,P.1/6,V.6A.10,C.15 (22),

Head length 3.06-3.71; body depth 3.83-4.95; maxillary barbel 1.00-1.08; nasal barbel 4.84-5.95; external mandibular barbel 2.24-2.90; internal mandibular barbel 4.03-4.76, prepectoral distance 3.53-4.40; prepelvic distance 1.80-2.16; predorsal (I) distance 2.19-2.44; predorsal (II) distance 1.26-1.52; preanal distance 1.31-1.54; pectoral fin length 3.83-6.57; pelvic fin length 4.84-6.04; 1st dorsal base 6.05-7.93; IIInd dorsal base 4.80-5.66; anal base 6.57-8.50; interdorsal distance 5.54-8.18; in standard length. Eye diameter 2.80-3.50, interorbital space 2.75-3.50; snout length 3.26-3.75; head width (maximum) 1.61-1.94; width of the mouth gape 2.50-2.90 in head length.

General features: Body elongated. Dorsal profile at the base of the 1st dorsal fin is somewhat elevated. Snout more or less narrow. Head surface somewhat rough with parallel lines on the operculum. Length of the occipital process is two times its base. Occipital process meets the basal bone of dorsal fin. Median longitudinal groove constricted at the middle and the narrow posterior region approaches the base of the occipital process. Barbels: Maxillary barbels reach the caudal fin base. Nasal barbels extend just to the posterior border of orbit. External mandibular barbels extend upto the tip of pectoral spine whereas internal mandibular barbels extend sometimes upto pectoral fin base, mostly end before pectoral fin originates.

Fins: Both dorsal and pectoral spines are with teeth. Pectoral spine stouter than the dorsal; teeth on the dorsal spine are minute—8 on the inner margin and 3 on the outer margin towards the tip. Pectoral spine has 10 teeth on the inner margin only; outer margin smooth. The longest fin rays of both the fins are longer than the respective spines. Origin and extension of fins are similar to *M. keletius* but in this species the caudal fin is very deeply forked. Base of IInd dorsal is longer than that of 1st dorsal and the interspace between the two fins.

Colour: Dull silvery laterally and ventrally. A bluish band along the lateral line with two greyish and one silvery band above and below the lateral line. A dark spot on head and shoulder. Dorsal fins bases are black. Ventral and pectoral fins are dull white, dorsal and caudal fins are dusky. Nasal and maxillary barbels dusky, mandibular barbels whitish.

Mystus keletius (Valenciennes):

Description based on 7 specimens of standard lengths 42.0-69.5mm. B.X,D.1/7,P.1/8-10, V.6.A,10-11,C.15-16(22).

Head length 3.25-3.56; body depth 3.84-4.66; maxillary barbel 1.03-1.33; nasal barbel 5.00-7.63; external mandibular barbel 2.45-2.89; internal mandibular barbel 3.95-5.25; prepectoral distance 3.78-4.34; preventral distance 1.88-2.04; predorsal (I) distance 2.35-2.52; predorsal (II) distance 1.31-1.55; preanal distance 1.30-1.44; pectoral fin length 3.95-4.70; pelvic fin length 5.13-6.21; 1st dorsal base 5.65-6.66; IInd dorsal base 3.60-5.25; anal base 6.69-8.07; interdorsal distance 5.54-8.18 in standard length. Eye diameter 3.00-3.25; interorbital space 2.76-3.37; snout length 3.00-3.57; head width (maximum) 1.66-1.92; width of the mouth gape 2.40-2.69 in head length.

General features: Body elongated. Dorsal profile slightly convex at the base of the 1st dorsal, otherwise straight; ventral profile straight. Snout narrow, upper jaw slightly longer than lower jaw. Head rough with closely set tubercles, some parallel

lines are present on the operculum. Median longitudinal groove constricted at the middle and extended upto posterior border of preopercle. Occipital process narrow, meets the basal bone of dorsal fin. Length of occipital process is $2\frac{1}{2}$ -3 times its base. Indistinct preanal papilla present.

Barbels: Maxillary barbels extend mostly upto posterior end of anal base, sometimes do not reach the posterior end of anal base. Nasal barbels extend upto or sometimes beyond the pectoral fin. Internal mandibular barbels either reach pectoral fin base or end just before pectoral fin origin.

Fins: Pectoral spine with 12 teeth on the inner side and is stronger than the dorsal spine which is having 9 teeth on the inner side and 3 teeth on the outer side towards the tip. Longest rays of dorsal and pectoral fins are longer than their respective spines. Length of the base of the IInd dorsal is more than that of the 1st dorsal and the interspace between the two dorsal fins. Ventral fins originate below the middle of 1st dorsal and end 2.3m.m. before the origin of anal fin. Anal fin base ends below the posterior end of base of IInd dorsal. Upper lobe of caudal fin longer than the lower lobe.

Colour: One greyish dark band along the lateral line, 2 silvery and 1 grey band above and 1 silvery and 1 grey band below the lateral line. Ventral region dull white with yellowish tinge. A black spot on head, another on shoulder. Maxillary and nasal barbels dusky, mandibular barbels dull white. 1st dorsal and anal fin show black upper region and dull white lower region.

Description based on 1 specimen of standard length 79.0mm.

Mystus armatus (Day):—

B.X,D.1/7,P.1/9,V.6.A.11.C.18(23).

Head length 3.43; body depth 4.27; maxillary barbel 1.61; nasal barbel 5.85; external mandibular barbel 2.98; internal man-

dibular barbel 4.93; prepectoral distance 4.05; prepelvic distance 1.81; predorsal (I) distance 3.33; predorsal (II) distance 1.32; preanal distance 1.46; pectoral fin length 4.51; pelvic fin length 6.07; 1st dorsal base 6.41; IInd dorsal base 9.62; anal base 6.86; interdorsal distance 3.95 in standard length. Eye diameter 3.83; interorbital space 2.70; snout length 3.83; head width (maximum) 2.19; width of the mouth gape 2.42 in head length.

General features: Body elongated. Broad flat snout. Considerable convexity in dorsal profile at the base of the 1st dorsal fin. More or less straight upto the base of IInd dorsal from where the profile decreases after the end of IInd dorsal. Length of occipital process is twice its base. Occipital process reaches basal bone of dorsal fin. Median longitudinal groove shallow, extended upto post orbital border. Head rough with tubercles arranged in lines. Operculum marked with straight longitudinal lines. Eye prominent. Anal papilla present.

Barbels: Maxillary barbels extend upto the middle of the ventral fin. Nasal barbels extend beyond the post orbital border. External mandibular barbels extend upto middle of pectoral spine and internal mandibular barbels upto the base of pectoral fin.

Fins: Pectoral spine has 11 teeth and dorsal spine 10 teeth on the inner side and the former stronger than the latter. The longest fin rays on both the fins are longer than the respective spines. Base of IInd dorsal is less than that of the first dorsal and is less than half of the interspace between the two fins. Anal fin originates before IInd dorsal. Ventrals originate below the posterior 1/3rd of the first dorsal fin. Upper lobe of the caudal fin is longer than the lower.

Colour: Dorsal region lead colour, ventral region lighter, dull white in color. Bases of pectoral, ventral, anal and lower half of caudal yellowish, fins are dusky; 1st & IInd dorsals

dusky. Head and maxillary barbels black, nasal barbels dusky, mandibular barbels dull white.

Mystus vittatus (Bloch):

Description based on 6 specimens of standard lengths 90.0-113.0mm

B.X.D.1/7, P.1/7-8, V.6.A. 11-13, C.17(22).

Head length 3.54-4.08; body depth 3.47-4.46; maxillary barbels 1.82-2.06; nasal barbels 6.66-8.37; external mandibular barbels 5.45-5.93; prepelvic distance 1.72-2.51; prerorsal (I) distance 2.43-2.76; predorsal (II) distance 1.22-1.54; preanal distance 1.32-1.44; pectoral fin length 4.09-4.66; pelvic fin length 5.48-6.32; 1st dorsal base 7.11-8.37; 2nd dorsal base 7.82-11.87; anal base 5.62-8.01; interdorsal distance 3.58-4.50 in standard length. Eye diameter 4.72-6.10; interorbital space 2.40-2.66; snout length 3.20-3.60; head width (maximum) 1.45-2.00; width of the mouth gape 2.18-2.54 in head length.

General features: Body elongated; both dorsal and ventral profiles are more or less straight but dorsally tending to convexity at the base of 1st dorsal. Snout broad and flat. Upper jaw slightly longer than the lower. Upper surface of head rough with tubercles. Some parallel lines are present on the posterolateral side of the opercle. Median longitudinal groove on head ends at the post orbital region i.e. far before the base of the occipital process. Length of the occipital process is two times its base. Occipital process reaches basal bone of dorsal fin. Anal papilla present.

Barbels: Maxillary barbels extend upto the base of the ventrals. Nasal barbels extend beyond the posterior border of orbit. External mandibular barbels extend beyond the origin of pectorals whereas internal mandibular barbels extend either beyond or just reaches the preopercular border.

Fins: Pectoral spine is stouter and longer than dorsal spine. On the innerside of both pectoral and dorsal spines

there are teeth, 12 in pectoral and 10-12 in dorsal. Outer side of dorsal spine is rough. The longest fin rays of both the fins are longer than the respective spines. Pectorals originate before 1st dorsal and extend upto the posterior base of 1st dorsal. Ventrals originate behind the first dorsal and anal originate behind the first dorsal and anal originates before the IIInd dorsal. Base of 2nd dorsal is always less than of 1st dorsal and about $1/3rd - \frac{1}{2}$ of the interdorsal space. Upper lobe of the caudal fin is longer.

Colour: Dull golden along the body. A faint dark band along the lateral line and another band dorsally present. Head dark, a prominent black spot present on the shoulder and another faint spot at the caudal fin base. Ventrals and ventral region with a golden hue, ventral, anal and pectoral fins dull white, both dorsals and caudal dusky. Maxillary and nasal barbels somewhat dusky, mandibular barbels dull white.

Mystus punctatus (Jerdon):—

Description based on 1 specimen of standard length 62.0mm.

B.XI:D.1/7,P.1/7,V. 6,A.13,C.18(25)

Head length 3.68; body depth 4.42; maxillary barbel 1.69; nasal barbel 7.75; external mandibular barbel 3.64; internal mandibular barbel 7.29; prepectoral distance 3.87; prepelvic distance 1.87; predorsal (I) distance 2.48; predorsal (II) distance 1.30; preanal distance 1.44; pectoral fin length 4.76; pelvic fin length 7.29; 1st dorsal base 8.26; IIInd dorsal base 10.33; anal base 6.88; interdorsal distance 4.13 in standard length. Eye diameter 3.40; interorbital space 2.61; snout length 3.40; head width (maximum) 1.78; width of mouth gape 2.42 in head length.

General features: Body elongated. Dorsal profile shows tendency to convexity with a steep rise at the region of dorsal

fin (I). Abdominal region is convex. Upper jaw slightly longer than lower. Snout narrow. Upper surface of head more or less smooth. Length of the occipital process is 1.5 times its base. Occipital process reaches basal bone of dorsal fin. Median longitudinal groove shallow and covered by skin. The groove extends a little distance in advance of post orbital border.

Barbels: Maxillary barbels extend upto middle of ventral fin. Nasal barbels extend upto post orbital border. External mandibular barbels just reach pectoral fin base and internal mandibular barbels extend upto preopercular border.

Fins: Both dorsal and pectoral fins possess spines of which pectoral spine is stouter than the dorsal one. Pectoral and dorsal spines show 9 and 7 teeth respectively on the inner margin. The longest rays of dorsal fin are longer than the spine whereas the spine is longer than longest fin rays in pectoral fin. Base of IInd dorsal is smaller than that of 1st dorsal; inter dorsal space is about $2\frac{1}{2}$ times the base of IInd dorsal. Anal fin originates before the origin of IInd dorsal. Ventrals originate below end of 1st dorsal and reach nearly upto the origin of anal. Upper lobe of caudal fin longer than the lower.

Colour: Head, back and lateral sides of the body brownish grey, ventrally dull white; bases of ventral and anal fins brownish. Tip of ventral fin black, anal fin light brown; pectoral, caudal and dorsal fins dusky. Maxillary and nasal barbels dusky, mandibular barbels white.

Mystus gulio (Hamilton):—

Description based on 8 specimens of standard lengths 53.5-89.0m.m. B. IX.D1/7,P.1/8,V.6,A.11-12,C.16-17(21-22).

Head length 3.32-3.70; body depth 4.16-5.35; maxillary barbel 1.32-1.74; nasal barbel 4.86-8.30; external mandibular barbel 2.43-3.29; internal mandibular barbel 4.11-5.56; pre-

pectoral distance 3.82-4.48; prepelvic distance 1.77-1.98; predorsal (I) distance 2.48-3.02; predorsal (II) distance 1.25-1.40; preanal distance 1.38-1.46; pectoral fin length 4.44-5.08; pelvic fin length 5.63-7.12; 1st dorsal base 7.40-8.87; IInd dorsal base 8.87-11.85; anal base 5.94-6.91; interdorsal distance 3.87-4.36 in standard length. Eye diameter 3.60-4.16; interorbital space 2.66-3.00; snout length 3.00-4.16; head width (maximum) 1.48-2.17; width of the mouth gape 2.20-2.66 in head length.

General features; Body elongated. Abdominal region convex, dorsal profile more or less straight but tending to convexity at the base of 1st dorsal. Snout broad, depressed slightly, upper jaw longer than the lower. Head surface finely granulated. Median longitudinal groove on head lanceolate and reaching post orbit. Length of the occipital process is twice its base. Occipital process reaches basal bone of dorsal fin.

Barbels: Maxillary barbels extend beyond ventral fin base, sometimes extending upto anal fin base, but not extending beyond the middle of anal fin base. Nasal barbels extending beyond posterior orbital border. External mandibular barbels extend upto middle of pectoral fin and internal mandibular barbels just reach pectoral fin base.

Fins: Pectoral spine is stouter than dorsal spine. Dorsal spine with 8-10 and pectoral spine with 9-10 teeth on the inner margin. Longest rays of dorsal and pectoral fins are slightly longer than their spines. Base of IInd dorsal is usually less than that of 1st dorsal and less than half the interspace between two dorsal fins. Pectorals originate before 1st dorsal and extend upto middle of 1st dorsal base. Ventral fins originate below the posterior end of 1st dorsal base and extend upto origin of anal fin. Anal fin originates before the IInd dorsal fin. Caudal fin is distinctly forked and the upper caudal lobe is longer.

Colour: Bluish brown dorsally, especially in head region, gradually becoming dull laterally and silvery white ventrally which sometimes show both in fresh and preserved conditions yellowish patches. Fins yellowish with margins black. Maxillary barbels blackish, others generally white.

Mystus malabaricus (Jerdon):

Description based on 5 specimens of standard lengths 46.0-60.5mm. B.X.D.1/7,P.1/9,V.6,A.11-13,C.18-19(23-24).

Head length 3.31-3.73; body depth 3.68-5.04; maxillary barbel 1.36-1.57; nasal barbel 4.60-8.64; external mandibular barbel 2.78-3.39; internal mandibular barbel 4.84-7.07; prepectoral distance 3.83-4.48; prepelvic distance 1.77-2.00; predorsal (I) distance 2.42-2.54; predorsal (II) distance 1.17-1.30; preanal distance 1.37-1.56; pectoral fin length 4.65-4.86; pelvic fin length 5.88-8.00; 1st dorsal base 7.57-8.64; IInd dorsal base 9.20-11.20; anal fin base 5.87-7.56; interdorsal distance 3.13-4.32 in standard length. Eye diameter 3.00-3.37; interorbital space 2.70-2.90; snout length 3.33-4.00; head width (maximum) 1.55-1.80; width of the mouth gape 2.33-2.70 in head length.

General appearance: Body elongated. Head depressed, snout blunt. Upper jaw slightly longer than the lower jaw. Head surface more or less smooth. Median longitudinal groove broad and extended upto post orbital region of head. Length of the occipital process is 1.6 times its base. Occipital process meets basal bone of dorsal fin.

Barbels: Maxillary barbels end before the anal fin origin. Nasal barbels extend upto the postorbital border. External mandibular barbels extend upto middle of pectoral fin. Internal mandibular barbels extend a short distance beyond preopercular border.

Fins: Pectoral spine stouter than dorsal spine. Pectoral spine with 6-8 and dorsal spine with 8-9 teeth on the inner mar-

gin. Pectoral spine rough and serrated externally and dorsal spine with 1-2 teeth externally towards the tip. Base of IInd dorsal is always less than that of 1st dorsal. The interspace between the two dorsals is about $2\frac{1}{2}$ -3 times the base of IInd dorsal. The longest fin rays of both dorsal and pectoral fins are longer than their respective spines. Ventrals originate from below the posterior half of the IInd dorsal. Upper lobe of the caudal fin is longer than the lower.

Colour: Ventral region dull white with bases of ventral, pectoral, anal and caudal fins yellowish. Dorsal region lead colour. Body with many irregular minute black spots, more towards the free ends of rays giving a dusky appearance. Maxillary and nasal barbels dusky, mandibular barbels whitish. A faint black spot is present on head.

DISCUSSION

Present observations and those of previous authors (Day 1878 and Jayaram, 1954) show some variations and in the light of present observations the ranges given for meristic characters by previous authors can be widened. Some of the morphometric ratios like base of IInd dorsal, length of barbels and body depth are subject to variation. Variations in colouration are also noted, as for instance:

(I) In *M. punctatus* Day mentions the presence of ten black marks along the lateral line and ventral region as yellowish, whereas on specimens it was found that there were no black marks on the lateral line and the ventral region is dull white; perhaps this may be due to the fact that the specimens may develop these colourations with age, since our specimen is very small (62mm. S. L.).

(II) In *M. gulio* while present observations show that the ventral region and the bases of fins on ventral side are yellowish, Day and Jayaram did not seem to have observed this.

(III) In *M. oculatus* while Day states that dark bands are present across the dorsal fin, Jayaram did not mention about these bands and our observations show that the bands are absent. However lateral bands were found to be present on the body, though there was no mention about these bands by Day and Jayaram.

It was not clearly defined by the previous workers the measures, length and base of occipital process; the relationship of these two measures of our specimens were found to be different from those given by Day and Jayaram in most of the species.

Our specimens of *M. vittatus* are agreeing with *M. vittatus vittatus* of Jayaram (p. 535) in general description, including the structure of the alimentary canal, except in the number of teeth on the pectoral spine (12) which is agreeing with *M. vittatus horai* (12), but not with *M. vittatus vittatus* (15-16). It is possible that this species contains many intraspecific groups and our collection may belong to a group different from both *M. v. vittatus* and *M. v. horai*.

Shaw and Shebbeare (1937) gave a key for the species they came across. Their key is mainly based on the length of barbels and colouration. Colouration is found to be a variable character, especially when there is size difference in the specimens and the length of barbels will not hold good for species which are closely related and show variation.

Misra (1962) mainly compiled his descriptions and key from Day's detailed description. His key does not cover all the species in the genus (only three of our eight species are found in his key) and controversial characters like the extension of occipital process in relation to basal bone of dorsal fin were taken as key character. This last character seems to vary with the growth of the specimen, as for instance in *M. gulio*, Day specially mentions this point as a footnote in page 445.

Further in our specimens of *M. gulio* no space was found between occipital process and basal bone of dorsal fin while Misra (p.19) states that the space is present in adult specimens. Hence this character cannot be taken as a key character.

While in the key (p.59) Misra states that in *M. vittatus* "occipital process reaching basal bone of dorsal," in specific descriptions (p. 190) he states, "Occipital process rough, 3 times as long as wide at its base, often separated from basal bone of dorsal by a short interpace." Length of barbels which is very variable within species also figure in Misra's key but this leads to confusion.

Jayaram studied many species and gave a key to many of the common Indian species. However, it is mainly based on the narrow ranges of morphometric ratios. Though his key is excellently suitable for the specimens studied by him, the same does not cover specimens of a different length range. Certain major differentiating measurements like length and width at the base of the occipital process were not clearly defined and consequently our ratios of length of the occipital process to its width at the base is found to be different from those given by Day and Jayaram for the same species. This character has also been shown above to vary with the growth of fish. A few discrepancies are also evident in Jayaram's key: *M. gulio* kept under the group in which "Occipital process not reaching basal bone of dorsal fin" (p.529), but in the figure of *M. gulio* (Fig. 7, p.543), it was shown that the occipital process actually reaches the basal bone of dorsal fin.

In view of the inadequacy of the keys of the previous authors, an attempt is made here to bring out a key for the identification of the species studied here basing on as many useful characters as possible in distinguishing the species. Care is taken to see that the key will be useful to identify and covering specimens of various length groups. This key is more useful in identifying the forms from West Bengal than other areas.

MYSTUS SPP. FROM WEST BENGAL

I. Interdorsal space in standard length more than 4.5.

.....*M. cavasius*

II. Interdorsal space in standard length 5.9.

A. Pectoral fin rays 6. Number of teeth on pectoral spine 10. Number of teeth on dorsal spine 8. Length of occipital process 2 times its base.

.....*M. oculatus*.

B. Pectoral fin rays 8-10. Number of teeth on pectoral spine 12. Number of teeth on dorsal spine 9. Length of occipital process is $2\frac{1}{2}$ -3 times its base.

.....*M. keletius*.

III. Interdorsal space in standard length either equal or less than 4.5.

A. Anal papillae present.

(a) Skin is leathery and lead colour, tending to lighter colour towards ventrally. Bases of pectoral, ventral, anal fins dusky. Bulbous stomach abruptly tapering into intestine (Plate I Fig. A). Anal papillae less distinct.

.....*M. armatus*.

(b) Dorsally dusky and ventrally dull white in colour. Dark shoulder blotch present. Both bases and fins of pectoral, ventral, anal and ventral part of caudal are dull white in colour. Stomach wedged and gradually tapering into intestine (Plate I. Fig. B) Anal papillae very prominent.

.....*M. vittatus*.

B. Anal papillae absent.

- (a) Ventral profile distinctly convex. Teeth on dorsal spine 7. Snout is narrow. Branchiostegals XI. Pectoral spine is longer than longest ray.

.....*M. punctatus.*

- (b) Ventral profile not distinctly convex. Teeth on dorsal spine 8-10. Snout broad. Branchiostegals IX-X. Pectoral spine is shorter than the longest ray.

- (I) Median longitudinal groove characteristically lanceolate in shape (Plate I, Fig C) Branchiostegals IX. Fins are lightly pigmented. Length of occipital process around 2 times its base.

.....*M. gulio*

- (II) Median longitudinal groove is irregular in shape (Plate I, Fig D.) Branchiostegals X. Fins are darkly pigmented. Length of occipital process around 1½ times its base.

.....*M. malabaricus.*

SUMMARY

A detailed description for eight species of the genus *Mystus* Scopoli (Pisces: Bagridae) obtained from West Bengal were presented. Differences with previous descriptions were discussed. A key for the identification of these eight species was formulated.

REFERENCES

Berg. Lec. S. (1947) *Classification of Fishes Both Recent and Fossil*. J. W. Edwards Ann Arbor, Michigan.

Day, F. (1878) *The Fishes of India, Vols. I & II*. William Dawson & Sons Limited. London.

Jayaram, K. C. (1954) Siluroid fishes of India, Burma and Ceylon XIV. Fishes of the genus *Mystus* Scopoli. *Rec. Indian Mus.* Vol. 51, Part 4, pp. 527-558

Misra, K. S. (1962) An aid to the identification of the common commercial fishes of India and Pakistan. *Rec. Indian Mus.* Vol. 57, parts 1-4 pp. 1-320.

Shaw, G. E. & Shebbeare, E. O. (1937) The fishes of Northern Bengal, *Journal Royal Asiatic Society of Bengal, Science*. Vol. III, Article No. 1. pp. 1-317.

ASSOCIATION OF SOLITARY ELEPHANTS

By

PRATAP SINGH

Solitariness in wild elephants is a puzzle. Many theories have been advanced to account for it but no convincing proofs have been put forward. What I am going to describe complicates the problem further.

THE AREA OF STUDY

I have been studying the behaviour of solitary elephants in the Chandi and the Gohri ranges in Lansdowne Forest Division, U. P. for the last 4 years. The places, where I used to go nearly every Sunday and every holiday, fall within a radius of 6 to 8 miles from Hardwar. The observations described in this article took place in Siddha Sot area of the Chandi range.

OBJECTIVES

The main objectives of the study are:—to find out the causes of solitariness in elephants, the process of solitarization, subsequent behaviour of the solitary bull towards the herd, towards other solitaries; whether he tries to enter the herd, whether he tries to approach the cows, whether the solitary bull ever resettles with the herd, whether after being turned out of one herd they are accepted by others, whether they form their own herds, whether bull and cow live in pair, how do the solitary ones satisfy their sexual urge etc. Meanwhile any other wild life does not come amiss.

METHOD

In addition to watching the herds, whenever I happen to see an elephant all by itself I try to find out such signs of recognition as may help me to identify the individual with certainty. For this purpose I try to observe and note about tusks, tail, body-colour, forehead, ears and any other signs on the body. I follow them as long as I can.

The two solitaries, whom I have seen alone as well as associated, have been observed by me as follows:—

THE FIRST SOLITARY BULL

I like to call him 'Stick-tusker' because of his thin and straight stick-like tusks. He has been observed six times during a period of 4 years. Details are as follows —

On 18-10-1964, after passing a night at machan we were returning home, climbing up and down the hills through dense grass. When we were moving along the spur of a low hill he was seen standing in the ravine below. I am not sure whether he perceived us or not as we kept quiet and he showed no reaction towards us. After some minutes he moved to a side.

On 24-12-1964, I saw him from a hill-top when he was moving up a hill. The previous night had been the coldest for many years and in the morning we had the heaviest dew-fall.

On 12-5-1965 we had a sensationally narrow escape from him. We had built a machan on the edge of a flat hill overlooking a small clearing in the bend of a semi-dry watercourse. Late in the evening we were going to occupy it passing through a long, dark and narrow nulla bounded by high hills on both the sides.

Up to a certain point in the nulla we expected some elephant. Having passed that place we relaxed and moved less carefully when a hissing blowing sound was heard from directly ahead. The elephant was standing just across a dry stony nulla, about 20 yards from us. He expressed his displeasure by raising his trunk above his head twice or thrice and ran away the way we had to go. It was getting darker and we feared an ambush so we climbed a hill and reached our machan with some difficulty. He had waited at a hair-pin bend but our move saved us.

We had been hearing the sound of breaking branches when at about 2 A.M. in the night which was brilliantly moonlit, he was again seen wandering aimlessly in the small clearing below. One of us coughed and disclosed our position to him. He slowly went to the other side of the hill, quietly climbed up the

path and stood at about 10 or 12 feet from our tree which was quite small and thin. He was standing motionless, watching us but we were frightened out of wits. He looked a veritable giant at this proximity and very dangerous. In fact he had come after us and was contemplating some mischief.

The place we had chosen to build the machan is regularly frequented by the Gujars every winter and the elephant being a permanent dweller of this forest must have known it, so it did not appear as if he came there by mere curiosity or by chance. He had come on purpose. I had a bugle which I blew very loudly and shrilly to frighten him away. He remained frozen for a moment after which gathering his wits he turned tail and ran down the way he had come.

After 3 months of this incident, in September '65 we sighted him on the slope of a bamboo covered hill., I had two students with me who followed him into the dense bamboo growth and after reaching sufficiently close to him climbed a tree. Then they blew the bugle. Hearing it, the elephant ran very frantically up the hill where finding no suitable path, returned and ran down the slope into the ravine. He passed very close to me but I did not see him.

The same December he began standing near the jungle paths in the day frightening milk-men but fortunately he did not molest anyone.

In June '66, while it was raining we tracked him in to a jungle bounded on one side by a high hill. When he heard us he stood behind a bush for some time. Then he moved away unseen. Wisely, we proceeded further keeping at a height on the hill when suddenly he blew with displeasure in some dense bamboo groves ahead. Then he trumpeted half-heartedly and moved away keeping to the cover all the time.

His behaviour leads me to the conclusion that he is slightly mischievous but has no courage to carry out any mischief.

On 9-10-66 when two of us were about to enter a densely wooded ravine he unexpectedly blew from some bushes ahead

and retreated very stealthily and sliently. We followed him for about a mile, keeping to the top of hill line while he moved along the ravine.

Many other people who move about these forests tell us that he is docile and harmless.

THE SECOND SOLITARY

I prefer to call him 'Banana-tusker' for the ends of his tusks resemble bananas. He is of much later acquaintance and bigger than the Stick-tusker.

On 28-5-1967, after passing a blank night on a hill, we were wandering in a nulla trying to get a glimpse of any wild animal when we suddenly came upon the fresh foot-prints of an elephant. We tracked him to the slope of a steep hill where he was seen feeding on almost dry bamboos, peeling and chewing with ease.

For sometime he did not notice us but later he became restless and went up the hill from where he returned back while we were manoeuvring to get above him and take some closer snaps. We had taken some from distance. At last he found a path open for him and hurried away. So far none of us had spoken but as soon as I cried to warn some bamboo-cutters, he became more nervous and trumpeted twice.

In July 1967, I had another chance to meet him. A naked hermit (Naga Baba) lives in the same jungle. He lives in a hut in a wide clearing where two nullas and two forest paths join. The Baba had some maize planted around his hut. The plants were barely 6 inches or so but some elephants had raided it the previous night. The Baba assured me that the elephants would certainly come. In the dusk of the evening the Banana-tusker hurried along the road and was about to step up to the hut when the Baba challenged him very loudly. He was so frightened that lifting his tail and trunk first he went across the road before running away. Nevertheless he kept hanging around the hut the whole night and the Baba kept challenging

and threatening him to come any nearer, requesting the lame tiger to punish him.

ASSOCIATION OF THE TWO SOLITARIES

On 19-8-1967 I passed another night with the Baba. This time no elephants came to the hut although maize corns had grown on the remaining few plants.

In the morning I moved towards the deeper jungle where I came upon a fresh elephant trail.

August is the peak of rainy season in this part. The grass holding pearly dew-drops clearly showed the passage of the elephant where it had not only lost the pearls but also had become trampled and mud-stained. I walked in the footprints, avoiding getting wet from the dew. After proceeding for some distance, I came upon dark green fresh dung. Then I heard the sound of breaking branches. Suddenly another feeding sound was heard from my left. It was very curious. I moved very cautiously and saw the Stick-tusker. The other one was not yet visible.

This place has a high hill to the north and a low hill to the east. This low hill continues to the south getting lower and lower. There is a wide stream in the west. The ground slightly rises to the east where a deep and narrow nulla flows along the foot of the eastern low hill to the south. The area has few trees, a number of bamboo groves and tall grass.

I crossed this nulla and climbed the eastern low hill keeping both the elephants to my left. At this time I lost sight of the Stick-tusker but was surprised to see the other elephant who was no other than the Banana-tusker.

I hoped to see both of them from the top of the hill and also expected them to cross this hill and to proceed to the east as there were many old elephant-tracks going in that direction most likely to be followed by them. I climbed a tree on the hill over one such track which appeared most likely to be followed by them. From the tree the Stick-tusker was seen but the

Banana-tusker although feeding very close to him was under cover.

The sky was clear and the sun was shining brilliantly in the rain-washed blue heavens. As the time passed on, their feeding slowed down as also their movements. It appeared as if they were going to pass the day in the very place. The Stick-tusker was leading and stood some 10 or 12 feet ahead of the Banana-tusker. I was frustrated to see that instead of following the elephant-track to the east which passed just under me the Stick-tusker faced south and after moving a few feet put his head and trunk into a bamboo-grove and came to a stand-still. It was about 11 A.M. and mildly hot.

I had promised to reach home by midday to celebrate the festival of Raksha-Bandhan which was not to be missed. It was dangerous to move in dense and high grass on that difficult ground in their vicinity so I decided to explode a fire-cracker to frighten them away.

The cracker banged very loudly and the elephants froze but as it was a wide ravine and explosion took place in the mid-air at some height, they could not pin-point its origin. The Stick-tusker appeared to be composed and showed no reaction but the Banana-tusker became very apprehensive and restless. Although he too appeared to be in no hurry and kept on feeding intermittently, he was very suspicious of the bang he had just heard. He turned first in this direction and then in the next, testing the air at various levels by raising and lowering his trunk, trying to get a scent of danger. Sometimes he thrust his hind-quarters in bamboo-grove. Only direction he did not test was where the Stick-tusker was standing. The effect of the explosion was lost in echo so I had to blow the bugle.

Hearing the first note the Banana-tusker rushed near the Stick-tusker. Maybe he touched him, I could not see clearly. Further bugle-notes made the Banana-tusker lead to the south along the spur of the hill closely followed by the Stick-tusker. They were also moving down towards the lower ground. For

a long time their mud-stained huge red backs were visible among the green trees, bushes and high grass as they moved freezing and advancing in true wild elephant style.

When they moved out of sight, I left for home.

They were together for some 4 or 5 days as I had come to know from their tracks earlier and evidence from Gujars. They were reluctant to separate as yet. The Banana-tusker was the leader and the Stick-tusker the follower. Judging from upper edges of their ears both were young animals. The reason of their association is subject of further study and observation.

Next trip to the same area was possible one month later when we encountered the Banana-tusker alone. He was behind some bushes when we approached quite near, unknown to him. He blew in anger, ran frantically hither and thither, climbed a high valley and disappeared on the other side. By this time he had separated from the Stick-tusker of whom no trace could be found.

In the same jungle I have seen a number of solitaries on different occasions. Twice I came across groups of bulls; first three old bulls were seen and next a group of two. But these groups are of long association and the members do not separate. But the two described above are confirmed solitaries and their association is an enigma. No clues as to their motive of association were apparent at the time of observation.

I shall be glad to hear from the members of the Society on the subject.

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THE HIMALAYAN FLYING SQUIRREL—SOME SPECIALITIES

By

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The Himalayan Flying Squirrel abounding in tree-tops of Darjeeling, in Northeast India, during nocturnal darkness has a few characteristics of its own. Popularly taken as 'a form damaging poultry birds', 'one that brings bad luck to its viewer', etc., this squirrel is adapted to both volant (=aerial) and scansorial (=tree-dwelling) habits. These are stamped all over its anatomy. We present below our preliminary observations in this respect since, as far as we are aware, there exists no similar previous study and standard literature on animal adaptation (Lull, 1947) badly needs the incorporation of the present study-material and the like.

The species covered now belongs to *Petaurista* Hodgson. The size of our material, however, seems shorter than the standard size and this may be due to our material representing a special variety or the early age-group.

The results of our present study are illustrated in figures 1 and 2. We are obliged to Dr. B. Dasgupta, Head and Professor of the Post-Graduate Department of Zoology, Darjeeling Government College, for initiating us to the present study including his helpful advices and to Dr. S. K. Das Gupta and others of the same Department for various courtesies.

OBSERVATIONS WITH POSSIBLE SIGNIFICANCES

(A). *Modifications for volant habit*:—These are essentially restricted to body contour and four limbs of the flying squirrel,

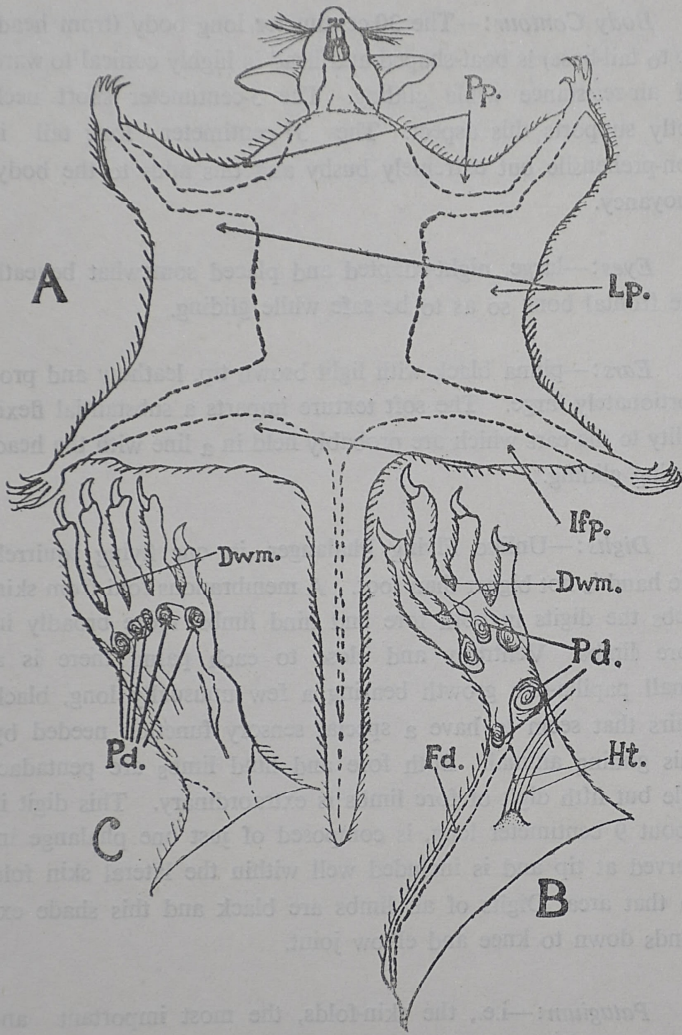


Figure 1: Free-hand sketches of a Himalayan Flying Squirrel; (A) the whole animal in ventral view showing body contour and various patagia, (B) Fore limb extremity of the same, in ventral view, showing digit-webbing-membrane, pads, elongated fifth digit and hair-tuft which are special adaptive features in that area, and (C) Hind limb extremity of the same, in ventral view, showing digit-webbing-membrane and pads of that area; Abbreviations: Dwm.—digit-webbing-membrane, Fd.—fifth digit, Ht.—tuft of long hairs on a papilla-like growth, Ifp.—inter-femoral patagia, Lp.—Lateral patagia, Pd.—adhesive pads, and Pp.—prepatagia,

Body Contour:—The 30-centimeter long body (from head-tip to tail-base) is boat-shaped and head is highly conical to ward off air-resistance while gliding. The 3-centimeter short neck aptly supports this aspect. The 37-centimeter long tail is non-prehensile but extremely bushy and this adds to the body-buoyancy.

Eyes:—large, night-adapted and placed somewhat beneath the frontal bone so as to be safe while gliding.

Ears:—pinna black with light brown tip, leathery and proportionately large. The soft texture imparts a substantial flexibility to the ears which are probably held in a line with the head during gliding.

Digits:—Unlike Flying Phalanger, in our flying squirrel, the hand is not bigger than foot. A membranous fold from skin webs the digits in both fore and hind limbs, more broadly in fore limbs. Ventrally and close to each palm, there is a small papilla-like growth bearing a few unusually long, black hairs that seem to have a special sensory function needed by this gliding animal. Both fore and hind limbs are pentadactyle but fifth digit of fore limbs is extraordinary. This digit is about 9 centimeter long, is composed of just one phalange incurved at tip and is included well within the lateral skin fold in that area. Digits of all limbs are black and this shade extends down to knee and elbow joint.

Patagium:—i.e., the skin-folds, the most important and showy of all adaptive structures in the animal under reference. The most massive patagia are the two lateral ones stretching from wrist to ankle for a length of about 35 centimetres. Then there are two prepatagia, each narrowly stretching between wrist and neck for a length of 14 centimetres, and two inter-femoral patagia, also narrow skin-strips stretching from ankle to 17 centimetres caudad from base of the bushy tail.



Figure 2 : Photographic view of two Himalayan Flying Squirrels in captivity,
in the field laboratory of Dr. B. Dasgupta.

(B) *Modifications for scansorial habit*:—These are essentially restricted to limbs of the animal.

Claws:—each digit ends in a strongly-curved and sharp-tipped claw, facilitating firm grip to tree-trunks. Fifth digit of fore limbs is, as mentioned before, clawless.

Pads:—Five pads are present in each of the soles and the palms. Those of the palm are in two rows and are unequal in size. But those of the sole are in a row and are roughly equal in size. These are convex outgrowths, each with concentric furrows, and probably lend to the clinging habit of the animal.

Of all the features listed above, the most interesting seems to us to be the long, cartilaginous and clawless fifth digit of the fore limbs. Being totally within the lateral patagia, this digit adds to the efficiency of those patagia for gliding through air. A similar state is known in bats and in extinct flying reptiles called *Pterosaurs*.

NOTES AND NEWS.

(1). NOTE ON COURTSHIP AND MATING IN ROLLER (*Coracias benghalensis*)

I got several chances to observe courtship and mating in Roller (*Coracias benghalensis*) at farms of Jodhpur in its breeding season (mainly in April and May). Courtship and mating behaviour in it is as follows.

Males roam near a female sitting on a branch of a tree. Generally two males get entangled in struggle with fight to get right to mate with the female. The two males fiercely attack each other with beak and wings, whether on a branch or even in flight. Some times they get entangled so much in fight that they fall down to the ground and even then fight goes on. They make sharp (*Kri...Kri*) cries while fighting. The defeated one flies away and the winner pursues it till

the defeated one leaves the field. The female calmly observes such activities of the males. Another male may come and fight with the victorious male in struggle for right to mate with the female. Then the victorious male flies to the female and hops and buzzes near the female with peculiar gestures. Then the female consentingly sits down in mating posture as commonly found in birds. The male flies and mounts on the back of the female, both make sharp cries (*Kri...Kri.....*), the male flaps its wings for balance till mating lasts, that is, for a few seconds. The male flies away and the female flies to a nearby branch and rearranges its plumes of cloacal region. Thus courtship and mating in Roller comes to the end.

Dated, 15th, June 1965.

Yours faithfully,

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(2) OBSERVATIONS ON SWIMMING OF GERBILS

N. B. Kinnear (1919. *J. Bombay Nat. Hist. Soc.*, 26:664-665) mentioned that many rats get drowned due to heavy rains. This statement aroused a curiosity in me to find out whether the gerbils can swim in water or not. For this, a few freshly captured adult gerbils were released in a pond measuring 15 X 9 metres in which water was about 5-6 metres deep.

One Indian desert gerbil (*Meriones hurrianæ* Jerdon) was dropped into the water from a height of 1.5 metre. It came to the water surface in about 2 seconds and started swimming. Both the pairs of its limbs were moving in a fore and aft fashion maintaining its body almost parallel and below the water surface but its nostrils and eyes were just above the water surface. It appeared that alternate action of the fore limbs was faster than that of the hind limbs. The gerbil swam swiftly for two minutes after which it returned to the edge of pond and took

rest for 40 seconds. Again it was pushed into the water and this time it swam for 3 minutes but its swimming speed had dropped and it was not able to keep its hind quarters parallel to water surface and the whole body was at an angle of 70° - 80° with the water surface. In the next one minute, however, the body became almost perpendicular to the water surface. The strokes of limbs also became very weak and it started drowning. After a dip into the water it came up and tried to swim violently but after 10 seconds of this effort it drowned. In all it travelled a distance of about 13-14 metres in $5\frac{1}{2}$ minutes. Another adult male *Meriones* also behaved in the same way in water.

One male Indian gerbil, *Tatera indica indica* swam continuously for six minutes in the same pond. The mode of its swimming was similar to that of *Meriones hurrianae* except that the speed of its swimming was faster than that of the latter. It swam about 30 metres in 6 minutes. At the end of this the *Tatera* was much exhausted and started drowning and was, therefore, rescued.

Considering that the gerbils can swim for 4-6 minutes in open water, ordinarily these rodents should be able to avoid death by drowning. The fact that they are, nevertheless, drowned after heavy rains may be due to the collapsing of their burrows, making it impossible for them to swim away safely especially against the strong current of gushing water.

Incidentally, when these gerbils were swimming two crows tried to pick them up from the water surface but they were scared off by us.

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